Jan. 22, 1957 J. DOLEMAN 2,778,065

METHOD OF AND MEANS FOR CONTINUOUSLY SPREADING FILAMENTS

Filed Aug. 13, 1952 4 Sheets-Sheet 1

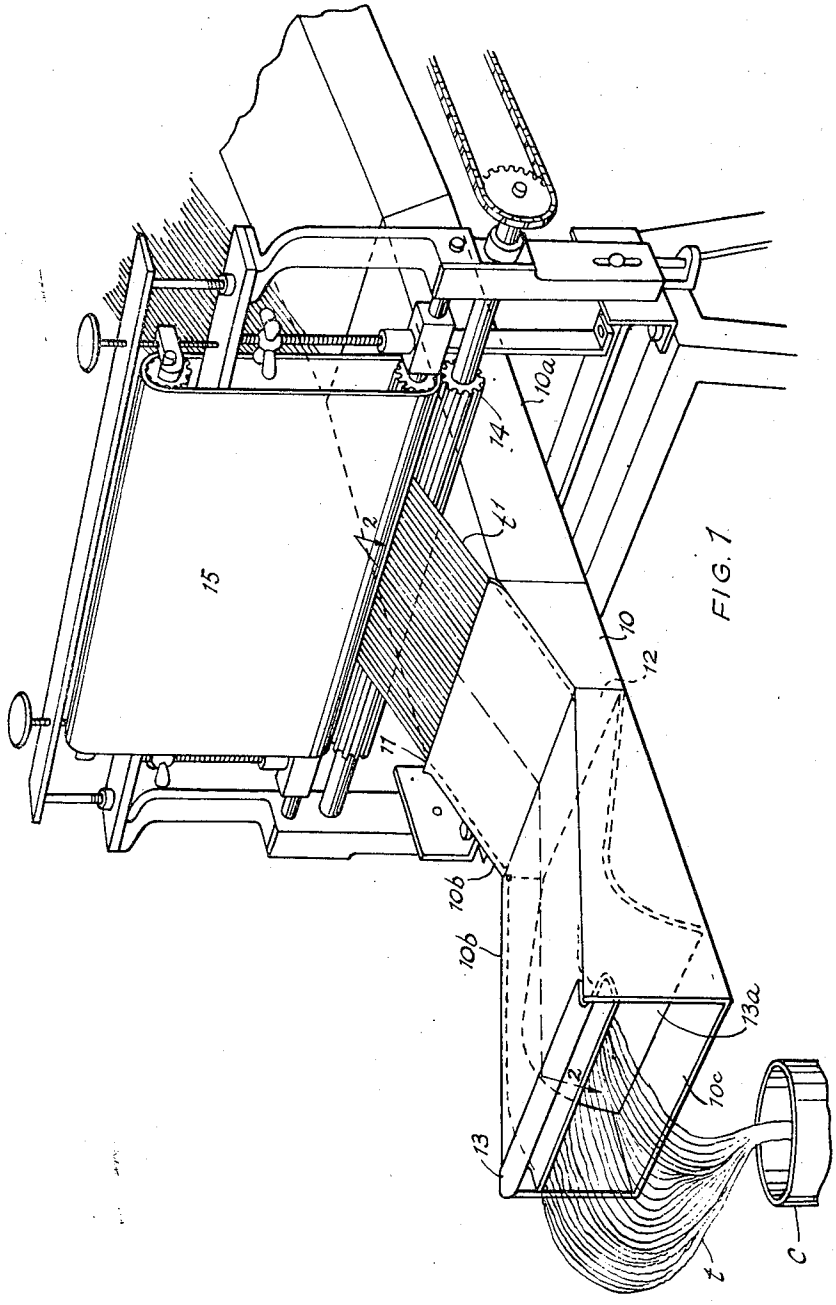


FIG. 1

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METHOD OF AND MEANS FOR CONTINUOUSLY SPREADING FILAMENTS

