

April 7, 1964

W. I. HEAD

3,127,729

METHOD AND APPARATUS FOR MAKING BULK YARN

Filed April 29, 1959

3 Sheets-Sheet 1

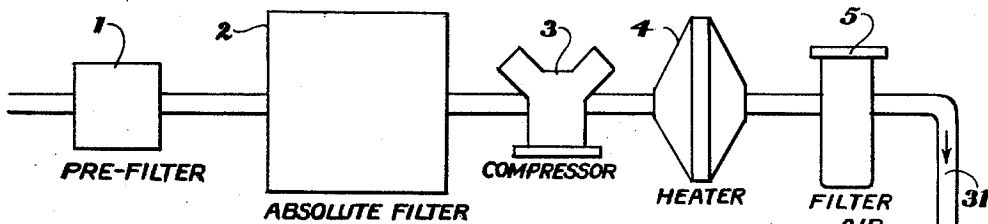


Fig. 1

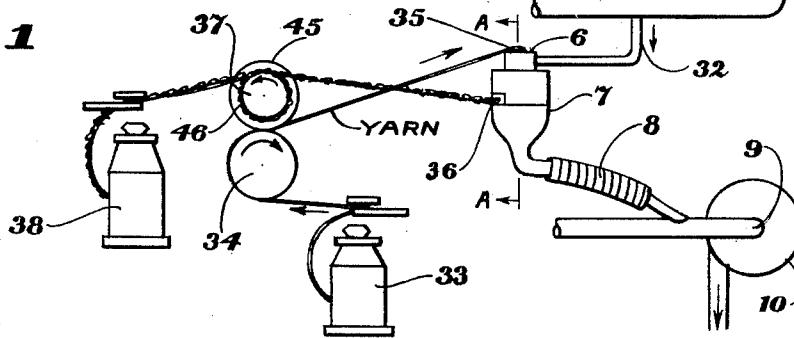


Fig. 2

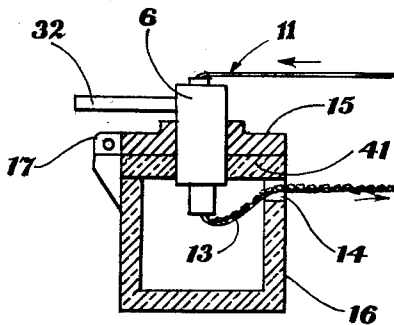


Fig. 3

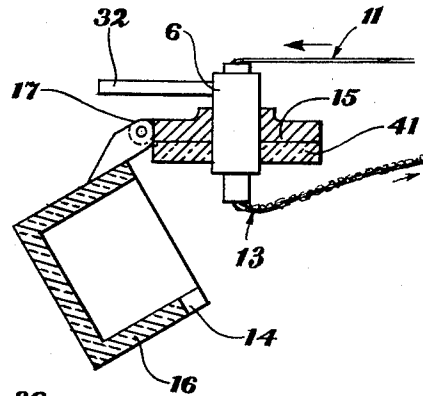
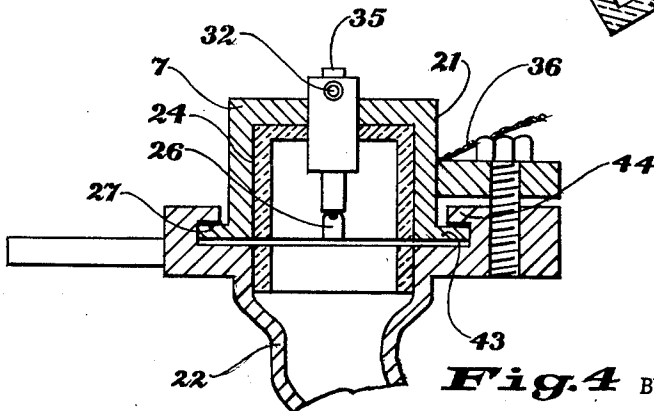


