May 13, 1958 D. W. VAN DOORN 2,834,061

PNEUMATIC FIBER CLEANING APPARATUS

Filed May 7, 1954 4 Sheets-Sheet 1

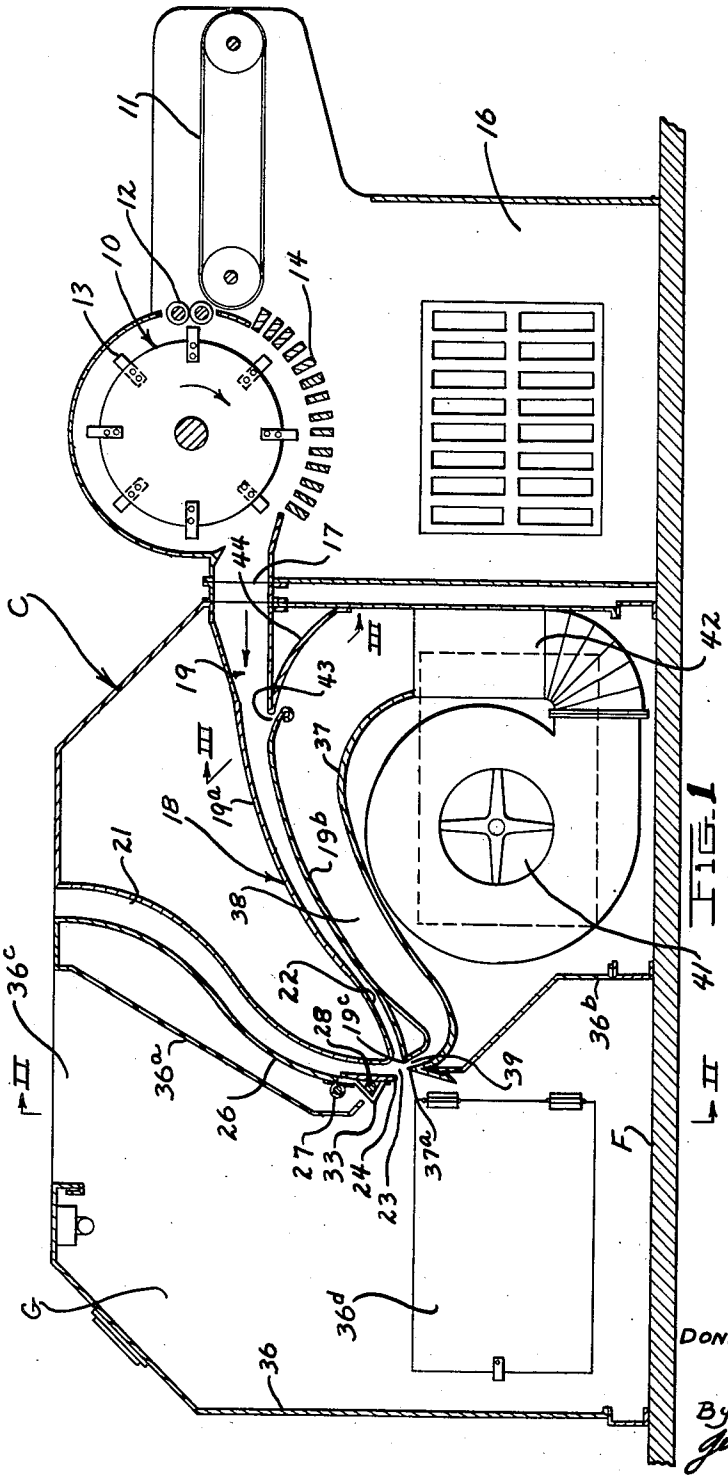


FIG. 1

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PNEUMATIC FIBER CLEANING APPARATUS

