Aug. 13, 1968 W. D. ROXLO 3,396,433

APPARATUS FOR MAKING NON-WOVEN WEBS

Filed June 28, 1965 2 Sheets-Sheet 1

FIG. 1

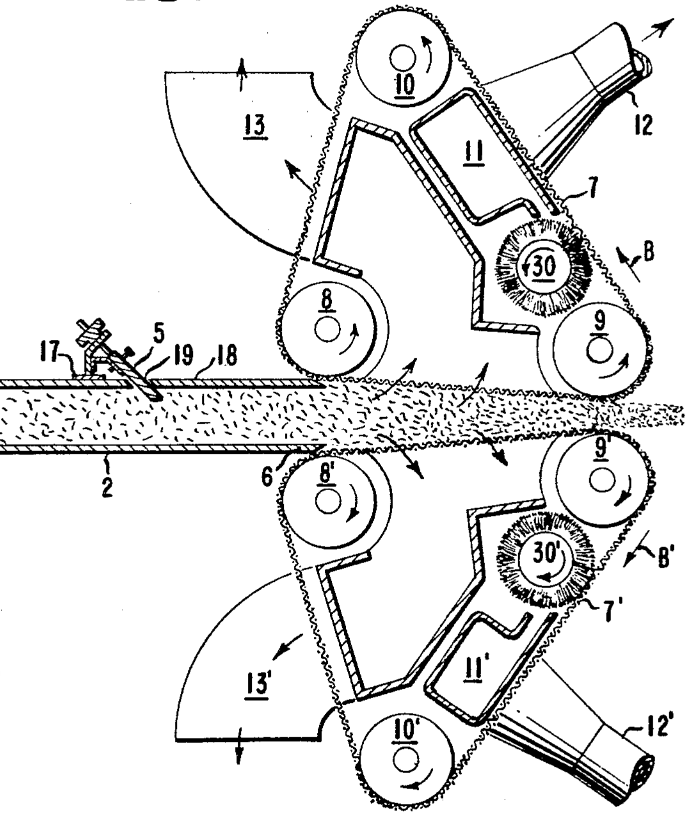


FIG. 2

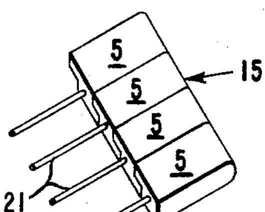


FIG. 3

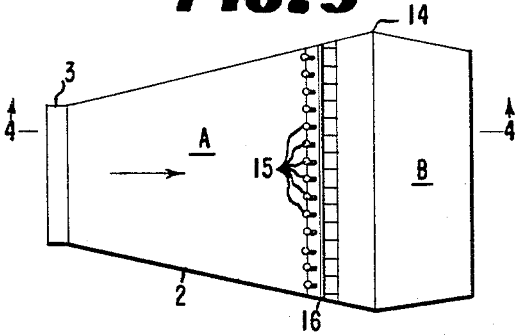


FIG. 5

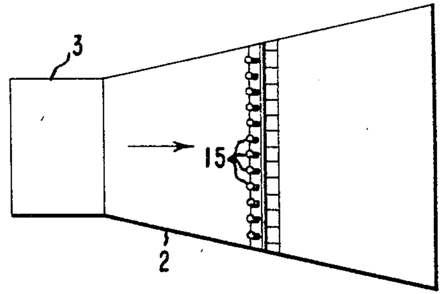
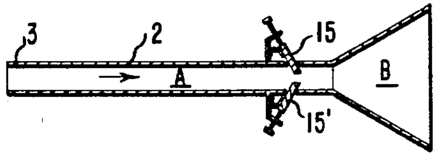