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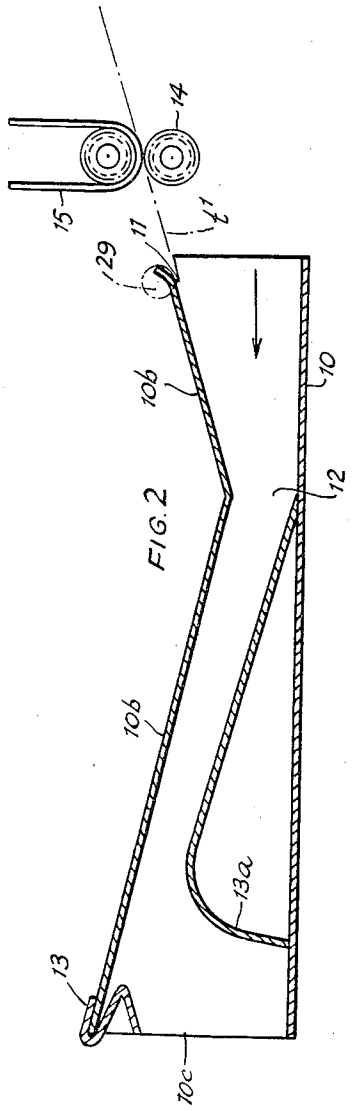


FIG. 2

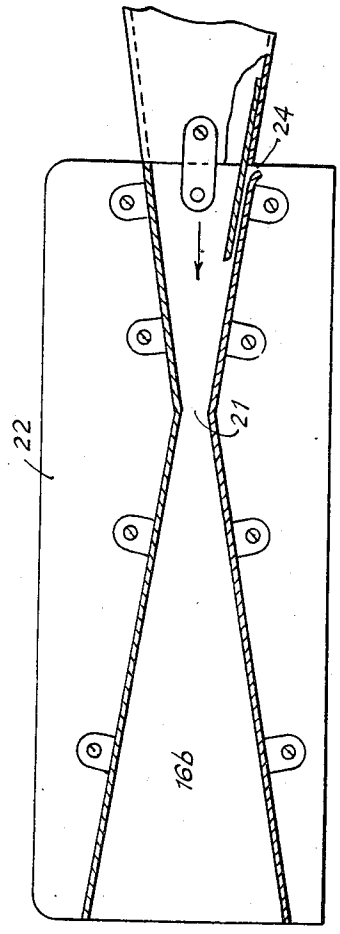


FIG. 5

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METHOD OF AND MEANS FOR CONTINUOUSLY SPREADING FILAMENTS

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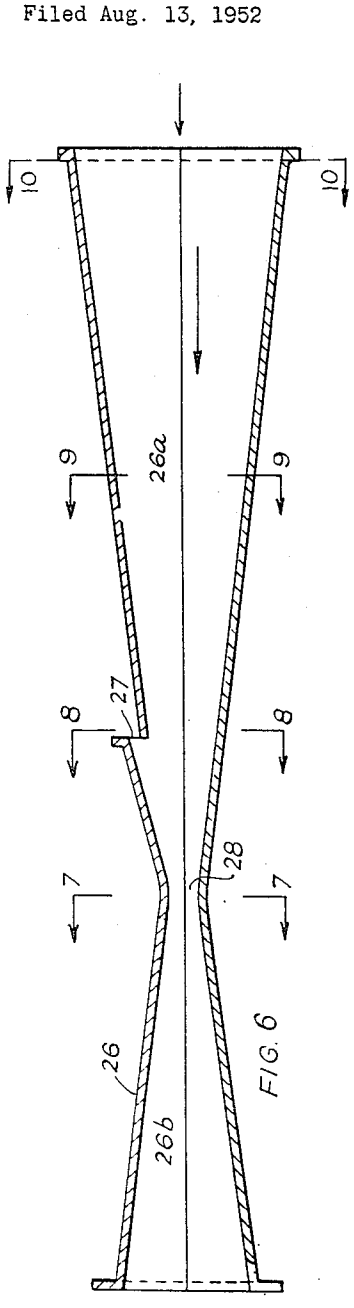


