

Aug. 18, 1953

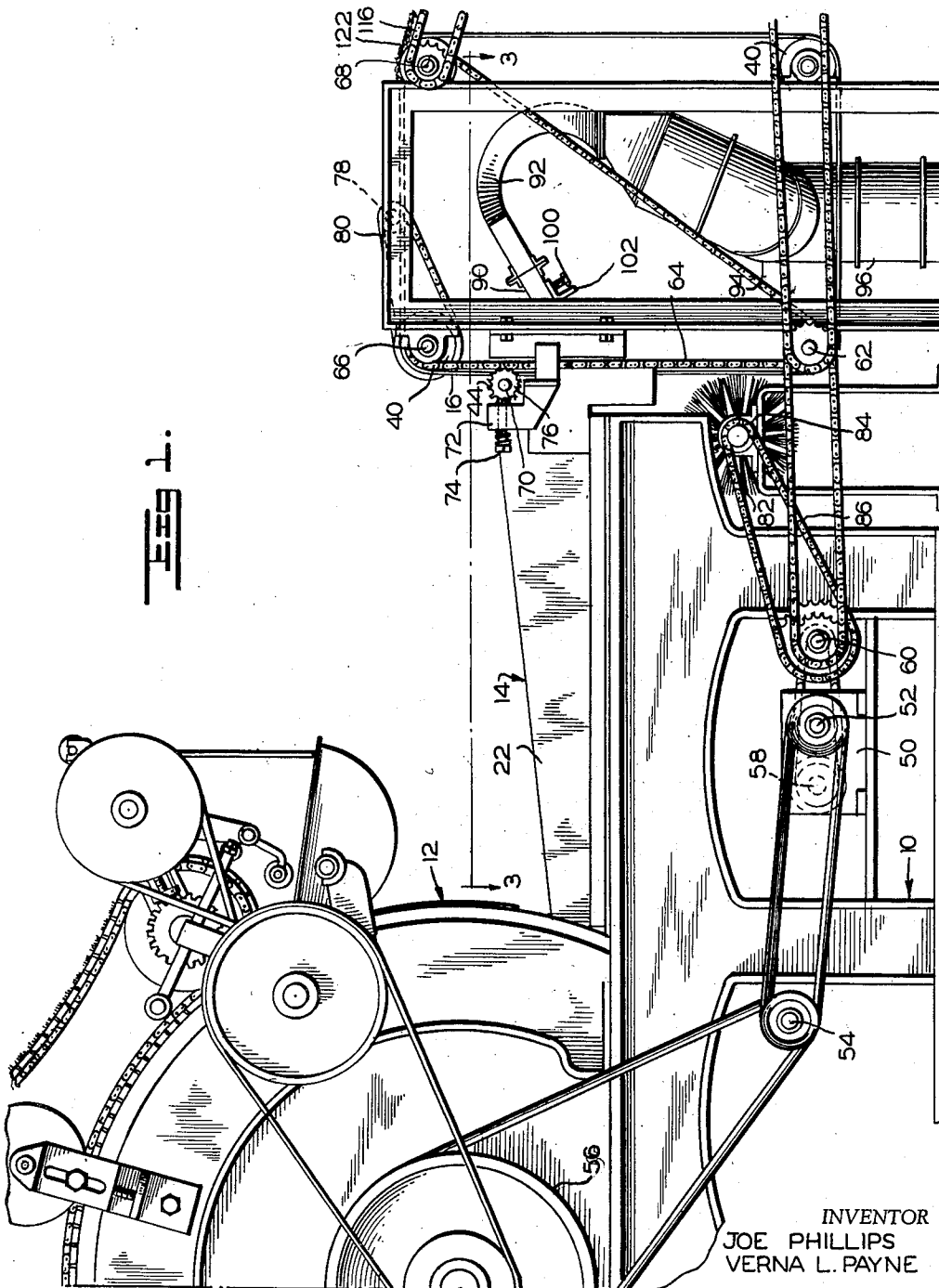
J. PHILLIPS ET AL

2,648,876

METHOD AND MACHINE FOR PRODUCING UNWOVEN FABRICS

Filed Sept. 19, 1950

4 Sheets-Sheet 1



INVENTOR
JOE PHILLIPS
VERNA L. PAYNE

BY *Cushman, Darby & Cushman*