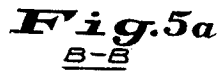
Fig. 4

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Fig. 7

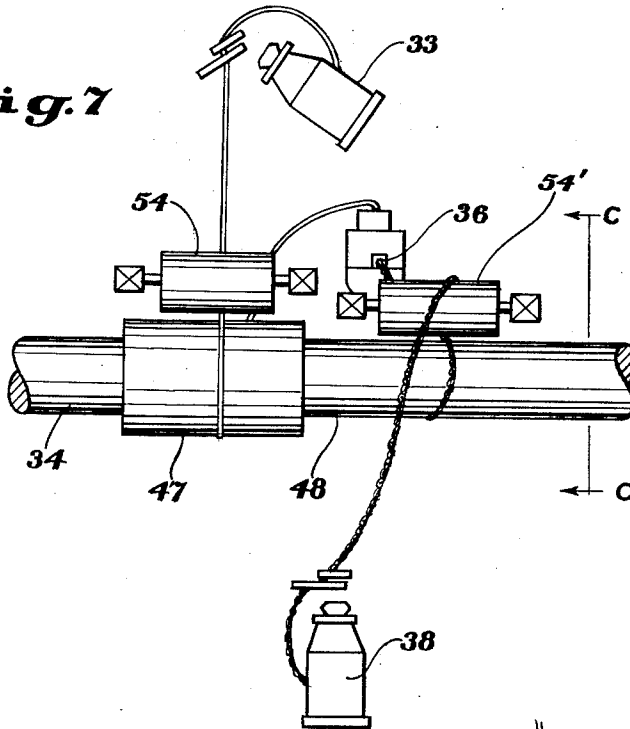
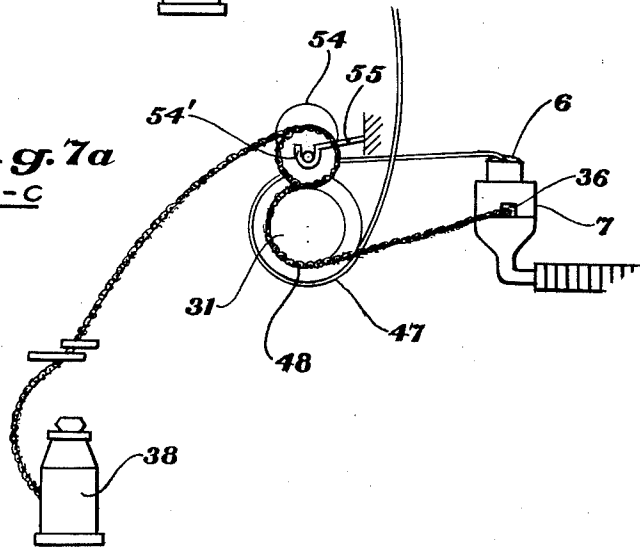


Fig. 7a
C-C



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3,127,729

METHOD AND APPARATUS FOR MAKING
BULK YARN

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7 Claims. (Cl. 57—34)

This invention relates to improvements in bulk yarn. More particularly this invention concerns the filtration, heating, exhausting and the muffling of the air used in making bulk yarn whereby an improved yarn product is obtained, better production rates accomplished and other advantages secured.

This application is a continuation-in-part of my co-pending application Serial No. 330,778, now U.S. Patent No. 2,884,756 of May 5, 1959.

The production of bulk yarn by passing multifilament yarn through jets wherein the yarn is acted upon by air to produce certain effects thereon is of considerable commercial interest in the textile industry. Such yarn is also referred to by other names such as lofted yarn, textured yarn and the like and a considerable amount of such type of yarn is currently produced. While such type of yarns as presently produced are quite useful, in a number of instances the yarn may not be of as high a quality as may be desired for certain purposes. Or, if the quality of the yarn is improved by certain prior art procedures, the speed or rate of production of the yarn may be reduced thereby increasing the cost of production.