FIG. 6

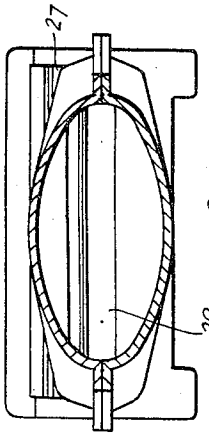


FIG. 9

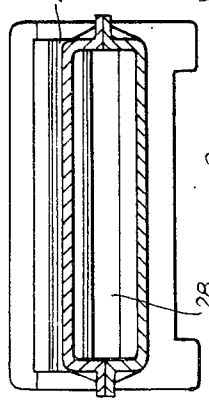


FIG. 8

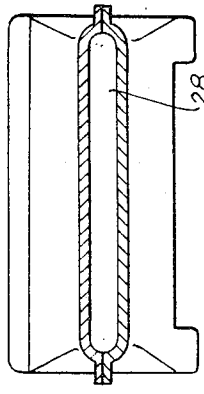


FIG. 7

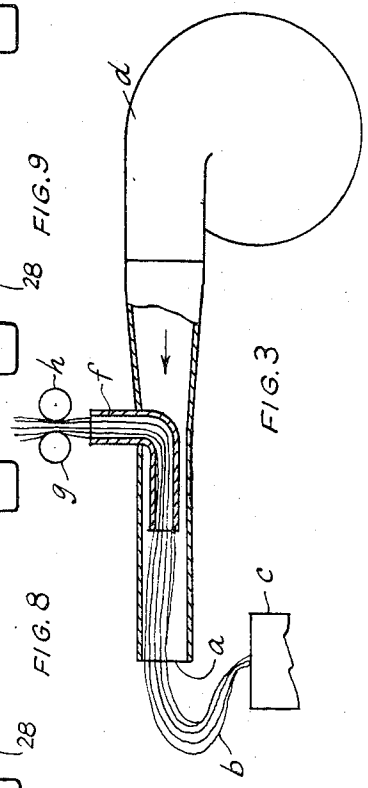


FIG. 3

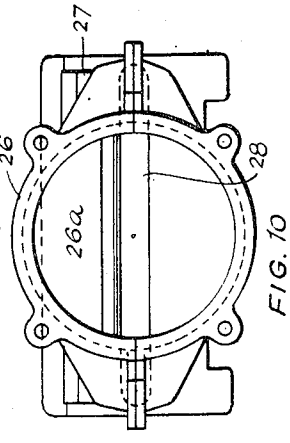


FIG. 10

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METHOD OF AND MEANS FOR CONTINUOUSLY SPREADING FILAMENTS

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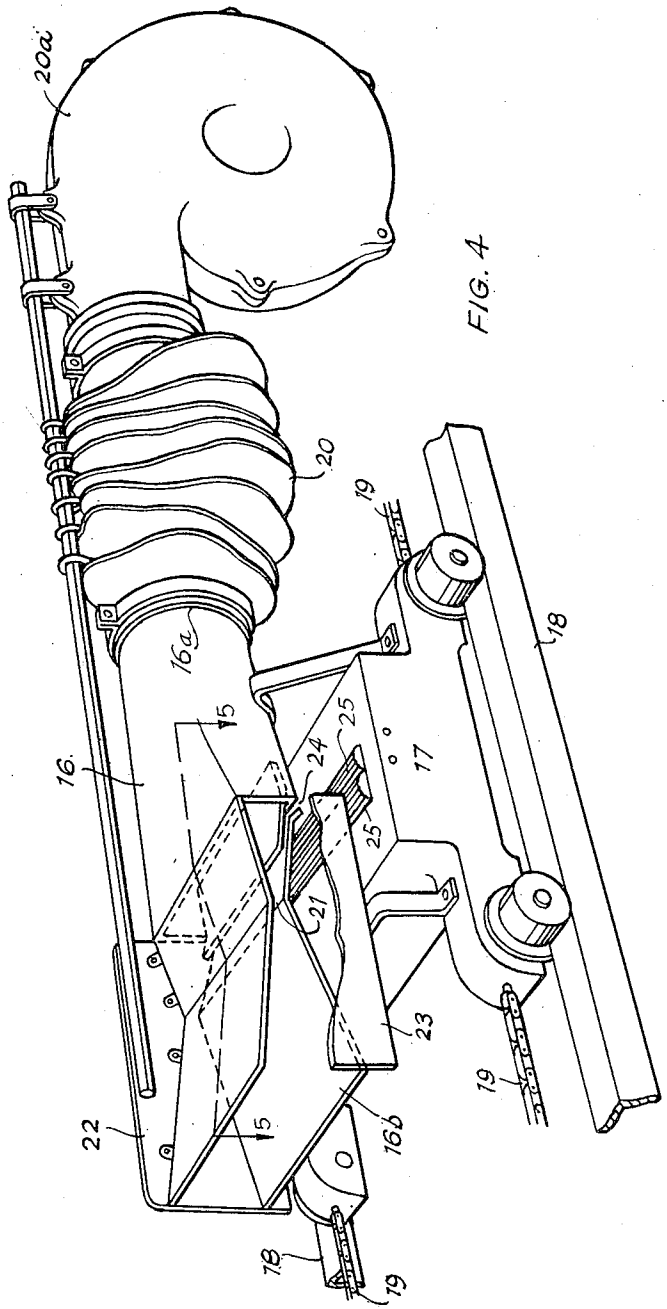


FIG. 4

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United States Patent Office 2,778,065 Patented Jan. 22, 1957

2,778,065

METHOD OF AND MEANS FOR CONTINUOUSLY SPREADING FILAMENTS

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Application August 13, 1952, Serial No. 304,149

Claims priority, application Great Britain August 14, 1951

16 Claims. (Cl. 19—65)

This invention relates to a method of and means for opening and/or spreading continuous filaments and is particularly though not exclusively applicable to the spreading of continuous textile filaments from a relatively narrow thick clustre such as a tow or bundle into a flat sheet for further processing, as for example for forming same into a top as described in co-pending application for patent Serial No. 222,062, which has been abandoned.

The object of the invention is to provide a new and improved method of and means for effecting the opening or spreading aforesaid.

The invention comprises the method of opening or spreading continuous textile filaments consisting in pulling the filaments endwise and in the form of an endless tow or bundle through a passage while simultaneously subjecting them to the action of a contra-flow air draught, whereby said filaments, whilst under tension of the air draught, are free to separate laterally and induced to assume an opened or spread order.

The method aforesaid may include the feature wherein the air flow is so directed relative to the filaments as to cause the filaments to spread laterally over the or part of the surface of the passage; or wherein the air flow is so directed relative to the filaments as to cause the filaments to be airborne adjacent to, or against, the upper surface of the passage.

The invention also relates to apparatus for spreading textile filaments comprising a tubular passage, means for drawing or pulling said filaments in the form of an endless tow or bundle into and through said passage, and means for simultaneously subjecting said filaments to the action of a contra-flow air draught, whereby said filaments whilst under tension of the air draught are free to separate laterally and induced to assume an opened and/or spread order.

Preferably the passage comprises an air duct which converges towards a throat of elongated cross-section, the converging part equalizing any uneven pressure distribution originating in the fan and supply ducts, the throat being followed by a slightly diverging zone in which the on-coming filaments may be airborne and free to open or spread laterally before being drawn through the throat in spread relationship. The variation of shape and sizes of the cross-section of the duct along its length is such that it creates equal pressure distribution and appropriate air speed during the action of the air on the filaments.