ATTORNEY

Aug. 18, 1953

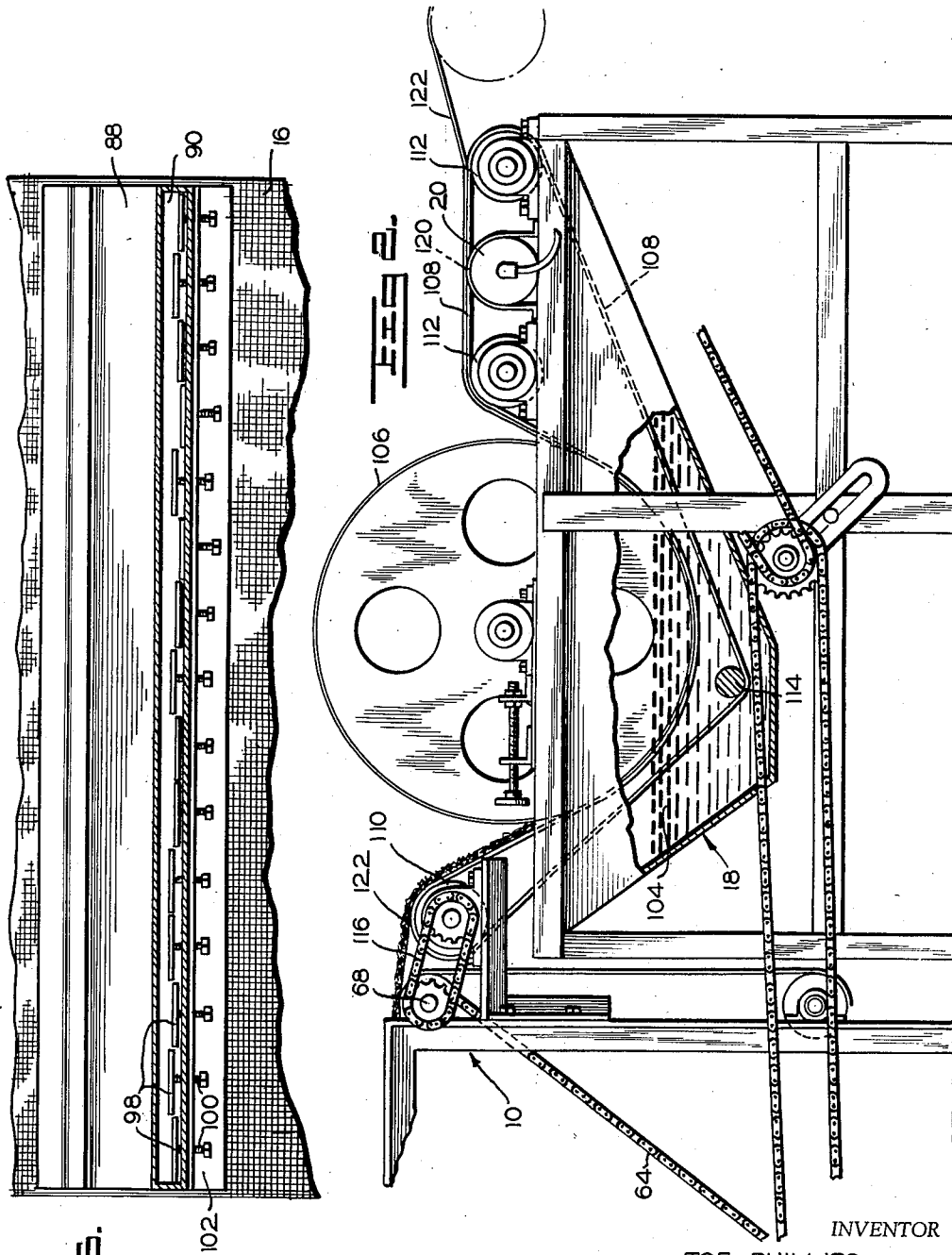
J. PHILLIPS ET AL

2,648,876

METHOD AND MACHINE FOR PRODUCING UNWOVEN FABRICS

Filed Sept. 19, 1950

4 Sheets-Sheet 2



INVENTOR

JOE PHILLIPS
VERNA L. PAYNE

