Jan. 6, 1953 T. C. DUVALL 2,624,079

MANUFACTURE OF AIR-LAID FELTS

Filed Aug. 16, 1949

Fig. 1

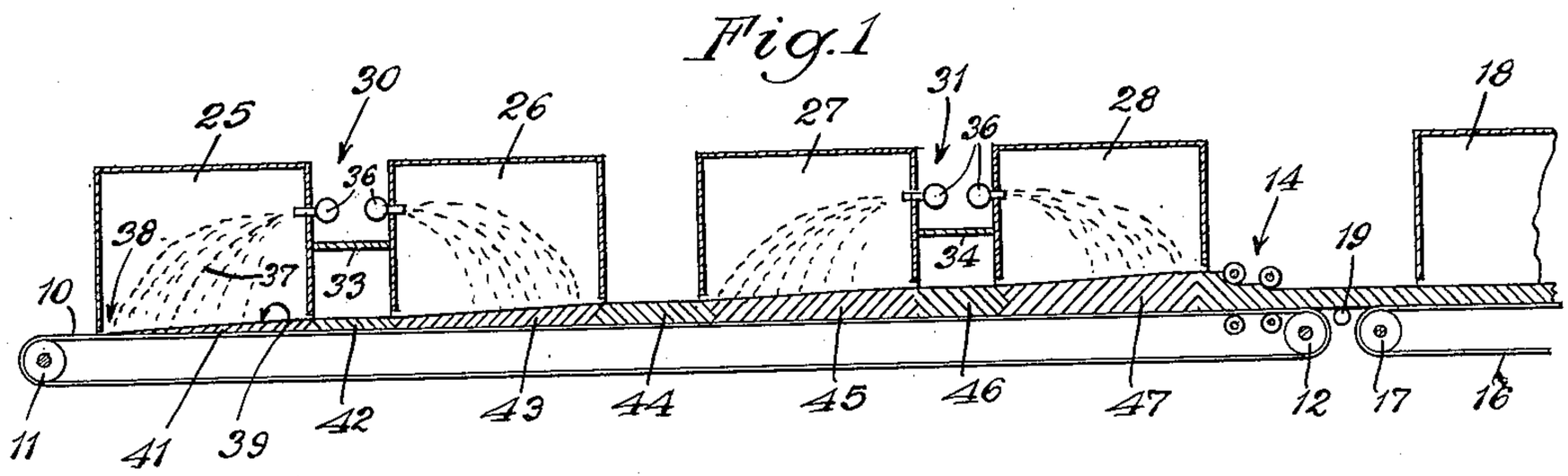


Fig. 2

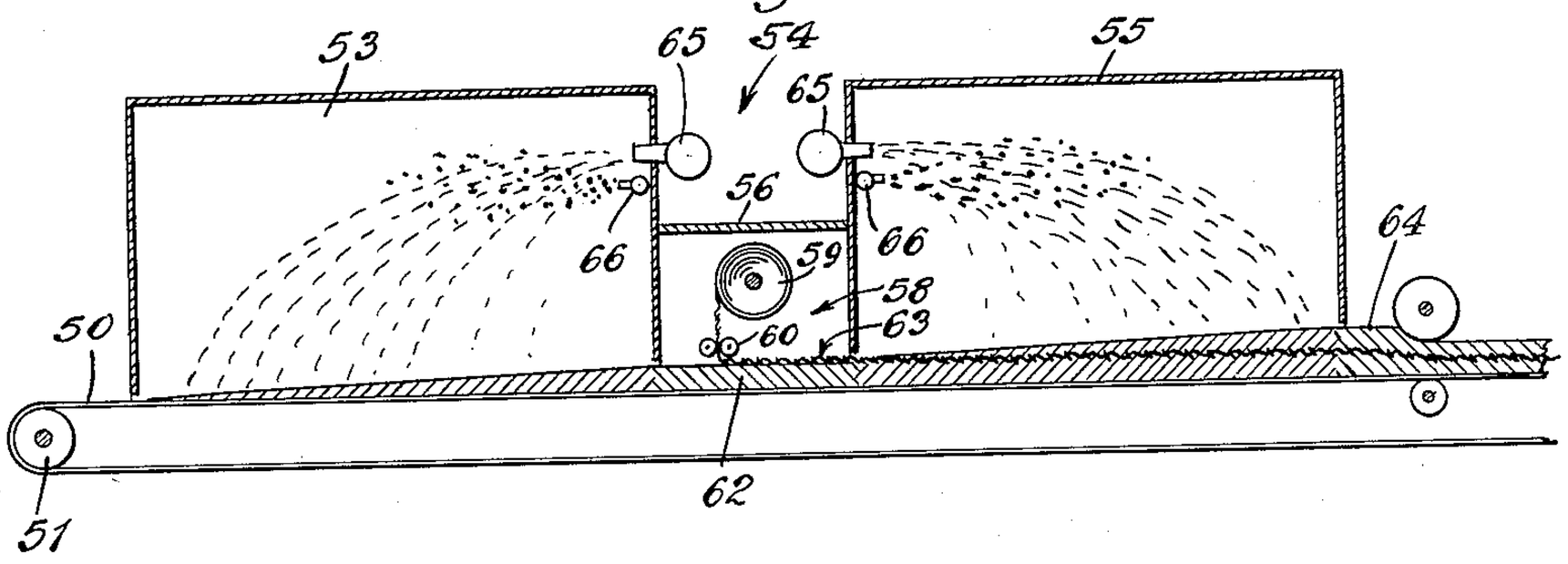
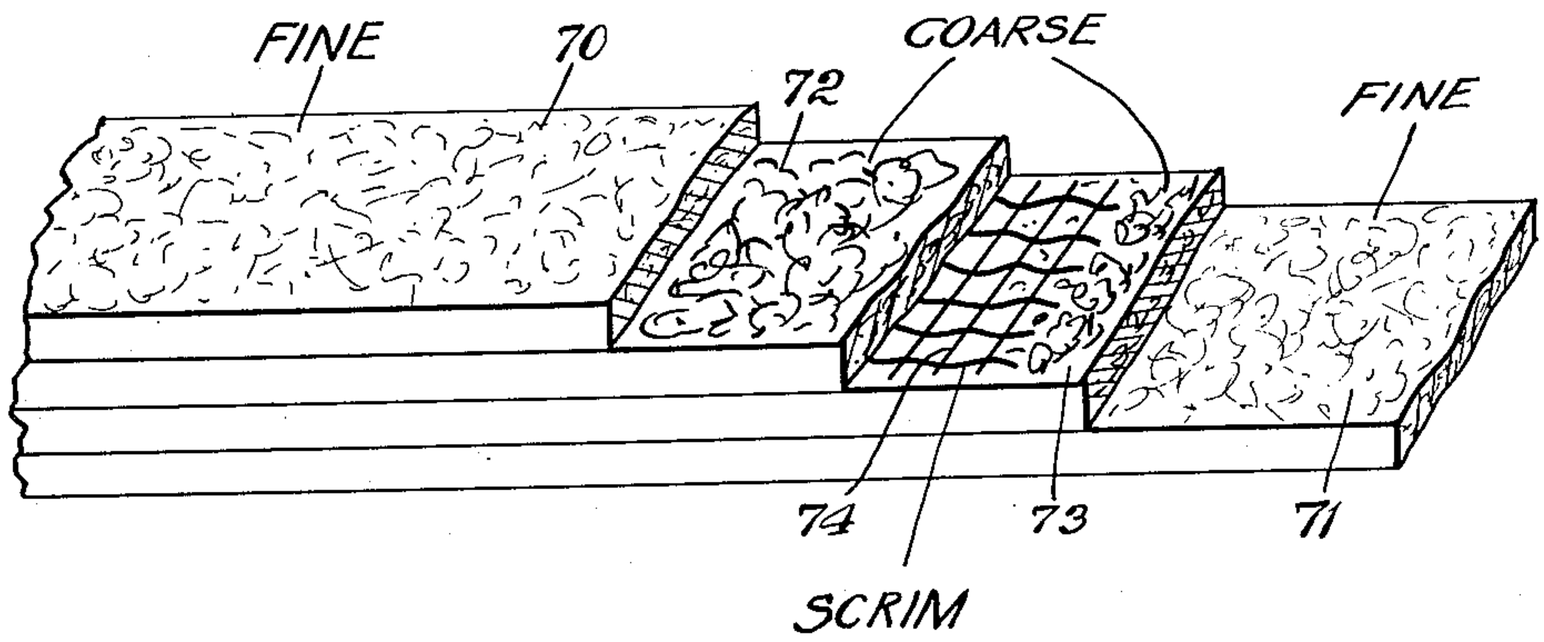