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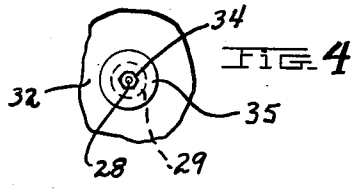
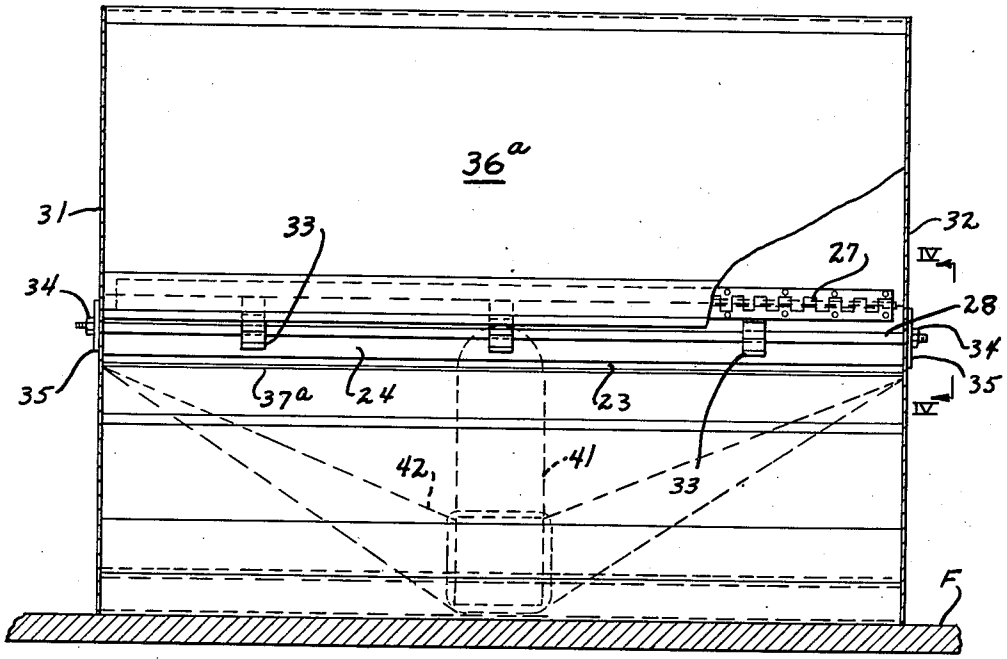