BY *Cushman, Darby & Cushman*

ATTORNEY

Aug. 18, 1953

J. PHILLIPS ET AL

2,648,876

METHOD AND MACHINE FOR PRODUCING UNWOVEN FABRICS

Filed Sept. 19, 1950

4 Sheets-Sheet 3

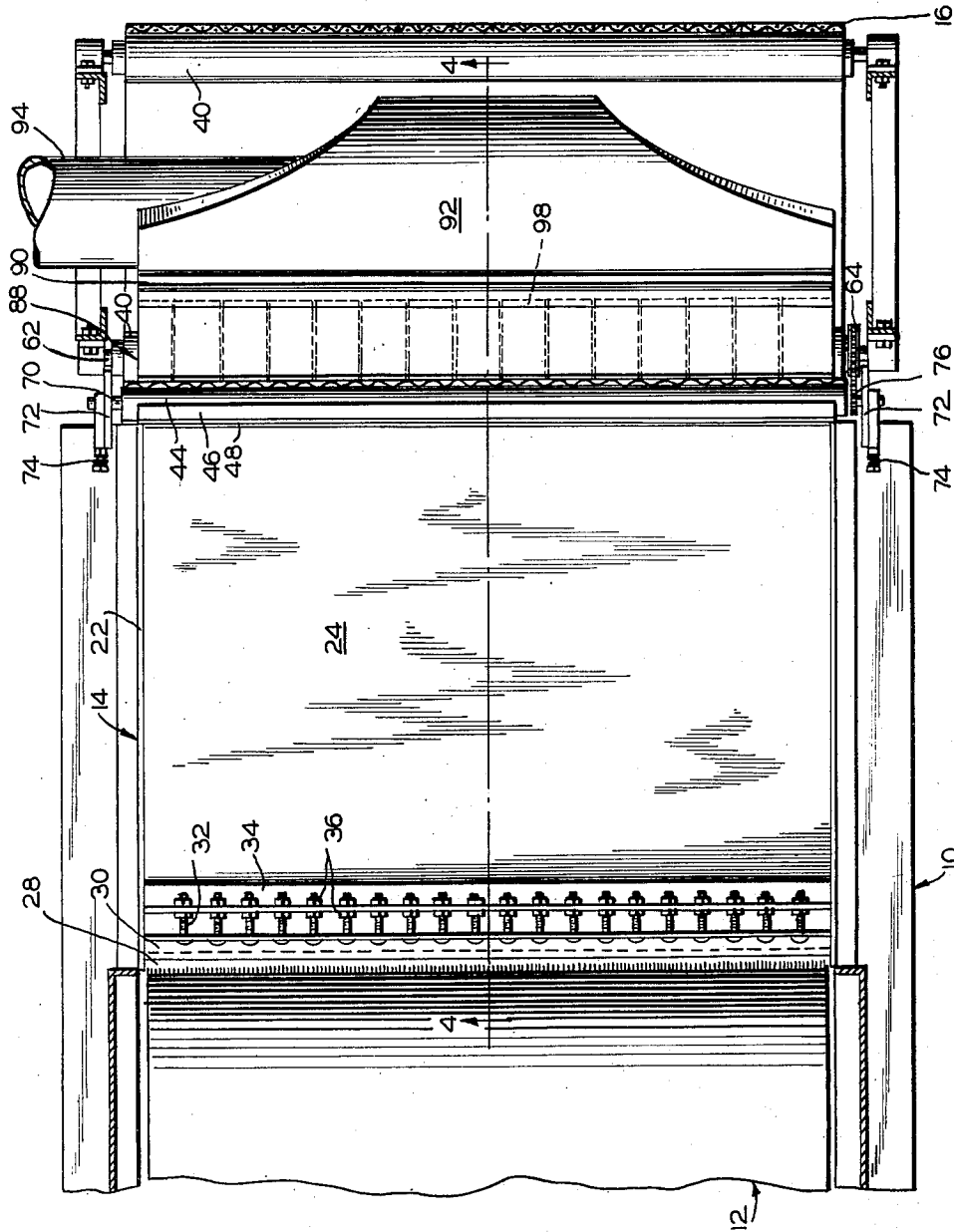


FIG. 3.