FIG. 4



INVENTOR
WILLIAM D. ROXLO

BY Raymond E. Blomstedt
ATTORNEY

APPARATUS FOR MAKING NON-WOVEN WEBS

Filed June 28, 1965 2 Sheets-Sheet 2

FIG. 6

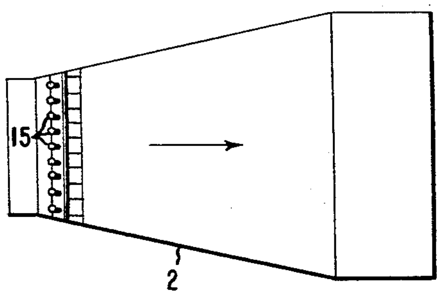


FIG. 7

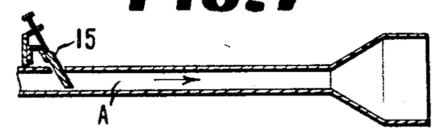


FIG. 8

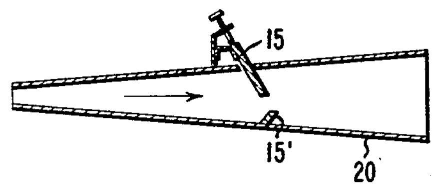


FIG. 9

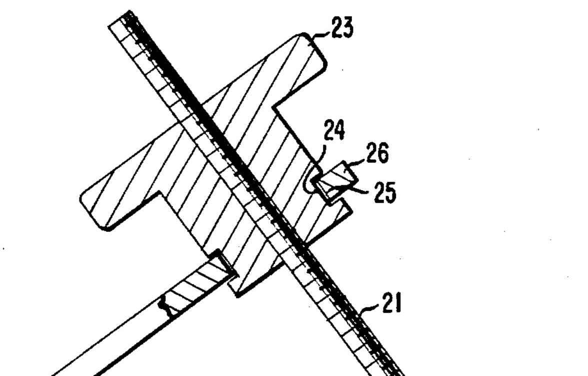
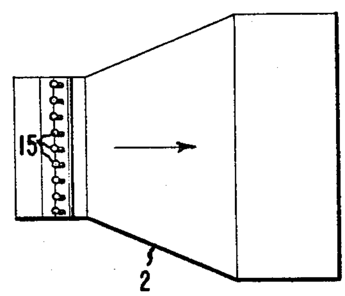
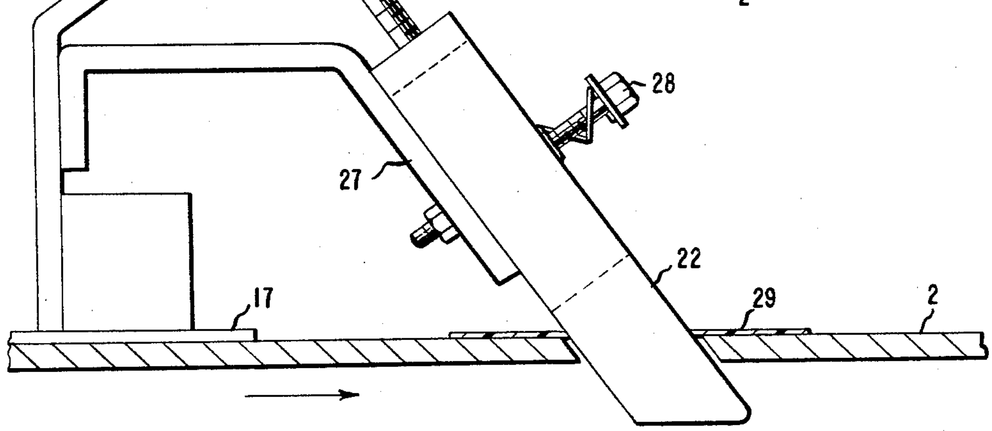


FIG. 6A





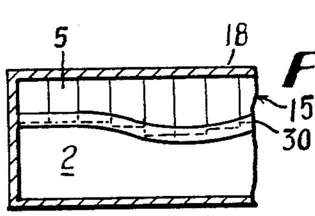


FIG. 10

INVENTOR
WILLIAM D. ROXLO

BY Raymond E. Blomstedt
ATTORNEY

United States Patent Office

3,396,433
Patented Aug. 13, 1968

1

3,396,433
APPARATUS FOR MAKING NON-WOVEN WEBS
William D. Roxlo, Nashville, Tenn., assignor to E. I. du Pont de Nemours and Company, Wilmington, Del., a corporation of Delaware
Continuation-in-part of application Ser. No. 434,591, Feb. 23, 1965. This application June 28, 1965, Ser. No. 470,322
10 Claims. (Cl. 19—156.3)

ABSTRACT OF THE DISCLOSURE

An apparatus adapted for use in manufacturing non-woven webs of great uniformity and width wherein a connecting duct which carries the fiber-containing air stream from the feeder to the foraminous collector is equipped with baffle means to divert at least the top portion of the air stream so that it flows downward at an obtuse angle and so that one or more portions thereof are diverted further than others yet all portions thereof travel at the same angle at the point of diversion, the level of said baffle means being adjustable in numerous closely spaced areas.