FIG. 4

FIG. 2



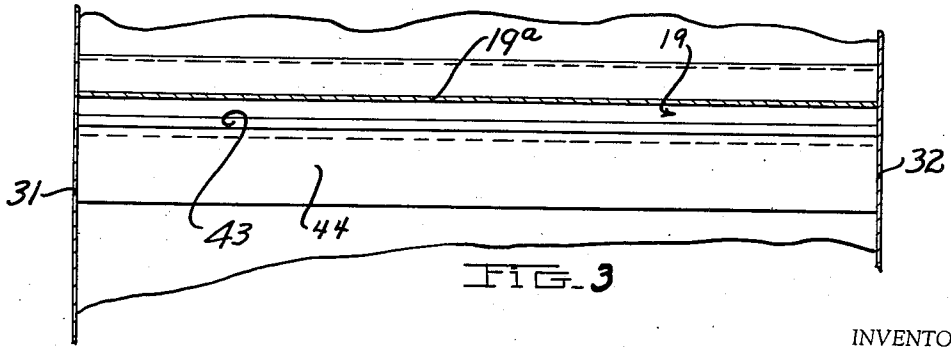


FIG. 3

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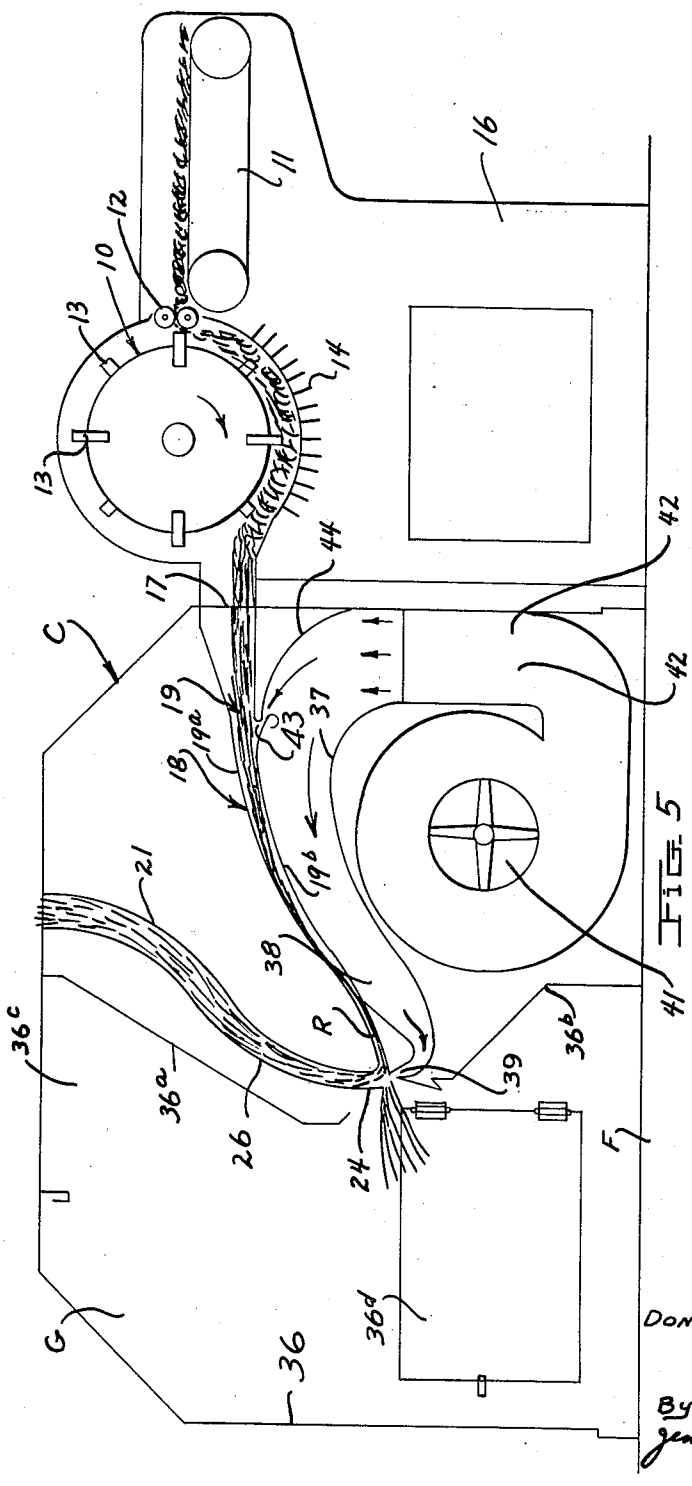
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PNEUMATIC FIBER CLEANING APPARATUS

Filed May 7, 1954 4 Sheets-Sheet 3



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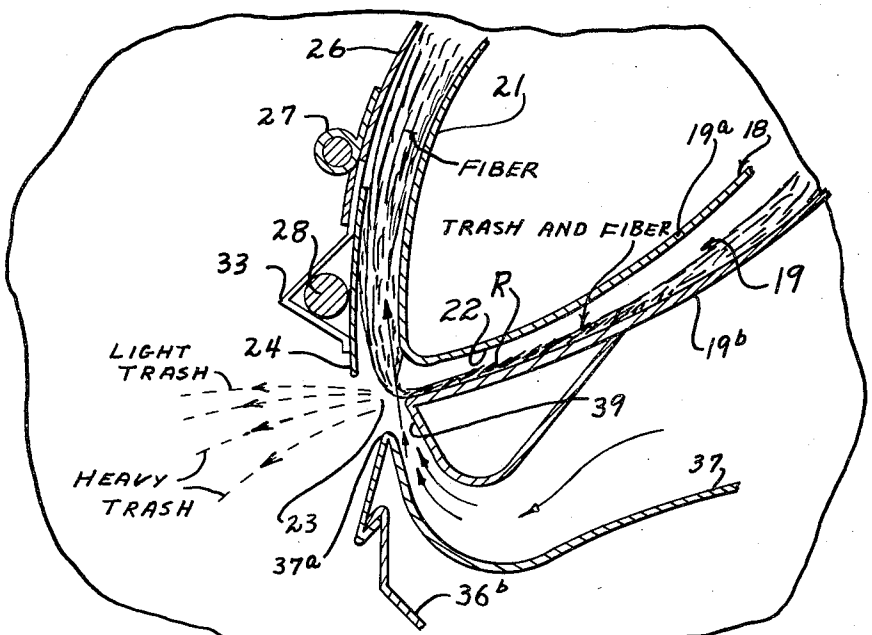
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May 13, 1958 D. W. VAN DOORN 2,834,061