INVENTOR
JOE PHILLIPS
VERNA L. PAYNE

BY *Cushman, Parby & Cushman*

ATTORNEY

Aug. 18, 1953

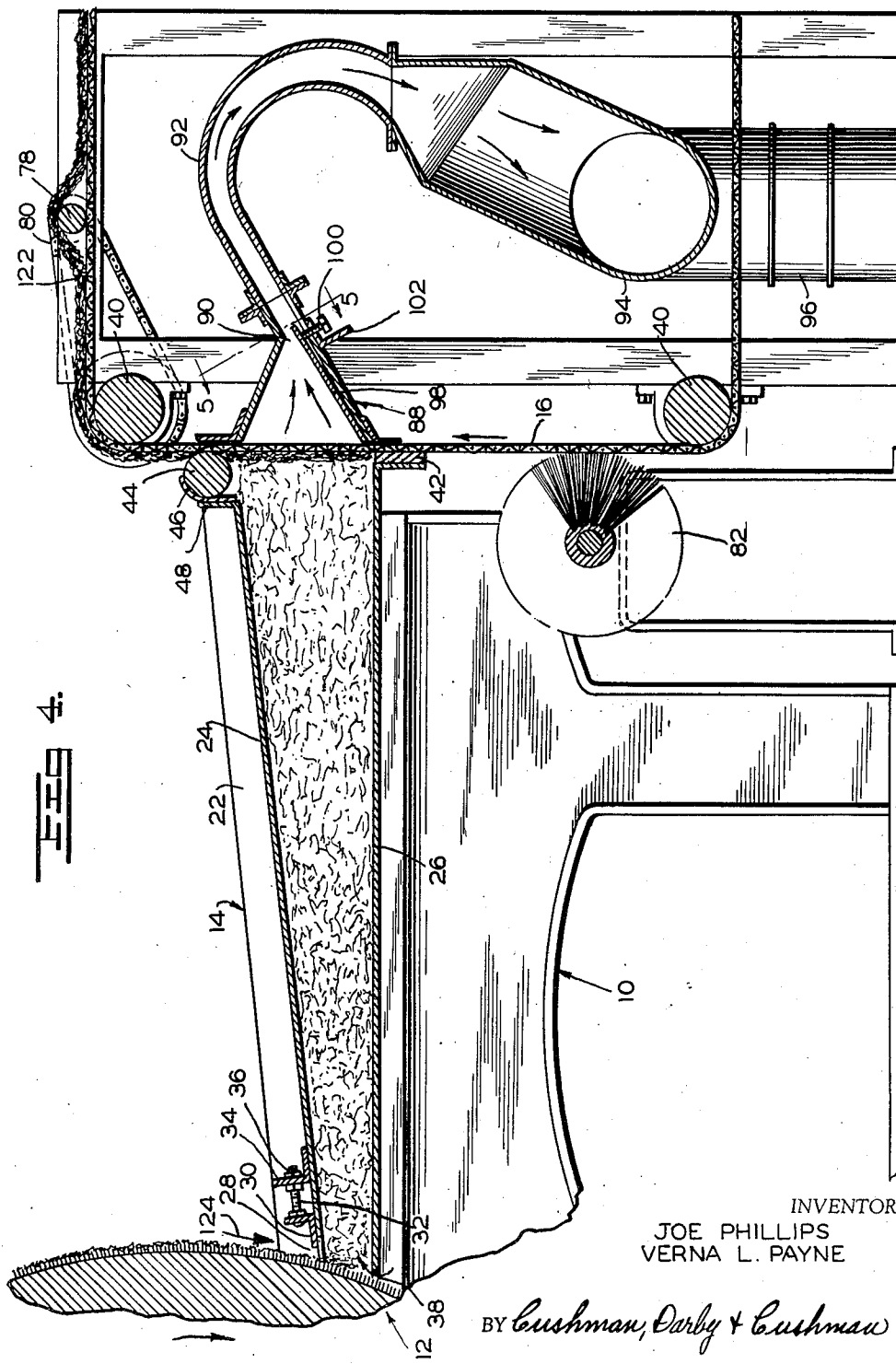
J. PHILLIPS ET AL

2,648,876

METHOD AND MACHINE FOR PRODUCING UNWOVEN FABRICS

Filed Sept. 19, 1950

4 Sheets-Sheet 4



UNITED STATES PATENT OFFICE

2,648,876

METHOD AND MACHINE FOR PRODUCING
UNWOVEN FABRICS

Joe Phillips, Fairfax, and Verna L. Payne, Plant City, Shawmut, Ala., assignors to West Point Manufacturing Company, Shawmut, Ala., a corporation of Alabama

Application September 19, 1950, Serial No. 185,590

6 Claims. (Cl. 19—156)

1 This invention relates to a method and machine for producing unwoven fabrics, of uniform texture and strength in all directions, composed of fibers deposited in random relationship.

In U. S. Patents Nos. 2,477,675 and 2,478,148, both issued August 2, 1949, to Wilson et al., are disclosed a method and machine for producing unwoven fabrics, which yield an eminently satisfactory product. While these inventions achieve a high rate of fabric production compared to prior art methods and machines, the capacity of a single machine is yet limited, and it is found that extremely heavy or thick fabrics cannot be made without some slight loss of textural uniformity. These limitations are inherently involved with the critical dimensional characteristics of the fiber transfer duct, which have been found essential to successful operation.