In the accompanying drawings:

Fig. 1 is a perspective view of one example of apparatus constructed in accordance with the invention and designed primarily for spreading continuous filaments initially in the form of a cable or tow.

Fig. 2 is a part sectional elevation in the line 2—2 Fig. 1.

Fig. 3 is a diagram of a further example of apparatus opening or spreading continuous filaments in cable or tow form.

Fig. 4 is a perspective view of a still further example of apparatus constructed in accordance with the invention.

Fig. 5 is a part sectional elevation on the line 5—5, Fig. 4.

Fig. 6 is a sectional elevation of a further modified example of air duct, whilst

Figs. 7, 8, 9 and 10 are sectional elevations on the lines 7—7, 8—8, 9—9 and 10—10, Fig. 6 respectively.

In the example illustrated in Figs. 1 and 2 the apparatus comprises a horizontal air duct **10** having an initial portion **10***a*, of uniform cross-section of say 10 x 6 inches. One end of the initial portion of the duct is connected to the delivery side of an air blower (not shown), whilst the other end merges into the operative portion of the duct, the roof **10***b* of which, after a slit **11** to allow exit of the spread filaments t^1, first declines sharply to form a converging zone and then inclines more gradually to provide a diverging zone and a throat **12**, which acts as a transverse direction-changing surface for the filaments. The throat is necessary to spread the tow or bundle t to ribbon form t^1. The outer end **10***c* of the air duct is open and at its upper edge there is a transverse baffle **13** intended to cause air turbulence. It will be noticed that the bottom of the operative portion of the duct is a flat, plane surface, but a curved plate **13***a* is provided located within the duct and below the more gradually inclined upper surface of the diverging zone, thus giving the air passage in that portion a venturi shape. The roof **10***b* is preferably of transparent plastic material so that the filaments can be seen during the spreading operation.

Above the initial portion of the air duct and the filament exit is a grooved roller **14** and complementary apron **15** between the nip of which the spread filaments are adapted to be drawn and which draw or pull the filaments freely through the duct from the can *c*. Suitable means may be provided for driving the roller and apron, and such apron and roller may comprise the feeding means of a tow-to-top conversion apparatus described and illustrated in co-pending application for patent Serial No. 222,062.

In operation, the tow of continuous filaments in the sliver can or other suitable package located below the open outer end of the air duct, is threaded through the operative portion of the duct and out through the slit **11** to the nip between roller **14** and apron **15**. For facilitating threading, the top of the operative portion of the duct may be removable.

When the air blower (not shown) is brought into operation and the feed roller rotated, the filaments are drawn through the operative portion of the air duct against the contra-flow air current. The air current holds the filaments air-borne pressing them adjacent to or against the top surface of the duct. At the outer end **10***c* of the duct the filaments *t*, by their weight, hang downwardly across the air current and float with a lot of movement which balloons them from the tow form and initiates the opening or spreading while evening-up the tension in the individual filaments. On the steeply inclined diverging part of the duct the air current presses the spread fibres firmly against the top surface, thus causing a defined bending or deflection at the transverse edge where change of direction occurs, and the combined action of tension on the filaments and deflection at such transverse edge completes the spreading of the filaments laterally and brings them together into a thin uniformly spread sheet t^1, which is maintained in the slit **11** and between the nip of roller **14** and apron **15**.

In Fig. 3 of the drawings, the apparatus comprises a passage in the form of an air duct *a* into one end of which an endless tow or bundle of continuous filaments

b is fed from a sliver can *c*. The filaments are subjected to the action of a contra-flow air draught from a blower *d* whereby said filaments whilst free but under tension of the air draught are induced to assume an opened and spread order, prior to being drawn in opened or spread relationship through the outlet tube *f* by the nip rollers *g*, *h*.