PNEUMATIC FIBER CLEANING APPARATUS

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FIG. 6



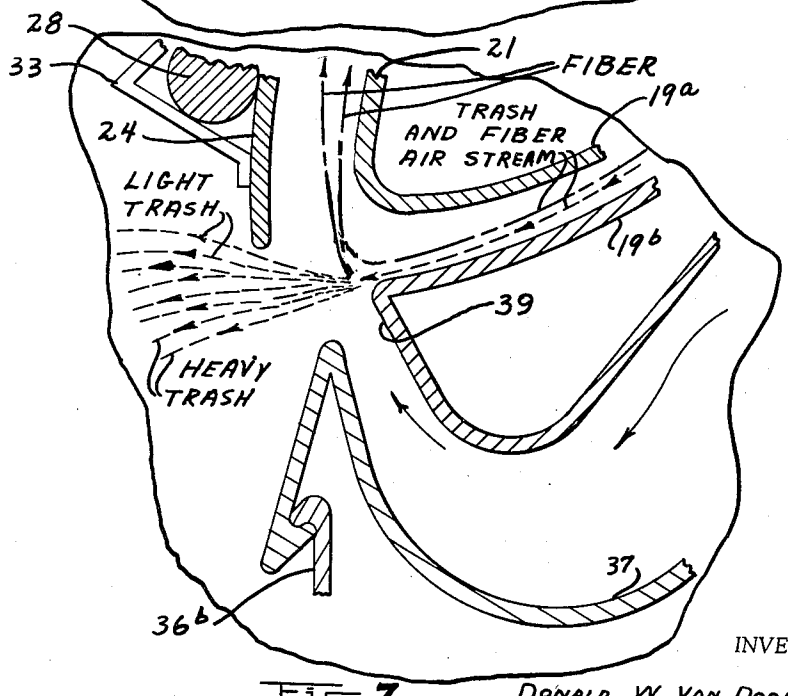


FIG. 7

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United States Patent Office 2,834,061 Patented May 13, 1958

2,834,061

PNEUMATIC FIBER CLEANING APPARATUS

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Application May 7, 1954, Serial No. 428,355

2 Claims. (Cl. 19—76)

My invention relates to apparatus for cleaning fibers such as lint cotton and the like.

My present invention relates to an improvement on that type of apparatus shown, described and claimed in my co-pending applications Serial Number 115,204 filed September 12, 1948, entitled, "Process and Apparatus for Separating Trash from Lint Cotton and the Like," now Patent No. 2,681,476, dated June 22, 1954, and Serial Number 180,996, filed August 23, 1950, entitled "Apparatus for Separating Trash from Lint Cotton and the Like," now Patent No. 2,681,477, dated June 22, 1954, and differs therefrom in several important respects. This apparatus is particularly useful in cleaning fibers which are relatively free of moisture and gummy substances such as are usually found on freshly ginned lint cotton. This invention also is particularly adapted for cleaning cotton in the cotton mill opening room and for cleaning short fibers such as cotton linters which are recovered from cotton seed in the usual cotton oil mill practice.