Fig. 3



Inventor
Thure C. Duvall
by W. Barnett Jones.
Attorney

Patented Jan. 6, 1953

2,624,079

UNITED STATES PATENT OFFICE

2,624,079

MANUFACTURE OF AIR-LAID FELTS

Thure C. Duvall, Cloquet, Minn., assignor to Wood Conversion Company, St. Paul, Minn., a corporation of Delaware

Application August 16, 1949, Serial No. 110,610

10 Claims. (Cl. 19—155)

1

The present invention relates to forming air-laid felts by deposition of fibers from suspension in air (or other gas), and in particular by gravity fall in a so-called deposition chamber.

In the deposition of fibers from air suspension to form felted structures, it is not as easy to maintain homogeneous distribution of the fibers at the point of deposition from the fluid vehicle as it is in the case of aqueous suspensions of fibers, for example, in conventional paper-making machinery. There tend to be separations of fibers into coarser and lighter fractions. Where constancy of conditions prevail in handling the air-suspensions, there may be found zones of predetermined location at the deposition area, in which zones the formation of the felt is different, whether due to size of fibers, direction of deposit, impact of striking, or other factor. Where a moving mat collector is employed to traverse these zones at a uniform rate, there may readily result a mat uniform in its variations from face to face. There may be many layers characteristically different, but in general the facial appearances are so different that such structures are called two-sided in character. This term therefore includes and contemplates multi-layer differences.

The present invention contemplates overcoming this general disadvantage by retaining the processes and equipment which present these difficulties, and using them to form a "half-mat" rather than the above described whole-mat, and then duplicating the process and equipment to form on the first "half-mat" a like but inverted "half-mat" whereby to produce a whole-mat substantially symmetrical with respect to its median plane.

The invention may be practiced in many known processes of forming felted mats from air-suspensions of fibers. These include forced felting by blowing the suspension against a felting screen, by applying suction to a screen on the other side of which there is an air suspension of fibers, by gravity fall of fibers from air-suspension onto a collector, or combinations of these, it being understood that there is action to replenish the suspension and action to provide a process continuous in nature to form a continuous felted mat.

Herein the invention is illustrated specifically by reference to the gravity process.

In the formation of air-laid felts from fibers by injecting substantially individualized or formed fibers in a stream into a chamber for dispersal in the air in the chamber, and for settling