This is a continuation-in-part of application Ser. No. 434,591, filed Feb. 23, 1965, now abandoned.

This invention concerns apparatus for making a deposit of fibrous material and is especially useful for making a continuous non-woven web of fibers. Deposits having a width greater than deposits previously obtainable from similar apparatus can be obtained from the apparatus of this invention.

Deposits of particulate material such as fibrous batts are ordinarily formed by using a combination of a "feeder" for producing an air stream carrying the fibers and a "collector" for removing the fibers from said air stream and forming a non-woven batt. Heretofore, batts thus formed have had substantially the same width and height as the outlet port of the feeder although some equipment has been capable of producing batts having somewhat increased height. Distribution of fibers in the resulting batts has been controlled to some extent by modifications within the feeder and/or the collector; however, easily maintainable accurate control over fiber distribution was not attained by these modifications. Even when good control was attained with one type of fiber, a change to other types of fibers usually necessitated substantial additional basic modifications of the apparatus.

Apparatus for making an accurately controlled deposit of fibrous material has now been discovered. This apparatus comprises (1) a feeder for producing an air stream carrying fibrous material, (2) a collector comprising at least one foraminous member for removing said fibrous material from said air stream and forming a continuous batt, (3) a "connecting duct" for conveying said air stream containing fibrous material from the feeder to the collector. In one embodiment the connecting duct contains a baffle bank consisting of a plurality of adjacent baffles attached to at least one wall of the connecting duct and extending into the duct a distance sufficient to have a material effect on the uniformity of the deposit of fibrous material in the collector. Preferably each of said baffles is independently and longitudinally adjustable from a first position in which it does not protrude into the connecting duct to a second position in which it extends at least one-fourth of the distance and desirably all the way to the opposing wall of the connecting duct. These adjustable baffles can also be held at any position between these extremes. This baffle bank can be provided with a smooth-curve profile by fitting an elastomeric channel (similar to an automobile window channel) over

2

the ends of the plurality of baffles to cover the step-wise profile formed when the individual baffles are adjusted to different heights (see FIG. 10). The adjustability of the profile of the baffle bank and regulation of fiber deposit control remains unimpaired.

The baffle bank can also consist of a single baffle in the form of a rectangular plate or parallelepiped of flexible material such as an acrylic resin ("Lucite ®"). Operation is similar to the above described baffle banks in that due to the vertical flexibility of the plate, localized portions of the plate can by application of external pressure be made to protrude more or less into the connecting duct to regulate air and fiber flow. Control of air and fiber flow can also be regulated by utilizing a connecting duct with a flexible or elastomeric ceiling so that localized portions of the ceiling can be pressed inwardly into the air stream to control its flow.

Apparatus of this invention is useful for forming continuous sheets of non-woven batts of synthetic and natural fibers and mixtures of these. Fibers of cotton, wool, hair cellulosic particles and fibers, fur, asbestos, polyamides such as nylon, polyacrylics such as polyacrylonitrile, polyvinyls such as polypropylene and polyvinyl chloride, polyesters such as polyethyleneterephthalate, etc., can be used. Uniform deposits of fibrous materials produced by the apparatus of this invention, especially deposits of polyester and polyamide fibers, are particularly useful in making substrates for poromeric materials. Other uses for uniform non-woven batts of fibrous material produced by the apparatus of this invention include applications in the manufacture of insulation, padding, filler for upholstery and packing, felting, absorbents, etc.

FIGURE 1 of the drawings shows a sectional side view of apparatus of this invention.