My present invention consists essentially of apparatus embodying a wide, relatively shallow, duct into which is introduced an airborne stream of fiber and trash and which has an abrupt turn intermediate its ends. As in my previous inventions above identified, I provide a relatively narrow trash discharge opening adjacent the point of bend in the fiber duct and toward which the commingled fiber-trash stream moves as the same is propelled along in the inlet section of the duct. The opening extends substantially across the entire width of the duct. Instead of creating a current of air through the opening from the atmosphere by induction as in my previous above identified inventions, I mount adjacent the trash discharge opening, a narrow nozzle co-extensive in length with the trash discharge opening. The nozzle is disposed to direct a ribbon-like stream of positively propelled air through the opening, transversely of the commingled stream of fiber and trash as the same approaches the trash discharge opening, thereby to turn the fiber into the outlet section of the duct without turning the trash, permitting the trash to be discharged from the opening into a suitable housing associated with the duct. The nozzle above referred to is connected to a source of air under such pressure that there is positively propelled from the nozzle a ribbon-like stream of air at a velocity considerably higher than the velocity of the commingled stream of fiber and trash moving along in the duct. In actual practice I have found that a nozzle directing a positively impelled, ribbon-like stream of air at a velocity greater than that of the fiber-trash stream provides improved separation for certain materials under certain conditions. Furthermore, such a positively induced, high velocity stream of air acts as a booster jet to aid in pneumatically conveying the fiber to subsequent machines or processes after it is separated from the trash. This high velocity stream of air directed into the duct through the trash discharge opening, transversely of the fiber-trash stream moving therein thus not only serves to retain the fiber in the duct while permitting the trash to escape, but also acts as an injector to help convey the lint onto the condenser drum, or on to other collecting means or machines as the case may be. Under some circumstances it is possible to employ the high velocity air stream as the sole means for conveying the fiber from the point of separation from the trash to the collecting means or to another machine which is to operate upon the fiber.

In view of all the foregoing it is an object of my invention to provide pneumatic fiber cleaning apparatus which shall be effective to remove from an airborne stream of commingled fiber and trash the trash component thereof by striking the commingled stream with a high velocity, positively impelled, ribbon-like stream of clean air, directed transversely of the fiber-trash stream which is effective to retain the fiber in the duct and yet ineffective to prevent passage of the trash out of the duct.

Another object of my invention is to provide apparatus of the character designated in which the commingled fiber-trash stream moving along in the relatively shallow, wide duct has its velocity increased just ahead of a relatively narrow, elongated trash-discharge slot located at a point of abrupt turn in the duct and further which has located adjacent said trash discharge opening a nozzle effective to direct a high velocity, positively impelled ribbon-like stream of air not only transversely of the commingled stream moving in the inlet section of the duct, but also generally toward the inlet end of the outlet section of the duct, whereby I take full advantage of the kinetic energy of the positively impelled stream to convey the fiber from the outlet section of the duct to a subsequent machine which is to operate upon the fiber.

A further object is to provide apparatus of the character designated embodying an elongated slot in the inlet section of the fiber-trash duct, substantially co-extensive in length with the width of the duct, through which opening there is directed a positively impelled, high velocity booster stream of air which is effective to increase the velocity of the fiber-trash stream prior to reaching a constricted portion of the duct, just ahead of the trash discharge opening.

A further and more detailed object is to provide apparatus of the character designated in which both the booster stream and the transversely directed separating air streams are supplied from a common air chamber under pressure.

Another object is to provide apparatus of the character designated in which a trash collection chamber surrounds the fiber duct, adjacent the trash discharge opening, and in which, due to the positively impelled air separating stream, which results in little or no air being induced into the trash discharge opening from the trash collection chamber the re-entry into the outlet section of the duct of fine dust and trash is substantially eliminated, thus providing a cleaner sample of fiber.

A further object is to provide apparatus of the character designated which embodies a duct of substantial width and whose depth is a minor fraction of its width, there being a curve in the duct intermediate its ends, a trash discharge opening located adjacent the point of curve of the duct, and an air nozzle having a narrow opening substantially the length of the duct directed substantially into the discharge section of the duct, together with means to move the fiber and trash along just ahead of the opening at a velocity above 3,000 feet per minute, together with means to impel an air stream from the nozzle at a velocity greater than 3,000 feet per minute, whereby the fiber is turned by the nozzle stream into the outlet section of the duct and the trash traverses the nozzle stream, discharging through the opening in the duct.

My invention is further characterized by the provision of a fiber-trash duct of considerable width and having a

depth which is a minor fraction of its width into which the commingled stream of fiber and trash is moved along at a velocity in excess of 3,000 feet per minute together with a narrow trash discharge opening at a point of bend in the duct, in combination with means to constrict the duct just ahead of the slot and to cause the lint and trash to approach said slot in a wide ribbon-like stream, together with a nozzle to direct a wide, ribbon-like stream of clear air transversely of the ribbon-like stream of fiber and trash, whereby the trash passes through the narrow stream of clean air and the fiber is turned thereby into the outlet section of the duct, where it is carried away.