In the example illustrated by Figs. 4 and 5, the air duct **16** is mounted on a wheeled carriage **17** adapted to move to and fro on rails **18** and to enable the reciprocation of the carriage to be effected by chains **19**. A bellows device **20**, is located between the initial portion **16***a* of the duct and the air blower **20***a* to allow reciprocation of the carriage. The initial portion of the duct is of round cross-section which converges into a throat **21** of substantially elongated rectangular cross-section and preferably the end portions of the throat may be semi-circular instead of flat, as shown in the figure, so as to prevent undesirable secondary (eddy) flow in the corners. It will be noted in this example that both the top and bottom of the operative portion of the duct are inclined towards each other and this construction assists equalizing of air pressure across the throat.

The operative portion of the duct has closure side members **22**, **23** attached to the carriage, and a portion of side member **23** has been broken away to disclose the throat and the exit slit-like aperture **24**. The spread filaments in the ribbon form are drawn through the converging portion of the duct and then through the exit aperture by rollers **25**, **25** rotatably mounted on the carriage prior to being plated down onto a conveyor apron or lattice (not shown) by the reciprocating movement imparted to said carriage.

As distinct from the example illustrated by Figs. 2 and 3 both the top and bottom portions of the outer end of the duct are inclined outwardly to provide an expansion zone **16***b* and it has been found in practice that the best results are obtained if the taper does not exceed 15°, as otherwise the air jet will separate from the walls.

It is obvious that the construction illustrated in Figs. 4 and 5 need not necessarily be mounted on a traversible carriage if plating down of the spread filaments is not required in any particular process.

It has also been found by experiment that the apparatus illustrated in Figs. 4 and 5 gives successful spreading of continuous filaments, e. g. of 1½ denier, if the following conditions are observed:

Speed of contra-air flow at fan exit	60. ft./sec.
No. of filaments in tow or bundle	200,000 approx.
Speed of tow	10 ft./min. approx.
Initial diameter of tow	1" approx.
Width of ribbon of spread filaments	9" approx.

This embodiment of the invention consists therefore essentially of three portions: a converging zone, a throat and a diverging part. Their mutual geometrical arrangement allows several possibilities. Thus, for instance, the length of the throat may be comparable with that of the converging section; or it may be quite short being essentially the cross-section where the diverging section is directly connected to the converging one; or, some or all, of the aforesaid three sections may or may not be symmetrical with respect to the axis, or lastly, the walls of the ducts may be plane or curved.

As indicated in Figs. 6 to 10, the operative portion of the duct may comprise a single casting **26** having an exit aperture **27** in the converging zone **26***a*, the latter at its flanged air entry end being of circular cross-section (Fig. 10) and converging to rectangular cross-section with semicircular ends (Fig. 7) at the throat **28**. At the air exit or tow entry end of the expansion zone **26***b*, the duct again diverges so that it is of circular cross-section.

In all the examples illustrated by Figs. 2 to 10 of the drawings the exit aperture for the spread filaments may be provided with a small roller **29** (see Fig. 2) to facilitate withdrawal of the filaments and to prevent chafing thereof. It is also important that all corners within the duct should be rounded off to avoid secondary flow and the internal surfaces should be smooth, whilst the cross sections should not change rapidly.

What I claim is:

1. Method of opening and spreading continuous filaments, comprising the steps of pulling at a point in a passage spaced from an open end of the same a bundle of filaments entering said passage at said open end and pulled to said open end from a supply point located outside of and transversely spaced from said passage; and directing a stream of gaseous matter at said bundle of filaments passing in countercurrent to the pulled bundle of filaments through said passage and thereby tensioning said bundle of filaments within said passage against the pull, said stream of gaseous matter leaving said passage at the open end thereof, and hitting said bundle of filaments transversely, thereby causing said filaments to open and spread before entering said passage.