FIGURE 2 is a perspective view of one type of baffle bank construction used in this invention showing how the rabbeted side walls of a plurality of contiguous baffles provide air-tight cooperation and independent longitudinal adjustability.

FIGURES 3, 4, 5, 6, 6A, 7 and 8 are views showing different duct configurations of apparatus of this invention and optional placements of baffle banks on these ducts.

FIGURE 9 is a detail drawing of a typical baffle system of this invention.

FIGURE 10 is a cross-sectional view of a duct of the type shown in FIGURE 3, as viewed in the downstream direction from a point immediately upstream from the baffle bank, the lower portion of the baffle bank being fitted with an elastomeric channel.

A specific embodiment of the apparatus of this invention for producing a fibrous batt is shown in FIGURE 1 where fibers dispersed in a moving air stream are produced by a conventional feeder. Typical feeders for producing an air stream carrying fibrous material useful in this invention are disclosed in U.S. patents Buresh 2,451,915; Langdon et al. 2,703,441; and Buresh et al. 2,700,188. Other means for producing an air stream carrying particulate material useful in this invention are disclosed in U.S. patents Thomas 1,959,845; Pearce 2,188,-373; McClure 2,318,243; Plummer et al. 2,676,363 and 2,676,364; and Kennette et al. 2,731,679. The disclosures of these patents are hereby incorporated into this specification.

As shown by the arrows which indicate direction of flow the air stream passes from the feeder **1** through connecting duct **2**, the entrance port **3** of which fits snugly with exit port **4** of feeder **1** to avoid air leakage. Duct **2** conveys the air stream past baffles **5** within the duct to a dual screen condenser which comprises a pair of continuous foraminous belts **7, 7'** each of which travels around three rolls **8, 9, 10** and **8', 9', 10'**, respectively. In a preferred embodiment the height of the opening between belts **7** and **7'**, at rolls **8** and **8'**, is equal to the height of exit port **6** of connecting duct **2** and about 0.75–10.0 times the height of the entrance port **3** of connecting duct **2**. The width of the belts **7** and **7'** and the width of exit port **6** of duct **2** may be from about 0.5 to 2 times the width of entrance port **3** of duct **2**. Belts **7** and **7'** converge from parallel rolls **8** and **8'** to parallel rolls **9** and **9'**, respectively, forming an exit opening between rolls **9** and **9'** having a height of as little as 0.05 of the height between rolls **8** and **8'**. The wedge thus formed by the belts acts as an efficient fiber removing area and also consolidates the resulting fibrous batt. If desired only one of the belts need be formainous. Heights of the entrance opening and the exit openings of the condenser are adjustable.

Belts **7** and **7'** are foraminous woven wire belts in this embodiment and are driven in the directions shown by arrows B and B' in FIGURE 1. Belts of about 12 mesh woven from about 22 gauge wire are satisfactory for handling most fibrous materials. The belts can be driven by chains connected to the edge of each belt and meshing with sprockets on the three rolls associated with each belt. The three rolls associated with each belt are conveniently interconnected by a set of gears (not shown) so that only one of the three rolls need be driven by a power source (not shown). Any suitable means for imparting uniform motion to the rolls and/or belt can be utilized.

Cleaning means such as rotating brushes **30**, **30'** can be utilized to clean lint from the belts and can be located anywhere along the belt except in the fiber collecting portion between rolls **8**, **8'** and **9**, **9'**. Lint catching conduits **11**, **11'** and lint exhaust tubing **12**, **12'** can be included to cooperate with this brush in keeping the room free of lint. Conduits for fluid exhaust **13**, **13'** are also shown in FIGURE 1.

FIGURE 2 is a perspective view of one preferred type of construction of baffle bank **15** used in practicing this invention showing how the rabbeted side walls of a plurality of individual contiguous baffle **5** provide air-tight independent longitudinal adjustability; each of the baffles is equipped at its upper end with a threaded stud **21** for attachment to an adjusting means, for example, as illustrated in FIGURE 9.