It has now been found that the production rate of the prior inventions, and the maximum limit of fabric thickness which may be satisfactorily produced, may be materially increased by employing a high speed air stream to doff and entrain the fibers from a fiber carrying supply instrumentality, the air stream travelling initially tangentially to and in the same direction as the fiber carrying instrumentality, and at a velocity bearing a fixed minimum relationship to the velocity of the supply instrumentality. Additionally, it has been found that by so entraining the fibers, and by the provision of novel flow control means in and beyond the transfer duct, the dimensional requirements of the transfer duct may be rendered less critical, permitting employment of ducts of varying configuration without sacrifice of uniformity in the resulting product.

It is an object of the present invention, accordingly, to provide a simplified method and machine adapted to produce unwoven fabrics at extremely high rate.

It is a further object of the invention to provide a method and machine adapted to produce heavy or thick unwoven fabrics of outstanding uniformity.

Another object is to provide in a machine of the type described controllable and differential adjustment means adapted to maintain smooth and uniform the flow of air through the fiber transfer duct and fiber receiving member.

Still another object is to provide in a machine of the type described novel fiber transfer duct structure, adapted to maintain a smooth, uniform flow of air therethrough, without dead air spaces, turbulence or other factors detrimental to formation of a uniform fabric.

2 Yet another object is to provide in a machine for producing unwoven fabrics by deposit of fibers through a transfer duct onto a foraminous receiving member, means adapted to effectively seal the trailing edge of said duct relative to said receiving member without impairing the surface of the fiber produced.

Other objects will be in part obvious and in part pointed out hereinafter.

10 The invention and the novel features thereof may best be made clear from the following description and the accompanying drawings, in which:

15 Figure 1 is a side elevational view of an exemplary machine according to the present invention, including a carding machine, a fiber transfer duct and a foraminous fiber receiving member;

20 Figure 2 is a side elevational view of further elements of the machine of Figure 1, including a dip tank employed to apply bonding material to the fabric produced;

Figure 3 is a partial plan view of the machine, taken on the line 3—3 of Figure 1;

25 Figure 4 is an enlarged sectional view taken on the line 4—4 of Figure 3, showing details of the fiber transfer duct, the fiber receiving screen and related elements, and

30 Figure 5 is a sectional view taken on the line 5—5 of Figure 4, showing details of the air stream control means incorporated in the throat of the air conduit downstream of the fiber receiving member.

Referring to the drawings, particularly Figures 1 and 2, an exemplary embodiment of the present invention comprises a frame 10, and suitably supported thereon a fiber attenuating and carrying instrumentality such as card cylinder 12. A fiber transfer duct 14 extends outwardly from the peripheral surface of the card cylinder, to a foraminous fiber receiving member exemplified by endless flexible screen 16. The unwoven fabric formed on the flexible screen is conducted through dip tank 18, and thence over a vacuum cylinder 20 to suitable drying or baking apparatus, not shown.

45 The fiber attenuating and carrying instrumentality is supplied from a fiber lap or similar source, fed thereto by feed rollers, a conventional taker-in, or other common means (not shown), the mechanism illustrated in Patent No. 2,478,148 being entirely satisfactory. The feed lap is attenuated into individual fibers by card cylinder 12, and the fibers are carried about the periphery thereof, in the clockwise direction as shown, to

the inlet end of transfer duct 14. As best shown in Figure 4, the transfer duct comprises side plates 22, top plate 24 and bottom plate 26. The edges of side plates 22 adjacent the card cylinder are disposed as closely as possible thereto without contacting the cylinder. The edge of top plate 24 adjacent the card is considerably spaced therefrom, defining an elongated air inlet 28 between the top plate and the card. As shown in Figures 3 and 4, the inlet 28 is partially closed by an adjustable gate 30, from which extends a plurality of transversely spaced bolts 32, which in turn extend through suitable apertures provided therefor in a rigid bracket 34 fixed to the upper surface of the transfer duct top plate. The bolts 32 are individually adjustable relative to bracket 34, and in the example shown are threaded whereby each may be individually fixed relative to the bracket by means of lock nuts 36. The gate 30 may be constructed of metal, rubber, leather or the like, but must be sufficiently flexible so that it may be differentially adjusted relative to the card along the length of the air inlet. Obviously, the gate 30 may be composed of individual segments, if desired, although a continuous, flexible gate member has been found to function with outstanding effectiveness. The edge of bottom plate 26 adjacent the card cylinder is slightly spaced therefrom to define therewith an auxiliary air inlet 38, for reasons presently apparent.