Therefore, the production of high quality of bulk yarn at good production rates represents a highly desirable result. After considerable investigation I have found certain procedures and apparatus whereby a high quality bulk yarn may be produced at relatively high production rates and other advantages may be obtained as will be pointed out hereinafter.

This invention has for one object to produce a high quality bulk yarn having exceptional cleanliness and uniformity. Another object is to provide means of increasing the speed of producing such type of yarn while maintaining a high level of yarn quality. Still another object is to provide improved apparatus features which contribute to the production of high quality yarn at good production rates. Still another object is to provide means for reducing the contamination of room air in areas where the bulk yarn is being produced. Still another object is to provide means for reducing the noise in areas where the bulk yarn is being produced without sacrificing yarn quality, production rates or the like. Other objects will appear hereinafter.

As described in my patent aforementioned and in my older Patent 2,807,864, compressed air is admitted to the bulking jet where it acts upon the yarn in a certain manner to form loops and entanglements in the production of the bulk yarn. In my Patent 2,807,864 I have described procedure for treating the yarn to be bulked with certain treating agents having the property of causing high static electrical charges to be formed on the yarn. Such electrical charges appear to facilitate the opening up of the yarn, the better formation of loops and the like production advantages.

I have now found that if moisture is entrained in the air used in the bulking process, since such moisture is a good conductor of electricity, this moisture in the air tends to prevent the formation of static electrical charges. Accordingly, the quality of the bulk yarn may be impaired if the air contains substantial moisture. Therefore, I have found that it is most desirable to use dry air or an air of low humidity for obtaining optimum treatment of the yarn in yarn bulking processes. The air supply for the com-

pressors used in delivering air to the bulking jet is usually taken directly from the atmosphere and therefore contains a certain amount of moisture and dirt. When this compressed air finally reaches the bulking jet, it has reached the temperature of the surroundings. The expansion cooling in the jet can cause condensation of the water vapor in this air. Condensation can also occur in the compressed air lines if the temperature is allowed to fall below the dew point of the air-vapor mixture in the line. As explained above, condensate is harmful in the bulking process for several reasons. The water wets and yarn and prevents the proper separation of filaments which is needed to permit loops and entanglement. The passage of condensate is frequently not uniform and thus causes fluctuation in the air velocity and degree of filament separation thereby causing a resultant nonuniform bulking of the yarn. As apparent, nonuniform yarn may be unacceptable for weaving quality fabrics. Also, the momentum of water droplets is greater than that of air and thus may cause unequal forces to act on the filaments and thereby cause uneven bulking.

Accordingly, I have found for the aforementioned reasons that by eliminating moisture and condensate from the air being supplied to the bulking jets that an improved more uniform bulk yarn may be produced.

I have further found that one practical method of eliminating the condensate from the air is by heating the air before it is allowed to expand in the bulking jet. Preferably such air is heated enough to keep the air temperature above the dew point as the air passes through the jet. I have found that in general a minimum temperature of 100° F. will prevent condensation in the jet if the air has previously been saturated with moisture at 70° F. An air temperature of 120° F. is generally adequate to prevent condensation even with extremes in atmospheric conditions. I have found that for best results the relative humidity for the compressed air used in the bulking jets should be below 30% for supply pressures up to 25 p.s.i.g.

Another problem associated with the production of high quality bulk yarn is the exhaust from the bulking jets. In other words, I have found that there is a problem in the disposal of the lint, oil and the like which may be blown from the yarn during the bulking process as the yarn exits from the bulking jet. For example, when yarn of different colors is being processed on adjacent machines, I have found that care must be taken to prevent the lint from the different colors from being mixed with the first yarn. Fine particles of oil are often blown from the yarn during bulking and these oil particles suspended in the room air may also present certain problems. Likewise, when heated air is used in the bulking process, there may be a heavy load placed on the cooling system of air conditioned buildings. This additional load could even at times exceed the cooling capacity of the operating area. Accordingly, I have found for these and other reasons it is desirable to remove the bulking air from the production area as will be described in more detail hereinafter.