FIGURES 3 and 4 are a plan view and a side view, respectively, of a preferred connecting duct **2**, with entrance port **3** adapted to be connected to a feeder exit port of similar size and configuration. As shown, the duct width increases in the direction of fluid flow (shown by arrow), while maintaining constant height and reaches a maximum width at **14**. A bank of baffles **15** is positioned across the duct at **16**, about 0–20 inches upstream of the connecting duct exit port. The section of duct **2** containing these baffles is referred to as expander section (A) of the duct and the section (B) immediately downstream of section (A) is the venturi section, so-called because of a substantial increase (usually several fold) in height of the duct in this section.

Generally speaking, the apparatus of this invention operates most efficiently and produces fibrous batts of greatest uniformity if the height of section (A) is substantially constant (except for the baffles) and the width of section (B) is substantially constant or decreases somewhat toward its exit port, i.e., 10% or less.

In one embodiment baffles **5** (FIGURE 1) are supported by transverse plate **17** attached by adhesive or welding or other suitable means to the outer face of top wall **18** of duct **2** and extending across the entire width of the duct. Piercing the top duct wall is slot **19** angled at 60° to the interior top surface of the duct. Positioned within this slot are a plurality of narrow adjustable baffles (shown in more detail in FIGURE 9) which are rabbeted or otherwise slidably interconnected with each other to form a continuous inverted air-tight dam across the upper interior of duct **2** for its entire width. Individual baffles 3–4 inches wide, about 0.1–1.0 inch thick and long enough to extend to the bottom of the duct are a convenient size but other sizes can be used. Narrow baffles provide better control of web uniformity than wide baffles. When a single baffle forms the dam across the duct, it can be attached to the ceiling or other wall of the duct in the same manner as the multiplicity of baffles above described and is controlled along its length by a plurality of threaded studs as in FIGURE 9 described below. For greatest control each baffle is individually adjustable to any desired level from a position in which it does not protrude into duct **2** to a position in which it protrudes into the duct very substantially and positively affects the flow of air therethrough thereby controlling web formation. Preferably the baffles can be adjusted to touch the opposing wall (bottom) of duct **2** but usually this is unnecessary. Naturally, more extreme baffle bank profiles are possible with a bank containing a plurality of baffles than when a single flexible baffle constitutes the whole bank. Normally, however, extreme profiles are unnecessary and a single flexible baffle is adequate, besides being free from fiber-catching corners and edges.

FIGURES 5 and 6 and 6A are plan views of alternative useful embodiments of connecting ducts and FIGURES 7 and 8 represent side views of alternative configurations which may be utilized. Any of the plan view configurations of FIGURES 3, 5 and 6 and 6A can be used in conjunction with the side view configurations of FIGURES 4, 7 and 8 to provide connecting ducts useful in this invention. With further reference to FIGURE 3, baffle bank **15** is fitted closely to the side walls of the duct **2** to prevent leakage of air between the side wall of the duct and the adjacent baffle. FIGURE 4 illustrates an embodiment in which connecting duct **2** contains two baffle banks **15** and **15'** in opposed relationship to each other. This embodiment provides substantially more control of product uniformity than a single bank of baffles. In practice, of course, it is possible, following proper adjustment of all baffles to obtain a desired uniformity of product, to substitute one or more fixed baffle banks for one or more of the banks of independently adjustable baffles. This is accomplished by simply cutting a single sheet of material to produce the same profie or a smooth curve of the same profile as the adjusted baffle bank it replaces. It has been found convenient in practice using a dual bank of baffles as in FIGURE 4 to have that baffle bank, which is attached to the bottom surface of the duct (represented by **15'**), in the form of a fixed solid sheet of material having a straight upper edge parallel to the bottom interior surface of the duct and spaced the distance of 0.1–1 inch therefrom for a duct having a height of 2 inches.