The outlet end of transfer duct 14 is disposed adjacent a vertical flight of the flexible screen 16, which is guided and supported by a plurality of rolls 40 rotatably mounted on the machine frame. The side and bottom plates of the transfer duct are effectively sealed against the screen by deformable seal members 42, which may be constructed of rubber or leather, and the top plate 24 is effectively sealed thereagainst by a seal roll 44, and a seal strip 46 disposed between the seal roll and the upwardly turned end flange 48 of the top plate.

The machine is driven from any suitable source of power (not shown) through reduction gear box 50. From the gear box, one take-off shaft 52 is suitably connected in driving relationship through idler shaft 54 to drive pulley 56 of the card. By means of a second take-off shaft 58, the gear box is drivingly engaged, by suitable chains and sprockets, through idler shaft 60 to the shaft 62 of one of the rolls 40 supporting screen 16. By means of chain 64, shaft 62 is engaged in driving relationship to shafts 66 and 68 of other rolls 40, whereby the screen 16 is positively and evenly driven at a speed coordinated with that of the card.

The shaft 70 of seal roll 44 is slidably supported in bearings 72, and is spring biased against screen 16, adjusting bolts 74 being provided to vary the spring pressure. At one end of shaft 70, a sprocket 76 is mounted thereon, which is engaged to chain 64, whereby the seal roll is positively driven at a predetermined speed relative to that of the flexible screen. A separating roll 78 is rotatably mounted immediately above the top horizontal flight of the screen, and is suitably driven from shaft 66, as by chain 80. A screen cleaning brush 82 is rotatably mounted, as by bearings 84, adjacent the outer surface of the fiber receiving screen, immediately below its point of entry into the transfer duct, and is suitably driven from the machine drive, as by means of chain 86 engaged to idler shaft 54.

Interiorly of the fiber receiving screen, and in

general alignment with the transfer duct, is disposed an exhaust duct 88, which converges into an elongated throat 90, which in turn merges into a downwardly curved and inwardly converging section 92, which communicates with an outwardly extending duct portion 94 terminating in a downwardly extending duct portion 96. In the throat 90 of exhaust duct 88 is provided means for differentially varying the opening thereof across the width of the throat. As shown in Figures 3, 4 and 5, a plurality of flexible leaf plates 98 may be employed, one end of each plate being fixed to the duct adjacent its open end facing the screen, the other end of each plate extending rearwardly into the throat. Below the throat end of each plate, an adjusting screw 100 is threadably mounted in a support bracket 102 extending transversely below the duct, each adjusting screw extending through the duct into contact with the lower surface of the free end of the leaf plate thereabove. It will be readily understood that by means of the individual adjusting screws, the leaf plates may be individually adjusted, as illustrated in Figure 5, whereby the throat opening may be differentially varied as required across the width thereof.

As seen in Figure 2, the dip tank 10 is disposed adjacent the rear vertical flight of the flexible screen. The dip tank may contain a quantity of fluid binder 104. Rotatably supported above the tank and extending below the surface of the binder 104 is an immersion drum 106. An endless wire cloth 108 or equivalent pressure member is maintained in contact with the lower portion of the immersion drum, the wire cloth extending about drive roll 110, the immersion drum, idler rolls 112, and thence below the submerged guide bar 114 to the drive roll. As illustrated in Figure 2, the drive roll 110 may be driven by means of chain 116 from the shaft 68, and the wire cloth 108 and immersion drum 106 driven thereby. Intermediate the idler rolls 112 is mounted the suction cylinder 20, provided with a series of apertures or a slot 120 in the upper surface thereof.

The operation of the apparatus and the method of the invention will now be described in detail. As previously indicated, the card 18 is supplied from a suitable source such as a fiber lap, and functions in the conventional manner to attenuate the fibers. The attenuated fibers are carried about the surface of the card to the inlet end of the fiber transfer duct. A high velocity air stream is caused to flow through the duct from the inlet end thereof to the foraminous fiber receiving member. In the example shown, the air stream is induced by means of an exhaust fan (not shown) connected to the downwardly extending duct portion 96, whereby a flow of air is induced through the transfer duct, the flexible screen, and the exhaust duct throat, air entering the transfer duct primarily through air inlet 28.