Apparatus illustrating features of my invention is shown in the accompanying drawings forming a part of this application in which:

Fig. 1 is a vertical sectional view through my improved apparatus showing the same in association with a type of cotton opening machine which may feed to my apparatus fiber such as lint cotton or the like;

Fig. 2 is a sectional view taken generally along line II—II of Fig. 1;

Fig. 3 is a detail sectional view taken generally along line III—III of Fig. 1 and showing the transversely disposed opening for introducing a booster jet of air into the duct, ahead of the trash discharge opening;

Fig. 4 is a detail fragmentary elevational view showing one means for adjusting the opening of the trash discharge slot and taken generally along line IV—IV of Fig. 2;

Fig. 5 is a wholly diagrammatic view illustrating the flow of the commingled fiber and trash in the duct, the discharge of trash and the like through the trash discharge opening, and the flow of the fiber turned into the discharge section of the duct by the transversely directed, positively impelled stream of air;

Fig. 6 is an enlarged somewhat diagrammatic transverse sectional view further illustrating the operation of my improved apparatus; and,

Fig. 7 is a still further enlarged detail sectional view showing the discharge of the trash and the turning of the fiber at the trash discharge slot.

Referring now to the drawings for a better understanding of my invention and more particularly to Fig. 1 thereof, I show at **10** the feeder cylinder of a cotton opening machine such as might be found in the opening room of the usual cotton mill. As is understood, the fibers of lint cotton are fed to the apparatus on an apron **11** and the same enter between rollers **12**. On the periphery of the rotating opening cylinder are members **13** which engage the cotton, separating the fibers and carrying them around over a grid structure indicated at **14** so that some of the trash therein drops down into the space **16** of the apparatus. The cylinder **10** and the apron **11** are driven by any suitable means, not shown, and the machine delivers lint cotton in an airborne stream, together with trash and the like therein through a dust **17**, to my improved apparatus which is indicated generally by the letter C.

My improved pneumatic cleaning apparatus comprises a fiber duct indicated generally by the numeral **18**. As will be seen, the duct **18** comprises an inlet section **19**, defined by an upper wall **19*a*** and a lower wall **19*b***, and an outlet section **21**. It will be understood that the duct **18** is of considerable width, for instance on the order of 42 inches wide. The inlet end of the inlet section **19** may be as deep as 6 or 8 inches but the same gradually tapers downwardly to provide a constricted passage at **22** which, in apparatus for handling the usual fibers such as cotton, may be an inch or less in depth.

It will be noted that the outlet section **21** of the duct joins the inlet section **19** at an abrupt angle. The outlet section **21** may be upwardly directly whereby the clean fiber moving along therein as presently will be explained may be conveyed away to subsequent machines or processes.

At the point of juncture of the sections **19** and **21** and located in the path of the fiber-trash stream moving in section **19**, I provide a narrow trash discharge slot or opening **23**, substantially as long as the width of the sections **19** and **21** of the duct **18**. The slot **23** may be adjustable in width by providing a section **24** of the outer wall of the duct **21** which is pivoted to the stationary portion **26** of the duct wall by means of a hinge **27**. See Fig. 2. The adjustment may be accomplished by means of a rod **28** which passes through enlarged openings **29** in the heads **31** and **32** of the apparatus. The rod is secured to the lower wall section **24** by means of straps **33**. By loosening nuts **34** on the ends of the rod I may move the same so as to pivot the wall section **24**, thus to vary the width of the slot **23**. Enlarged washers **35** may be employed to cover the openings **29** to prevent the loss of air or fiber at those points. Spaced from the slot **23** is a wall **36**, which, together with the heads or end plates **31** and **32**, the floor F of the building and other walls **36*a*** and **36*b***, forms a trash receiving compartment G. The compartment G may be closed, but I prefer to leave the same open at the top as at **36*c***. Trash may be removed from the compartment G through a door **36*d***.

Spaced beneath the lower wall **19*b*** of the inlet section **19** is a wall **37**. The walls **19*b*** and **37** define between them an air chamber **38**. The wall **37** extends around and upwardly as shown and its end **37*a*** co-acts with the end **19*c*** of the wall **19*b*** to provide a long, narrow air nozzle **39** which is disposed to direct a stream of air into the intake end of duct section **21**, across the fiber-trash stream, as will further appear. Connected to the other end of the chamber **38** as defined above is a blower **41** driven by any suitable means, not shown. The blower connects by means of a transition piece **42** to the wide air chamber **38**.