Accordingly, in the broader aspects of the present invention I have found that if the air supplied to the bulking process is carefully controlled in certain ways, that the bulked yarn produced as well as the bulking process for the production thereof may be considerably improved. In addition, if the air exhausted from the bulking system is handled in a certain manner the process and product may be further improved.

For a further understanding of my invention, reference will be made to the attached drawings forming a part of the present application.

FIG. 1 is a side elevation view of the over-all assem-

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bly of apparatus which may be used for producing bulk yarn in accordance with the present invention.

FIG. 2 is a detailed side elevation view partly in section of the air jet assembly of the present invention.

FIG. 3 likewise is a side elevation view partly in section and similar to FIG. 2 excepting that it shows the parts in an opened relationship.

FIG. 4 is a side elevation view partly in section taken on A—A of FIG. 1.

FIG. 5 is a front elevation showing another means of feeding and removing the yarn from the lofting zone.

FIG. 5a is a cross sectional view of FIG. 5 on the line B—B.

FIG. 6 is a front elevation of another means of feeding and removing the yarn from the lofting zone.

FIG. 7 is a front view of a fourth alternate means of feeding the yarn to and removing it from the lofting zone.

FIG. 7a is a side elevation of FIG. 7 taken on the line C—C.

Referring to FIG. 1, there is provided in series in the air line a prefilter 1, an absolute filter 2, the compressor 3, a heater 4 and a further filter 5, the function of which will be described hereinafter. In other words, the air in conduit 31 would be of high quality, free of moisture, oil and other contaminants.

A portion of this air is withdrawn at 32 to the lofting jet 6. This lofting jet may be of a construction as described in detail in my companion patents, hence extended description herein is unnecessary. A two-piece shroud 7 encloses the jet in a manner that the exhaust air from the jet can be conducted through flexible tube 8 into the exhaust header 9 which is coupled to an exhaust fan 10.

Means are provided such as yarn package 33 for supplying the multifilament yarn to be bulked to feed roll 34 from which it enters the jet at 35. The bulked yarn is withdrawn at 36 and passed around withdrawal roll 37 from which it may be conducted to a wind-up package such as on spindle 38. Other variations of apparatus may be used in feeding the yarn to the jet and removing it therefrom. For example, in FIG. 5 and FIG. 5a which is a cross sectional view along the line B—B of FIG. 5, the yarn is fed from the package 33 directly to the large diameter 45 of roll 37 and thence to the jet. The yarn is then removed from the jet shroud through opening 36 and passes one or more times around the reduced periphery 46 of roll 37. The roll 37 is freely rotatable in bearings 51 and 51', and is driven by frictional contact of the large diameter 45 and 45' with roll 34. Roll 34 acts as a common drive means for rotating roll 37 and as such acts as a common drive means for both feeding the yarn and removing the yarn from the bulking zone.

In FIG. 6 there is shown another variation of yarn feeding and removal apparatus in which the roll 37 is rotated by the pull of the yarn being wound on package 38. That is, the yarn constitutes a common drive for roll 37 since it acts as a belt drive between the wind-up package 38, with associated traverse guide means 53, and the small diameter 46 of roll 37. Since roll 37 is a unitary yarn feeding and removal device with two diameters it will be recognized that the rate of feed of the yarn to the jet 6, around the large diameter 45 will be in direct and fixed proportion to the rate of removal of the yarn around the small diameter 46. Roll 37 is mounted on bearing 51 so as to be freely rotatable. In some cases it may be desirable to make the large diameter section 45 of roll 37 and the small diameter section 46 of roll 37 in two separate pieces. These pieces may be securely fastened together by means of screw 52 which passes through roll section 46 on its axis and fastens securely in a tapped hole on the axis of roll portion 45. This makes it possible if desired to change the amount of loft effect by substituting other diameters of yarn removal roll for the reduced periphery portion 46 of roll 37.