FIGURE 7 illustrates a connecting duct in which the baffle bank **15** is positioned near the entrance port of expanding section (A) of the duct. FIGURE 8 illustrates another embodiment in which the side view configuration of the connecting duct uniformly increases in height in the direction of flow of air indicated by the arrow and the upper baffle bank **15** is positioned about mid-way between the entrance and exit ports of the connecting duct. The lower baffle bank **15'** is in the form of a fixed sheet of metal attached to the bottom wall **20** of the duct and angles forward at about 60° to the bottom surface of the duct. Baffle angles of 10 to 90° on this basis are useful. In each of the embodiments of this invention each baffle bank extends from one side wall of the connecting duct to the opposite wall and is closely fitted to each wall to prevent leakage between the side wall and the adjacent baffle. Any of the baffle banks illustrated can be positioned in any part of expander section (A) of connecting duct **2** and there can be one, two or several baffle banks depending upon the uniformity requirements of the particular material being deposited and its physical characteristics taken together with the rate of fluid flow, the size and thickness of the deposit desired and the width of the deposit produced relative to the width of the feeder exit port.

A typical baffle arrangement useful for controlling air streams carrying fibrous material is shown in detail in

FIGURE 9. In the specific embodiment of a baffle represented by FIGURE 9, a threaded stud **21** is attached to or integral with baffle **22**, and control wheel **23** having a circumferential groove **24** around its lower portion is threaded on the stud. The groove of the control wheel rides in an opening **25** in a support member **26** fixed to a wall of duct **2** so that rotation of the control wheel moves the attached baffle into or out of the duct. Each baffle is slideably secured to a guide member **27** by means of a spring loaded bolt **28**. Baffle position is empirically determined for each combination of primary factors involved in operating the apparatus, including the nature of the feeder, collector, air velocity, ratio of air volume to volume of particulate material, duct configuration, etc. Other useful means for providing variable baffle positions include the use of clamps, cotter pins, spring clips, etc., to hold a slideable baffle in the desired position. Alternatively, stud **21** can be rotatably attached to baffle **22** and threadably mounted in a support member **26** so that rotation of the stud by means of a screw driver, wrench, etc., moves the baffle into or out of the duct. This arrangement is also suitable for control of a baffle bank consisting of a single flexible baffle as described above, the only difference being that a plurality of threaded studs are attached to the baffle along its length and operate to move the associated portions of the flexible baffle into or out of the duct. Seals **29** shown in FIGURE 9 can be used to minimize air leakage around the baffles.

FIGURE 10 is a view in cross-section of a duct **2** of the type shown in FIGURE 3 as viewed in the downstream direction from a point immediately upstream from the baffle bank **15** which protrudes from top wall **18**, the lowermost portion of the baffle bank being fitted with an elastomeric channel **30**, whereby the channel covers the step-wise profile formed by the individual baffles **5** and provides the baffle bank with a smooth-curve profile.

In FIGURE 10, the uppermost portion (not shown) of the baffle bank **15** which extends upwardly from top wall **18** has a structure generally as illustrated in FIGURES 3 and 9.

Although baffles can be located near the entrance part of section (A) of duct **2** (e.g., as shown in FIGURES 6 and 6A) best control of deposit uniformity is attained if an adjustable baffle bank is located horizontally perpendicular to the air flow across the top of duct **2** and close to the widest portion of section (A) e.g., as shown in FIGURE 3), preferably about 2–10 inches upstream from the widest portion. Such a baffle bank is angled about 40–75° forward (with the direction of air movement) relative to the top interior surface of the duct and is free from air leakage through the bank and around the ends thereof. Preferably also, there is a second adjustable baffle bank or alternatively a fixed baffle bank protruding upward from the bottom of duct **2** in opposed relationship to the first named adjustable baffle bank and angled forward at about the same degree of slant but relative to the bottom interior surface of the duct. The second bank is conveniently a thin rigid rectangular plate welded or otherwise attached to the bottom and sides of the duct interior and with one face having an area ranging from 10–50% of the cross sectional area of duct **2** at the position of this second baffle bank. For greater control one or more additional baffle banks can be included in the connecting duct but usually none is necessary. Using the above baffle arrangement (FIGURES 3 and 4) continuous non-woven fibrous batts 124 inches wide are produced having an average deviation as small as 0.2 ounce per square yard from a mean of 14 ounces per square yard based on 25 samples.