Opening into the fiber-trash duct section **18**, preferably through the lower wall **19*b*** thereof, is a slot **43** which is substantially co-extensive in length with the width of the section **19**. It will be noted that the slot **43** opens into the air chamber **38**. Therefore, with the blower **41** supplying air under pressure it will be apparent that due to the curved wall section **44** adjacent slot **43**, a booster stream of air is delivered into the inlet section **19**, in a direction to move the fiber and trash toward the slot **23**. Likewise, and as will be further described, from the common air chamber **38** a ribbon-like stream of air under pressure is directed transversely against the stream of fiber and trash approaching the slot, toward the inlet end of duct section **21**, for the purposes already mentioned and also to be explained.

Referring now more particularly to Fig. 5 of the drawing it will be seen that as the stream of fiber and trash moves along in the inlet section **19** of the duct it is compressed or flows in a thin ribbon R just ahead of the trash discharge opening **23**. Therefore, just ahead of the opening **23** the commingled lint and trash move in a path directly toward the slot **23** and at a high velocity due to the constriction **22** and the booster jet coming through slot **43**. While the upper limits of velocity of the commingled stream are not known to me, I have found that the commingled stream should be moved along in the inlet duct at constriction **22** at a velocity no less than 3,000 feet per minute. In order to turn the fiber component from such a stream I find that the thin ribbon-like air stream striking the commingled stream and emerging from the nozzle **39** should be higher than the rate of travel of the stream in the duct at constriction **22**. In fact, I note considerable improvement in efficiency of separation if the air stream issuing from nozzle **39** has a velocity considerably in excess of the velocity of the fiber and trash stream. For instance, if the fiber-trash stream just ahead of the opening **23** is moving at 3,000

feet per minute, I prefer to impel the thin ribbon of air from the nozzle **39** at a rate of no less than 5,000 feet per minute. Under such conditions I find that the trash crosses the stream of air coming from the nozzle **39** as indicated by the dotted lines, without being materially deflected from its initial path of movement. The air stream carrying the fiber, however, is turned by the stream of air coming from the nozzle **39** and enters the inlet end of the duct section **21**, as indicated by the dot-dash lines in Fig. 7. The kinetic energy of both air streams thus is available to convey the fiber along in the duct section **21**.

In order that the relative sizes of the ducts, the pressures and velocities therein may be more clearly appreciated, the following is cited as an example of an apparatus embodying features of my invention which has been found suitable for cleaning lint cotton in the opening room of a textile mill:

The fan **41** should be of a capacity to produce from 10 to 15 inches water column (static) pressure in the air chamber **38**. The discharge opening of nozzle **39** should be approximately ¼ inch in width. The booster jet slot **43** should be approximately ½ inch wide and co-extensive in length with the width of inlet section **19**. The cotton is introduced into the section **19** from the opener under about 0.10 inch water gauge super atmospheric pressure and when the same reaches the constricted passage **22** of the inlet section **19** is traveling at the rate of approximately 7000 feet per minute. Under the conditions just mentioned, the fan positively impels a thin ribbon of air from the nozzle **39**, transversely of the commingled lint and trash stream at a velocity of approximately 10,000 feet per minute. Under these conditions a large percentage of the trash continues along its initial path of movement, out of the slot, while the lint and the air stream carrying the same are turned into the outlet section **21** for discharge from the apparatus. Operating under the conditions just mentioned I find that my improved apparatus induces a very small quantity of air from the atmosphere into the slot **23**. This has the advantage of permitting any loose, very fine dust or the like floating in the chamber G to settle out in the bottom of the chamber G, where it may be removed. Re-entry of fine trash and dust into the lint discharge duct therefore is substantially eliminated.