It is obviously essential that the air stream entering the air inlet effectively doff the fibers from the card cylinder surface adjacent thereto, and it is equally essential that the fibers so entrained be conveyed through the duct to the fiber receiving member by a uniform and evenly flowing air stream, so that the fibers are deposited on the fiber receiving member in random distribution and in uniform manner and quantity across the width thereof. It has been found that this can be most effectively accomplished by employing a high velocity air stream, which, as

5

6

indicated by arrow 124, Figure 4, initially moves tangentially to the surface of the card cylinder, and then moves longitudinally of the transfer duct. The most critical factor of satisfactory operation has been found to be the velocity of the air stream entering inlet 28 relative to the peripheral velocity of the card cylinder or other fiber carrying supply instrumentality. It has been found that if a minimum velocity ratio of at least four to one is maintained, a highly satisfactory fabric may be produced at high production rate. An air velocity ranging up to six or seven or more times the peripheral velocity of the supply instrumentality may be employed with excellent results, but a velocity ratio of less than four to one is found to result in transfer duct turbulence, balling up of the fibers and other factors resulting in a non-uniform or otherwise unsatisfactory product.

In order to control the high velocity air stream, and maintain uniformity of flow across the width of and throughout the transfer duct, differentially adjustable control means have been provided at the air inlet and at the throat of the exhaust duct, downstream of the fiber receiving member. Transverse uniformity of the fabric formed may be readily achieved and maintained by differential adjustment of the air flow at these two points. The uniform and smooth flow of the air stream through the transfer duct may also be enhanced, it has been found, by provision of the auxiliary air inlet 38, by means of which a limited quantity of air is permitted to enter at the bottom of the entry end of the duct. The auxiliary air so entering serves the primary function of obviating dead airspace in this vicinity, and has been found to very materially reduce any tendency toward turbulence in the duct.

The employment of a high velocity air stream, controlled in the manner described, has been found to permit operation of the machine at higher capacity than previously obtainable. The fiber attenuating and carrying instrumentality may be driven at a speed limited only by reason of its relationship to the velocity of the fiber transfer air stream, and may operate relative to its fiber source at extremely high draft, wherein correspondingly excellent attenuation of the fibers is obtained. For example, the card operates relative to its fiber source most efficiently at drafts of four thousand or more, drafts of five thousand to seventy-five hundred being readily attained with excellent results. The term "draft" as here employed refers to the numerical relationship between the weight of fibers carried per foot of fiber carrying instrumentality and the weight of fibers per foot of fiber lap fed thereto, or more specifically, the ratio of the latter to the former. Accordingly, by the present invention, not only a high rate of production, but also a high rate of fiber attenuation is made possible. The air stream need not be induced in the manner described, but may be effected in equivalent manner.

As best shown in Figure 4, the entrained fibers are carried through the transfer duct and deposited upon the upwardly moving foraminous screen to form a lap of fabric 122, the air stream passing on through the flexible screen and the exhaust duct. The formed fabric is compacted somewhat in passage under seal roll 44, and then is conducted over the top horizontal flight of the flexible screen. The seal roll 44, especially in the case of thick fabrics, is prone to

wrinkle or otherwise impair the smooth outer surface of the formed fabric. It has been found that by positively driving the seal roll at a peripheral velocity slightly exceeding the velocity of the flexible screen and the lap carried thereon, this effect may be obviated. The compacted lap is separated from the flexible screen in passage over the driven separating roll 78, and is then carried by the screen to drive roll 110 associated with dip tank 18. The flexible screen 16 continues its path about the rolls 40, and immediately prior to entering the transfer duct is cleaned of any adhering fibers or foreign substances by the rapidly rotating brush 82.

It will be understood that for many purposes the fabric so formed may be employed without further treatment. For many purposes, however, it is desirable to strengthen and condense the fabric by application of binder thereto. This may be conveniently accomplished by the dipping mechanism illustrated, the fabric passing onto the cloth 108, and being conducted thereby around the lower periphery of immersion drum 106, through the fluid binder 104. The wire cloth being relatively open, the fabric is thoroughly saturated with the binder, and may be compacted by pressure of the wire cloth against the drum. The saturated fabric is then carried by the cloth over the first idler roll 112, and then over the suction cylinder 20, which induces a flow of air therethrough and removes excess binder. The impregnated fabric 122 then passes over the second idler roll 112, and may be doffed at this point for passage into suitable drying and/or baking mechanism, if required. Finally, the finished fabric is wound in rolls or otherwise collected for shipment.