Individual baffles about four inches wide are a convenient size for use in a connecting duct up to about three inches in height and 50–200 inches wide, although better control is attained with the narrow ducts in this range by baffles 2–3 inches wide. Preferably the baffle should slant forward in the direction of air flow at 60° to the interior surface of the duct to which the baffle is attached. Baffles usually have rounded or chamfered edges to prevent snagging of fibers thereon. A desirable height for section (A) of the connecting duct is 1–5 inches with a height of 1.5–3 inches preferred as affording best control with conventional feeders and collectors.

Air velocity is at least 1000 feet per minute and preferably about 6000–8000 feet per minute at the entrance port of the connecting duct and 4000–6000 feet per minute as it passes the last bank of baffles in the connecting duct. Of course the entire connecting duct and its connection with the feeder is air-tight.

With the apparatus of this invention, and using connecting ducts shown in FIGURES 3 and 4 particularly, extremely uniform non-woven batts of synthetic fibers are produced in continuous lengths having widths of 10–100% wider than the width of the feeder exit port supplying air/fiber mixtures to the apparatus. The thickness of such batts will normally be about the same as the entrance port of the collector utilized.

Operation of the apparatus of this invention is extremely simple. The feeder is operated to provide an air stream containing fibrous material and this material is conveyed through duct **2** and removed from the air stream by the collector. Then if examination of the initial deposit reveals a lengthwise streak of lean or heavy deposit, the operator need then merely note the distance of the streak from the edge of the deposit and adjust the baffle or baffles at a corresponding distance from the corresponding edge of duct **2**. Sometimes more than one baffle in this area will need slight adjustment. Baffle adjustments are very sensitive and it is common for an adjustment of a baffle (lengthwise) by 0.010 inch to produce a change in a fibrous deposit of one ounce per square yard in the area of the deposit controlled by that baffle. Increasing the protrusion of the baffle into the air stream normally decreases the deposit in the affected area of the batt and vice versa.

In place of the preferred dual condensing belts, other collectors useful in this invention for removing particulate material from an air stream can be used. These include rotary foraminous drums such as the drums disclosed in U.S. Patents 2,451,915 and 2,700,188 referenced above and a continuous foraminous belt such as the above referenced U.S. Patent 2,703,441 discloses. The other U.S. patents referenced above disclose additional foraminous members useful as collectors in this invention and the disclosures of these collectors are hereby incorporated into this specification.

The discharge end of feeders useful in this invention is desirably about ½–5 inches in height and about 10 to 120 inches or more in width and fits snugly with entrance **3** of duct **2** to provide an air-tight smooth interior surface with a minimum of interference to air flowing therethrough. Similarly exit port of duct **2** should cooperate with the entrance opening between belts **7** and **7'** at rolls **8** and **8'** and be about the same size and configuration as this opening.

In other embodiments of this invention duct **2** height and/or width can increase or decrease in certain cross sectional areas. Most uniform products are obtained with apparatus of this invention in which duct height or width changes are gradual. For most purposes, connecting duct **2** desirably has a width considerably greater than its height because improved control over distribution is then possible. A connecting duct having a length of from about 1–15 feet is most satisfactory.

Apparatus of this invention is particularly useful in making wide uniform deposits of particulate material. When duct **2** increases in width in the direction of air flow, it forms deposits having a width greater than the width of the feeder outlet. This is paticularly advantageous because it permits production of wide batts without the expense of buying large feeders. Good control over distribution of fibrous material can be attained using apparatus of this invention in which connecting duct **2** width changes at a rate up to about 0.75 unit per unit of length. Satisfactory distribution of particulate material adequate for most purposes can be attained using apparatus of this invention when duct **2** width changes at a rate beyond this figure.

Duct **2** preferably has a rectangular cross-section throughout but other configurations which permit control of air/fiber flow by baffles can be used and need not be symmetrical. For example, a duct with a semi-circular cross-section with one flat side or any similar arrangement can be used.