2. Method of opening and spreading continuous filaments, comprising the steps of pulling at a point in a passage spaced from an open end of the same a bundle of filaments entering said passage at said open end and pulled to said open end from a supply point located outside of and transversely spaced from said passage; and directing a stream of gaseous matter against one side of said bundle of filaments, said stream of gaseous matter passing in countercurrent to the pulled bundle of filaments through said passage urging said bundle of filaments against an inner surface of said passage and into a position extending in the direction of said stream of gaseous matter and thereby tensioning said bundle of filaments within said passage against the pull, said stream of gaseous matter leaving said passage at the open end thereof, and hitting said bundle of filaments transversely, thereby causing said filaments to open and spread before entering said passage.

3. Apparatus for spreading continuous filaments, comprising, in combination, a passage having two open ends and an opening between said open ends; filament supply means located longitudinally and transversely spaced from one open end of said passage; pulling means outside of and transversely spaced from said opening and said passage for pulling a bundle of filaments from said supply means through said passage and through said opening; and blower means at said other end of said passage for blowing a stream of gaseous matter in countercurrent to said bundle of pulled filaments through said passage, whereby said bundle of filaments is tensioned in said passage against the pull, while a portion of said bundle located adjacent said supply means is transversely hit by said stream of gaseous matter and opened and spread.

4. Apparatus for spreading continuous filaments, comprising, in combination, a passage having two open ends and an opening between said open ends and an inner face between said opening and one of said open ends; filament supply means located longitudinally and transversely spaced from said one open end of said passage; pulling means outside of said passage and transversely spaced from said opening and said passage for pulling a bundle of filaments from said supply means through said passage and along said inner face and through said opening; and blower means at said other end of said passage for blowing a stream of gaseous matter in countercurrent to said bundle of pulled filaments through said passage, whereby said bundle of filaments is pressed against the inner face and tensioned in said passage against the pull, while a portion of said bundle located adjacent said supply means is transversely hit by said stream of gaseous matter and opened and spread.

5. Apparatus for spreading continuous filaments, comprising, in combination, a passage having two open ends and an opening between said open ends and an inner face between said opening and one of said open ends, said inner face having a projecting tensioning edge constrict-

ing said passage; filament supply means located longitudinally and transversely spaced from said one open end of said passage; pulling means outside of said passage and transversely spaced from said opening and said passage for pulling a bundle of filaments from said supply means through said passage against said tensioning edge and along said inner face and through said opening; and blower means at said other end of said passage for blowing a stream of gaseous matter in countercurrent to said bundle of pulled filaments through said passage, whereby said bundle of filaments is pressed against the inner face and against said tensioning edge and tensioned in said passage against the pull, while a portion of said bundle located adjacent said supply means is transversely hit by said stream of gaseous matter and opened and spread.

6. Apparatus for spreading continuous filaments, comprising, in combination, a passage having two open ends and an opening between said open ends and an inner face between said opening and one of said open ends, said inner face having a projecting tensioning edge constricting said passage said inner face being composed of two inner face portions extending at an angle to each other from said projecting tensioning edge in opposite directions to said opening and said one end of said passage, said inner face portions receding transversely toward said opening and said one end; filament supply means located longitudinally and transversely spaced from said one open end of said passage; pulling means outside of and transversely spaced from said opening and end of said passage for pulling a bundle of filaments from said supply means through said passage against said tensioning edge and along said inner face and through said opening; and blower means at said other end of said passage for blowing a stream of gaseous matter in countercurrent to said bundle of pulled filaments through said passage, whereby said bundle of filaments is pressed against the inner face portion associated with said other end and tensioned in said passage against the pull, while a portion of said bundle located adjacent said supply means is transversely hit by said stream of gaseous matter and opened and spread.