The transfer duct may be disposed generally normal to the surface of the card, but need not be, and may be disposed at an acute angle thereto, as shown. The method described above may be employed to form unwoven fabrics of extremely heavy thickness, either by slowing the movement of flexible screen 16 relative to the card, or preferably by so doing and enlarging the downstream end of the transfer duct, to insure product uniformity. By reason of the fine control of the high velocity air stream through the duct, effected by the plural differential means described, it has been found that the duct may be made converging or diverging as best suited to the width and thickness of fabric being produced, but should be straight, smooth-sided and uninterrupted.

It will thus be seen that there has been provided by this invention a structure in which the various objects hereinbefore set forth, together with many practical advantages, are successfully achieved. As various possible embodiments may be made of the mechanical features of the above invention, all without departing from the scope thereof, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawings is to be interpreted as illustrative, and not in a limiting sense.

We claim:

1. The method of forming a fibrous web which comprises the steps of attenuating a body of fibers onto a toothed moving fiber carrying instrumentality, removing the fibers from the teeth of said fiber carrying instrumentality by means of an air stream moving substantially tangentially thereto and in the same direction, the velocity of said air stream at the point of fiber removal being at least four times the velocity of said fiber carrying instrumentality, passing said air stream

7

and the fibers suspended therein to a foraminous fiber receiving member through a confined uninterrupted path, passing said air stream through said foraminous fiber receiving member whereby said fibers form a web thereon, and removing the web from said member.

2. The method of forming a fibrous web which comprises the steps of attenuating a body of fibers onto a toothed moving fiber carrying instrumentality at a draft of at least four thousand, removing the fibers from the teeth of said fiber carrying instrumentality by means of an air stream moving substantially tangentially thereto and in the same direction, the velocity of said air stream at the point of fiber removal being at least four times the velocity of said fiber carrying instrumentality, passing said air stream and the fibers suspended therein to a foraminous fiber receiving member through a confined uninterrupted path, passing said air stream through said foraminous fiber receiving member whereby said fibers form a web thereon, and removing the web from said member.

3. The method of forming a fibrous web which comprises the steps of carding a body of fibers at a draft of at least four thousand, removing the fibers from the card by means of an air stream moving substantially tangentially thereto and in the same direction, the velocity of said air stream at the point of fiber removal being at least four times the peripheral velocity of said card, passing said air stream and the fibers suspended therein to a foraminous fiber receiving member through a confined uninterrupted path, passing said air stream through said foraminous fiber receiving member whereby said fibers form a web thereon, and removing the web from said member.

4. Apparatus of the class described comprising fiber attenuating means to provide a moving source of fiber supply, a fiber transfer duct having an uninterrupted passage therethrough and a fiber receiving end in close contact with said fiber supply source, an elongated air inlet in the leading edge of said duct, gate means defining said inlet, means for adjusting individual portions of the length of said gate means relative to said source of fiber supply, a foraminous fiber receiving member at the delivery end of said duct, means for moving said receiving member relative to said duct, means for creating an air stream through said air inlet, duct and fiber receiving

8

member to remove fibers from said supply source and transfer them through said duct to said receiving member to form a web thereon, and means for removing said web from said member.

5. Apparatus as defined in claim 4, wherein said air stream creating means includes a second duct downstream of said fiber receiving member in alignment with the delivery end of said transfer duct, and obstructing means in said second duct for differentially adjusting the flow of said air stream across the width thereof.

6. Apparatus of the class described comprising carding means, a fiber transfer duct having an uninterrupted passage therethrough and a fiber receiving end in close contact with said carding means, an elongated air inlet in the leading edge of said duct, gate means defining said air inlet, means for adjusting individual portions of the length of said gate means relative to said carding means, a foraminous fiber receiving member at the other end of said duct, means for moving said receiving member relative to said duct, means for creating an air stream through said air inlet, duct and fiber receiving member to remove fibers from said carding means and transfer them through said duct to said receiving member to form a web thereon, said air stream creating means including a second duct downstream of said fiber receiving member in alignment with the delivery end of said transfer duct, obstructing means in said second duct for differentially adjusting the flow of said air stream across the width thereof, and means for removing said web from said receiving member.

JOE PHILLIPS.
VERNA L. PAYNE.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
227,063	Scattergood	Apr. 27, 1880
490,271	Crooks	Jan. 24, 1893
1,827,183	Bennett	Oct. 13, 1931
2,451,915	Buresh	Oct. 19, 1948
2,477,675	Wilson et al.	Aug. 2, 1949
2,478,148	Wilson et al.	Aug. 2, 1949

FOREIGN PATENTS

Number	Country	Date
220,149	Great Britain	Aug. 14, 1924
545,638	Great Britain	June 5, 1942