2

therefrom onto a conveyer running through the bottom of the chamber, there is a decided tendency toward two-sidedness in the resulting felt. This is evident from consideration of the Brownlee Patent No. 2,389,024 in which wood fibers are injected into a chamber to form a mat in the manner previously described, with simultaneous injection of a spray of liquid binder for wetting the fibers with a bonding agent. Said patent shows the introduction of an air stream at one end of the chamber to form an expanded trajectory of the more confined original stream of fibers, centered at the bottom of the chamber between the two ends. Material deposits in both directions away from this trajectory. The characters of the initially depositing layer and of the finally depositing layer differ greatly and in each case the individual character more or less depends upon the nature of air currents in the chamber, which in turn depend upon the chamber's construction, especially relative to locations of openings for venting from the chamber the air which is introduced as the carrying medium for the fibers. In the center of the chamber, that is in the main trajectory, the bulk of fibers is deposited. However, fibers wet with adhesive liquid clot into flakes or flocks and float out of the main trajectory. In certain chambers, the back wash of air carries these flocks to the inlet end and the initially deposited layer is resultingly irregular and spotty in formation. Where there is such an initial deposit, the chamber is commonly such that fines, more free of such flocks, carry to the far end of the chamber and form the finally deposited layer, which is resultingly more uniform in its texture and formation. Eddy-currents may increase the back wash of flocks to the inlet end of the chamber and result in poor formation in the initial deposit relative to a better formation in the final deposit in a suitably long chamber. Where the wet deposited mat is heavily compressed after formation and before drying, the inequalities of each of its surface layers, and the inequalities of thickness from top to bottom, become less evident, but as the density of the compressed felt is less, these inequalities are more in evidence in presenting a two-sidedness in quality and appearance.

The present invention aims to minimize the two-sidedness in air-laid felts, and also to achieve other advantages in manufacture.

The invention is applicable to air-laid felts of both mineral and vegetable fibers, but its advantages are more pronounced in the case of wood fibers because of the inherent shortness thereof,

the resulting multiplicity of fibers per unit of weight, and the inherent curliness of the fibers with the resulting greater tendency to clot, festoon and interfelt. Consequently, the invention will be described in connection with apparatus and process for producing air-laid vegetable fiber felts.

In the accompanying drawings:

Fig. 1 represents more or less diagrammatically forming apparatus comprising chambers of a known kind, but in a novel arrangement in accordance with the present invention.

Fig. 2 is an illustration in more or less diagrammatic form of a preferred arrangement for two adjacent forming chambers.

Fig. 3 is a perspective illustration of a mat made by the present invention, showing the several layers cut away to indicate their character.

In general, the invention comprises the provision of at least two or more deposition chambers in series, with the end chambers of the series in reverse directional relationship to a moving conveyor-collector passing through all of the series.

Thus, the kind of formation which starts the mat on the conveyor may be secured in finishing the deposition. This results in a more uniform appearance of the two faces, disregarding uniformity of quality within these two faces. Intervening chambers of the series, if any, are preferably even in number and in function symmetrically arranged with respect to the two half portions of the series when it is desired to minimize two-sidedness in structure and quality within the two faces as well as two-sidedness in appearance.

The invention may be carried out in a variety of ways, having regard to variation in the number of depositing chambers from two upwardly, and having regard for the direction of fiber injection in each chamber. There must be at least two chambers so that at the ends of a series of two or more chambers the direction of injection of the fibers may be opposed to each other, there being in each end chamber a directional relationship to the wire which is reversed in the opposite end chamber. When there are more than two chambers in the series, it is preferred that the number be even and that they function symmetrically with respect to a line dividing the series into two half portions across the direction of operation. Where there is a pair of adjacent chambers which function in mutually reverse directions, it is preferred that the injection of fiber take place in opposed directions from a common region, and that this region be a space between the two chambers. Such a space provides for a platform area in which an operator may take charge of the injection apparatus for fiber and spray to both chambers without leaving the platform area. Another reason for providing a space between two such chambers, in which the operator's platform is at a raised level with relation to the path of the conveyor, is to permit of free space over the mat passing from one chamber to the other as a station at which some operation may be performed on the mat. For example, in the case of any two chambers so arranged as to have such a station, the unfinished mat leaving one chamber and entering the other may receive, as from a roll, a web which is to be incorporated within the final mat. Such web may be a coarse scrim through which the felted structure of the mat becomes continuous, with resulting reinforcement of the mat by the scrim.