From the foregoing it will be seen that I have devised an improved pneumatic cleaning apparatus for separating certain fibers and trash in which it is possible to separate lint or other fibers from a moving stream of commingled fiber and trash without the necessity of providing suction on the outlet duct. While it is true that the fiber is carried away from the point of separation from the trash for a short distance under sub-atmospheric static pressure, there is a point in the duct section **21**, removed from the slot **23**, where the pressure is positive on the static gauge. It will be apparent that the static pressure and velocity pressure relationships will vary considerably in apparatus of the general type in which suction is applied to the outlet section as compared to the type shown herein in which no suction is applied and the separating air stream is positively impelled. In fact, my improved apparatus is fully capable of operating always with a static pressure-velocity pressure relationship such that the total pressure (the sum of static pressure and velocity pressure) is always above atmospheric pressure. For cleaning certain types of fibers this is of considerable advantage over the suction type wherein the total pressure falls considerably below atmospheric pressure during the operation of the apparatus.

In my prior suction type apparatus the force to turn the fiber and prevent it from passing out of the slot along with trash is the impingement on the surfaces of the fiber of the air stream being drawn in through the slot from the atmosphere by reason of the suction means on the outlet. The suction fan must handle not only the volume of air being drawn in through the slot from the atmosphere, but also the larger volume of air that comes from the inlet duct. The air drawn into the inlet duct in my prior apparatus thus acted on the material at the outlet over a wide area resulting in a relatively large volume of air entering the slot. In my present apparatus, employing a positively impelled jet of air to turn the lint, the size of the jet opening is independent of the trash ejection slot width and therefore a very narrow jet under a higher pressure differential may be employed. Since the fiber turning force of the air stream is a function of the air velocity and air volume, by increasing the air velocity I can reduce its volume and achieve the same turning force. This reduction in volume is advantageous in allowing smaller subsequent apparatus such as ducts, condensers, cyclones, and fans to be used.

It will be seen also that my new fiber separating apparatus may discharge the trash into a space G which is entirely closed off from the atmosphere if, under any circumstances that is necessary or desirable. However, I prefer to leave the same open at the top as at **36c** as already explained.

From the foregoing it will be apparent that my improved apparatus carries out the principles described in my hereinbefore identified applications and that the same is particularly useful for separating trash from lint cotton in the textile opening room and in separating trash from short fibers such as linters. There is substantially no turbulence in or induction of air from the trash discharge chamber G which would tend to draw back into the outlet section **21** of the duct any light trash floating in the air adjacent the trash discharge opening.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What I claim is:

1. In apparatus for separating trash from an air borne commingled stream of fiber and trash, a duct having an inlet section into which the commingled stream is introduced and an outlet section joined at an abrupt angle to the inlet section and through which fiber is discharged, said duct being of substantial width and having a depth which is a minor fraction of its width, there being a narrow trash discharge opening extending the width of the duct and located at the juncture of the inlet and outlet sections in the path of movement of the fiber-trash stream flowing in the inlet section, an air nozzle disposed near the trash discharge opening and having a narrow opening co-extensive in length with the trash discharge opening and disposed to direct a ribbon-like stream of clean air therethrough and transversely onto the fiber-trash stream approaching the trash discharge opening, and means to supply air to the nozzle under pressure positively to impel said ribbon-like stream of air at a velocity above the velocity of the fiber-trash stream as the latter reaches said trash discharge opening.

2. In apparatus for separating trash from fiber, a wide duct having inlet and outlet sections joined to each other at an abrupt angle, said inlet section being of width and depth to confine a stream of mixed fiber and trash moving along therein to a ribbon-like body no greater than one-half inch in depth, means to introduce an air borne stream of mixed fiber and trash into the inlet section of the duct and move it along therein at a velocity above 3,000 feet per minute, there being a narrow slot at the juncture of said sections extending the width thereof and disposed in the path of said ribbon-like stream of mixed fiber and trash moving along in the inlet section, an air nozzle disposed adjacent the slot and having an air discharge opening no greater than one-half inch wide and co-extensive in length with the slot for directing a ribbon-

like stream of air transversely of the fiber-trash stream and into the outlet section of the duct, and means positively to propel from the nozzle opening said ribbon-like stream of clean air at a velocity of not less than 5,000 feet per minute, whereby substantially all of the fiber in said fiber trash stream is turned into the outlet section of the duct and substantially all the trash therein continues its path of movement and passes through the clean air stream and out of said trash discharge slot.

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