Properties of fibrous batts and granular material produced by the apparatus of this invention can be varied by increasing or decreasing air velocity at the removing means. Fibrous batts having a very desirable combination of strength, uniformity and surface smoothness are formed when duct height increases just before the entrance to the dual screen condenser and air velocity at this entrance is about 1000 to 3000 feet per minute. A large proportion of the fibers in batts produced with these conditions are disposed in a chevron configuration (>>>>>) in the vertical plane. The shape of these chevrons can be varied by varying the air velocity. Larger variations in air velocity or variations in the rate of change of duct height or width just before the condenser entrance can produce batts in which a large proportion of the fibers are randomly oriented or batts in which a large proportion of fibers are linearly oriented in a certain direction. The most unifom fibous deposits are produced on dual screen condensers when duct height changes at a rate from about 0.1–2.5, and preferably about 0.2 unit per unit of length (in section (B)).

Interior surfaces of ducts of this invention preferably have a minimum number of obstructions and interruptions to fluid flow. Fluid leakage from ducts of this invention is also preferably held to a minimum. Ducts can be fabricated from sheet metal, plastic materials (polyacrylic resins, polyamides, polyaldehydes), wood, glass and any other suitable conduit material.

The term "baffle" is used in this specification to designate any member useful in controlling air flow ducts of this invention including paddles, vanes, gates, threaded members, etc. Baffle width is not critical but a large number of baffles per baffle bank permits more exact control of product uniformity than a small number. Although it is most convenient to operate the present invention with air, other fluids such as steam, wet or dry, may be used and in some instances, the fluid carrying the fibers may be a liquid such as water or other suitable medium.

I claim:

1. Apparatus for making a uniform deposit of fibrous materials which comprises

a feeder for providing an air stream carrying fibers,

a collector comprising at least one foraminous member for removing said fibers from said air stream,

a connecting duct positioned to convey said air stream from the feeder to the collector, and

at least one continuous baffle bank positioned to protrude from an interior wall of the duct toward the opposite interior wall, said bank extending transversely across the entire width of the duct and comprising a plurality of contiguous baffles, and means for independently longitudinally adjusting each baffle from outside the duct to vary the length of protrusion thereof into the duct, said baffles being inclined towards said collector thereby forming an acute angle with the interior wall of the duct, each baffle during adjustment thereof maintaining its acute angle relationship with the interior wall.

2. The apparatus of claim **1** in which the baffle bank is located in a laterally expanding section (A) of the connecting duct having a rectangular cross section and forms a dam across the top interior of the duct and horizontally perpendicular to its longitudinal axis, the width of section (A) increasing in the direction of its exit port.

3. The apparatus of claim **2** wherein said baffle bank includes an elastomeric channel strip capped over the protruding ends thereof.

4. The apparatus of claim **2** in which a second baffle bank is positioned transversely across the lower interior portion of section (A) of the connecting duct in opposed relationship to the bank formed by the first-mentioned baffle bank.

5. The apparatus of claim **2** in which section (A) of the connecting duct is located 0–20 inches from the exit port of said duct.

6. The apparatus of claim **5** in which a vertically expanding section (B) of the connecting duct is attached to the exit port of section (A) and section (B) increases uniformly in height toward its exit port at a rate of 0.1–2.5 units per unit of length.

7. The apparatus of claim **6** in which section (B) of the connecting duct decreases uniformly in width toward its exit port in an amount up to 10%.

8. The apparatus of claim **2** in which said collector comprises a dual screen condenser.

9. The apparatus of claim **6** in which section (A) has a rectangular cross section of substantially constant height of about 1–5 inches and a width which is 10–100% greater at the exit port than at the entrance port and section (B) has a rectangular cross section of substantially constant width equal to the width of the exit port of section (A) and a height at its exit port of about 0.75–10 times that at its entrance port.

10. The apparatus of claim **9** in which said collector comprises a dual screen condenser.

References Cited

UNITED STATES PATENTS

735,217 8/1903 De Long ---- 19—148
735,218 8/1903 De Long ---- 19—148
2,195,158 3/1940 Watts ---- 19—156.3
2,731,679 1/1956 Kennette et al. ---- 19—156.4
3,039,137 6/1962 Smith ---- 156—369 X
3,110,182 11/1963 Moss et al.

FOREIGN PATENTS

1,124,490 7/1956 France.
861,476 2/1961 Great Britain.

MERVIN STEIN, *Primary Examiner.*

DORSEY NEWTON, *Assistant Examiner.*