In Fig. 1 the numeral **10** designates an endless conveyer on which the mat is formed, passing

over end rolls **11** and **12**, the conveyer leaving the roll **11** passes into and through a series of depositing chambers, and then it may pass under one or more compression rolls indicated by the numeral **14**, thereby to compress the low density mat of the original formation to a suitable higher density. Such compression is commonly practiced to give the mat sufficient strength from felting to permit it to be couched from the forming conveyor **10** to another conveyer, such as the conveyer **16** passing over end roll **17** for carrying the couched mat through a treating chamber, which is commonly an oven **18** when the mat is wet with aqueous adhesive solution. The numeral **19** designates a suitable transfer device for so moving the wet mat from the conveyer **10** to the oven conveyer **16**, such a device being described in the application of A. W. Heino, Serial No. 713,150, filed November 29, 1946, now U. S. Patent No. 2,493,194, issued January 3, 1950.

In Fig. 1 there is indicated more or less diagrammatically a series of depositing chambers, presently four in number, and designated **25**, **26**, **27** and **28**. The chambers **25** and **26** are located and operated symmetrically with respect to the remaining chambers **27** and **28**. In Fig. 1 the chambers **25** and **27** show injection of the fiber in one and the same direction, while chambers **26** and **28** operate in the reverse direction. As illustrated, the pair of chambers **25** and **26** discharge in opposite directions from a common space **30** between them, and the chambers **27** and **28** likewise discharge from a common region **31** between them. In the spaces **30** and **31** the numerals **33** and **34**, respectively, designate operating platforms on which an operator (not shown) may stand to control the injection apparatus for each chamber, such apparatus in each case being designated generally by the numeral **36**.

Thus, in operation of the series shown in Fig. 1, the chamber **25** has a main trajectory **37** in which the bulk of its fibers deposits, there being regions **38** and **39** at the ends of the chamber outside of the main trajectory, in which there are formations different from each other and different from that in the trajectory **37**. In chamber **27** the same relationship exists in the same relation to the conveyer **10**. Within the chambers **26** and **28** the same relationships exist, but the relationship of each chamber to the direction of the conveyer **10** is reverse from the relationships of chambers **25** and **27** to the conveyer **10**. The shaded portion on the conveyer designates how the mat is built up in four separate areas of deposit as the conveyer passes through the bottoms of the series of four chambers. In chamber **25** the mat is designated **41**, this representing an integration of fibers in forming the mat. The section designated **42** between the chambers **25** and **26** is in static condition, and it exhibits a face of an incompleted mat on which some operation may be performed. The section designated **43** is another integrating section within the chamber **26**. Next is a second static section **44** between chambers **26** and **27** on which some operation may be performed. Section **45** is another integrating section followed by a static section **46** and another integrating section **47**. The mat so formed at this point is of low density, in the case of wood fibers deposited by gravity, having a density of about ½ to 1 lb. of dry fiber per cubic foot and very low in felted strength. The mat may be increased in density, with resulting gain in strength from felting by action of one or more of compression rolls **14** prior to

transfer at 19 to the conveyer 16 for drying in the oven 18 when the fibers are wet.

In Fig. 2 there is shown an arrangement wherein only two depositing chambers are used, and these are shown in the preferred back-to-back spaced relationship wherein they discharge in opposed directions from a common region between them. There is a conveyer 50 passing over end roll 51, from which the conveyer moves into depositing chamber 53, then across open space 54, and then through depositing chamber 55. The numeral 56 indicates an operator's platform located in the space 54 and elevated above the level of the conveyer 50 to provide operating space 58 for the conduct of other operations, as may be desired. As illustrated, there is shown a roll of scrim 59 passing downwardly and over feed rolls 60 to lay on mat 62 in the space 54 a web 63 of such scrim so that when the scrim-covered mat 62 passes through chamber 55, the mat continues to form over the scrim so that in the end the mat 64 is substantially free from two-sidedness and has a mid-web of scrim for reinforcement.