7. Apparatus for spreading continuous filaments, comprising, in combination, a passage having two open ends and an opening between said open ends and an inner face between said opening and one of said open ends, said inner face having a projecting tensioning edge constricting said passage said inner face being composed of two inner face portions extending at an angle to each other from said projecting tensioning edge in opposite directions to said opening and said one end of said passage, said inner face portions receding transversely toward said opening and said one end and forming flaring portions in said passage; a curved wall located in said passage adjacent said one end of the same, said wall having an inwardly projecting face constricting part of the flaring end portion of said passage associated with said one end; filament supply means located longitudinally and transversely spaced from said one open end of said passage; pulling means outside of and transversely spaced from said opening and end of said passage for pulling a bundle of filaments from said supply means through said passage against said tensioning edge and along said inner face and through said opening; and blower means at said other end of said passage for blowing a stream of gaseous matter in countercurrent to said bundle of pulled filaments through said passage, whereby said bundle of filaments is pressed against the inner face portion associated with said other end and tensioned in said passage against the pull, while a portion of said bundle located adjacent said supply means is transversely hit by said stream of gaseous matter and opened and spread.

8. A method of opening and spreading continuous textile filaments consisting in pulling the filaments endwise and in the form of an endless tow or bundle into a passage, and simultaneously subjecting said filaments to a contra-flow air draught, said filaments being caused to undergo a change of direction at a region where they are subject to the influence of said air draught so that they are tensioned by said draught against the endwise pull but, before and up to said change of direction are relatively untensioned and free to be opened and spread by said draught.

9. A method of opening and spreading continuous textile filaments consisting in pulling the filaments substantially endwise into a passage, simultaneously passing a contra-flow of air through said passage, said filaments being caused to lie over their length of travel through said passage initially in one direction and then in another direction at an angle to the said one direction and to said contra-flow of air, and supporting the filaments against the air flow only after their change of direction so that they are there tensioned against the endwise pull but, before said change of direction is completed, are free to be opened and spread by said air flow.

10. Apparatus for opening and spreading continuous textile filaments comprising in combination a tubular passage, means for pulling said filaments endwise in the form of an endless tow or bundle into said passage, means for directing within said passage a contra-flow air draught onto said filaments, and means for causing said filaments to undergo a change of direction at a given region where they are subject to the influence of said air draught so that they are tensioned by said draught against the endwise pull but, before and up to said change of direction are relatively untensioned and free to be opened and spread by said draught.

11. Apparatus for opening and spreading continuous textile filaments comprising in combination a tubular passage, pulling means for pulling said filaments substantially endwise in the form of an endless tow or bundle into said passage, means for simultaneously passing a contra-flow of air through said passage, means for causing said filaments to lie over their length of travel through said passage initially in one direction and then in another direction at an angle to the said one direction and to said contra-flow of air, and means for supporting said filaments against the air flow after their change of direction in the region of said pulling means so that they are there tensioned against the endwise pull but, before said change of direction is completed, are free to be opened and spread by said air flow.

12. Apparatus for spreading continuous textile filaments comprising in combination, a tubular passage, means for pulling said filaments substantially endwise in the form of an endless tow or bundle into said passage, an air blower connected to said passage capable of passing a contra-flow of air axially through said passage, a direction changing surface in said passage forming a throat, and a narrow transverse exit for said filaments defined by the leading edge of said direction changing surface and a wall of the passage, said means for pulling being aligned so as to draw the filaments over the part of the direction changing surface between said throat and said exit before passing through said exit, so that the filaments, after passing said throat are tensioned by the air flow against the endwise pull but, before passing said throat are free to be spread laterally by said air flow.

13. Apparatus as set forth in claim 12 in which said passage consists of an air duct, one end of which is connected to the delivery side of the air blower, and which converges towards a throat of transversely elongated cross-section, before diverging to form a zone in which the oncoming filaments are free to open or spread before being drawn through the throat in spread relationship.

14. Apparatus as set forth in claim 13 in which the cross-section of the air duct changes from circular, where it is connected to the blower, to substantially rectangular, at the throat.

15. Apparatus as set forth in claim 14 in which the cross-section of the air duct at the throat has outwardly arcuate ends.

16. Apparatus as set forth in claim 13 in which the lower transverse wall of the passage is flat and, in which, the diverging part an upwardly convex baffle plate is provided, forming a Venturi shape with the opposite wall.

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