The two-sidedness is substantially avoided by reason of the fact that the two chambers 53 and 55 operate directionally in opposition to each other, and as shown, the fibers are discharged from the common region 54 between the chambers. The numeral 65 designates the fiber injection apparatus available at platform 56, and the numeral 66 designates the adhesive spray devices available also from said platform 56.

It is to be understood that in Fig. 1 the injection apparatus generally designated as numeral 36, and in Fig. 2 the injection devices 65 and 66 designate not only one but a bank of several such devices crosswise of the web to be formed where the width of such web is so great as to render one such injection device inadequate in its lateral range.

It is to be understood that the invention is not limited to identical use of each chamber. The arrangement is flexible, permitting different kinds of material or different forming conditions to exist in the several chambers. Also, the differences may be employed in such a way as to build up a symmetrical composite mat, for example, one such as is shown in Fig. 3.

In Fig. 3 there is illustrated by way of example, a mat which has four distinct fiber layers and a reinforcing mid-web, yet the mat is a continuous felt and substantially free from two-sidedness, being symmetrical with respect to the mid-web. The surface layers 70 and 71 may be of very high grade material, such as bleached sulfite fibers. The two inner layers 72 and 73 adjacent the scrim 74 may be of coarse or unbleached fiber material. Such a structure may be made by apparatus illustrated in Fig. 1. Chambers 25 and 28 may be operated similarly with similar fiber to form the layers 70 and 71. Chambers 26 and 27 may be similarly operated with the same kind of fiber, but different from that used in chambers 25 and 28. The space between the chambers 26 and 27 may be employed for embodying in the mat being formed a layer of scrim in the manner illustrated in Fig. 2.

Thus, it is to be understood that the invention may be employed in numerous ways and operated to advantage for the production of a variety of products not heretofore possible with the apparatus previously known. Such changes and modifications are contemplated as falling within the scope of the invention as expressed in the appended claims.

I claim:

1. Apparatus for forming air-laid fiber felts comprising a movable endless conveyer on which fibers are deposited to build up a mat, a plurality of deposition chambers alined over said conveyer in which fibers suspended in air are allowed to deposit on the conveyer, and feeding means for each chamber to introduce fibers suspended in air and to inject them into each chamber, the end chambers having said feeding means at one end only for injecting the fibers in alinement with the conveyer for dispersal therein and settling therefrom, the feeding means of the two end chambers being arranged to feed in opposite directions.

2. Apparatus for forming air-laid fiber felts comprising a movable endless conveyer on which fibers are deposited to build up a mat, two deposition chambers alined over said conveyer in which fibers suspended in air are allowed to deposit on the conveyer, and feeding means at one end only of each chamber to introduce fibers suspended in air and to inject them into said chamber in alinement with said conveyer for dispersal therein and settling therefrom, the feeding means of the two chambers being arranged to feed in opposite directions.

3. Apparatus for forming air-laid fiber felts comprising a movable endless conveyer on which fibers are deposited to build up a mat, two deposition chambers alined over said conveyer in which fibers suspended in air are allowed to deposit on the conveyer, and feeding means at one end only of each chamber to introduce fibers suspended in air and to inject them into said chamber in alinement with said conveyer for dispersal therein and settling therefrom, the feeding means of the two chambers being arranged to feed in opposite directions from a single location.

4. Apparatus for forming air-laid fiber felts comprising an endless conveyer on which fibers are deposited to build up a mat, two deposition chambers spaced from each other and alined over said conveyer in which fibers suspended in air are allowed to deposit on the conveyer, and feeding means at one end only of each chamber to indroduce fibers suspended in air and to inject them into said chamber in alinement with said conveyer for dispersal therein and settling therefrom, the feeding means of the two chambers being arranged to feed in opposite directions from the space between the chambers.

5. The method of forming air-laid felts which comprises injecting one or more streams of substantially individualized fibers all in the same generally horizontal direction into a settling chamber, moving an endless conveyer through said chamber in a direction generally parallel to the injected fibers for deposition of the fibers into a mat thereon and for removal of the mat from the chamber, injecting one or more streams of substantially individualized fibers into a second settling chamber all in the same generally horizontal direction but opposed to that of the first-mentioned injection and at a location to deposit fibers on said conveyer above the deposited fibers of the first-mentioned injection.

6. The method of forming air-laid felts which comprises injecting one or more streams of substantially individualized fibers all in the same generally horizontal direction into a settling chamber, moving an endless conveyer through said chamber in a direction generally opposed and parallel to the injected fibers for deposition

of the fibers into a mat thereon and for removal of the mat from the chamber, injecting one or more streams of substantially individualized fibers into a second settling chamber all in the same generally horizontal direction but opposed to that of the first-mentioned injection and at a location to deposit fibers on said conveyer above the deposited fibers of the first-mentioned injection.

7. The method of forming air-laid felts which comprises depositing fibers from suspension in air at two separate areas of deposition by injecting one or more streams of substantially individualized fibers all in the same generally horizontal direction into a settling chamber, moving an endless conveyer through said chamber in a direction generally parallel to the injected fibers for deposition of the fibers into a mat thereon and for removal of the mat from the chamber, injecting one or more streams of substantially individualized fibers into a second settling chamber all in the same generally horizontal direction but opposed to that of the first-mentioned injection and at a location to deposit fibers on said conveyer above the deposited fibers of the first-mentioned injection.

8. The method of forming air-laid felts which comprises depositing fibers from suspension in air at two separate areas of deposition by injecting one or more streams of substantially individualized fibers all in the same generally horizontal direction into a settling chamber, moving an endless conveyer through said chamber in a direction generally opposed and parallel to the injected fibers for deposition of the fibers into a mat thereon and for removal of the mat from the chamber, injecting one or more streams of substantially individualized fibers into a second settling chamber all in the same generally horizontal direction but opposed to that of the first-mentioned injection and at a location to deposit fibers on said conveyer above the deposited fibers of the first-mentioned injection.

9. The method of forming felts from air-suspensions of fibers which comprises directing fibers in air suspension in a constant stream upon a moving collector to initiate a felted fiber

deposit on the collector, said stream being characterized by substantial constancy in its variations in constitution as reflected by said deposit on said collector being a half-mat having two-sidedness in formation, and then depositing on said half-mat an inverted but like half-mat by directing thereon like fibers in a like air suspension in a like constant stream, in such a reverse relationship that the first deposited fibers on the collector from the first stream correspond to the last deposited fibers on the collector from the last stream, whereby the resulting mat is substantially symmetrical in formation with respect to its median plane.

10. The method of forming a felted fiber mat substantially free from two-sidedness which comprises continuously moving a collector on which the mat is formed through depositing regions separated by a reference plane of symmetry crosswise of the direction of movement, continuously depositing fibers on said collector in one region on one side of said plane in a manner to discharge from said region on said collector a felted half-mat characterized by two-sidedness, and continuously depositing fibers on said half-mat in the other region on the other side of said plane in a manner to form a like but inverted half-mat characterized by like two-sidedness, whereby to discharge from said second region a whole-mat substantially symmetrical with respect to its mid-plane.

THURE C. DUVALL.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
41,727	Stoddard	Feb. 23, 1864
255,381	Doubleday	Mar. 21, 1882
292,187	Tyler	Jan. 22, 1884
1,503,605	Shaw	Aug. 5, 1924
1,786,669	Manning	Dec. 30, 1930
2,232,647	Zirkman	Feb. 18, 1941
2,255,206	Duncan	Sept. 9, 1941
2,543,101	Francis	Feb. 27, 1951