In FIG. 7 still another form of yarn feeding and removal means is shown as a front view. FIGURE 7a

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shows the same apparatus in cross section along the line C—C. In some cases where the apparatus of FIG. 1 is used it is difficult to obtain enough friction between the yarn and the yarn feeding and removal surfaces to prevent any likelihood of yarn slippage. In some cases this yarn slippage can be prevented by coating the yarn feeding and removal surfaces to promote a high value of friction between the yarn and the roll surfaces. In some cases, however, this still does not positively insure against yarn slippage. The nip roll type arrangement shown in FIGS. 7 and 7a may then be used to advantage. As shown the roll 34 is provided with two diameters of suitable ratio to give the desired bulk or increase in diameter. Weighted nip rolls 54 and 54' are then provided and ride on roll 34 to aid in preventing yarn slippage. In this case, the yarn is fed from the supply package 33 to the large diameter 47 of roll 34, partially around roll 34 and between the nip of roll 54 and roll 34 and then to the lofting device 6. On removal from the jet through shroud opening 36, the yarn is fed to the small diameter 48 of roll 34, around this diameter 48 and into the nip of rolls 34 and 54', partially around roll 54', and thence to the wind-up device 38. It has been found that the yarn of this invention after treatment in the lofting device 6 possesses lower frictional properties than the untreated continuous multifilament yarn which is fed to the jet. For this reason, it is often desirable and in fact usually necessary to provide a greater amount of peripheral contact of the treated yarn with the output roll surface than is required between the untreated yarn and the in-feeding large diameter roll surfaces. In the cross sectional view in FIG. 7a, there is shown one simple type of U-shaped bracket 55 which may be used to support the nip roll axles. In considering all of the foregoing variations in the manner of feeding the yarn to and removing it from the bulking zone it will be recognized that in every case a common yarn feeding and removal roll is utilized. This roll means including a reduced periphery portion and an unreduced periphery portion both of which roll portions are directly associated with a common drive means so that the rate of rotation of the reduced periphery portion with respect to the other portion is always constant. For purposes of clarity in some of the figures the jet 6 and its associated shroud 7 and the feeding rolls are shown somewhat farther apart than is desirable in actual practice. In actual practice it has been found conducive to the production of lofty yarn having a high degree of uniformity, to position the rolls as closely adjacent to the jet as is possible and in such a manner that the yarn is fed into the jet at a relatively abrupt angle and the treated bulky yarn leaves the jet at a relatively abrupt angle.

In any case it is desirable that the rate of rotation of the reduced periphery portion of the roll relative to the large periphery portion is always constant. This can be best achieved as shown in FIGS. 1, 5, 6 and 7 by use of a unitary roll means. It will then be recognized that whether the yarn feeding and removal roll is driven by frictional contact with a drive roll as in FIGS. 1 and 5 or by the yarn itself as in FIG. 6 or by any other means such as chain, belt or gears, the ratio of yarn feed to the jet and the yarn removal from the jet will always be maintained in an exact and constant fixed ratio. Thus, a common drive means is of considerable advantage as compared to the use of two separate drive connections to drive two separate rolls, one for feeding the yarn into the jet and one for removing it from the jet.

Since the bulky yarn product of this invention is woven into fabrics which must be uniform in appearance to achieve maximum acceptance in the apparel and home furnishings trade, it follows that the yarn itself must possess a high degree of uniformity. Claus in U.S. Patent No. 2,100,588 shows the making of a curly wool-like thread product. However, no means were shown for accurately controlling the degree of curliness from yard to

yard along the thread since the rate of removal of the yarn from the jet was not controlled in fixed constant relationship to the input speed of the thread to the jet.

One way of measuring the uniformity of the yarn is to measure the denier variation along the yarn strand before and after treatment and to express the denier ratio in terms of percent loft.

$$\text{Percent loft} = \frac{\text{final denier} - \text{starting denier}}{\text{starting denier}} \times 100$$

Denier is by definition length per unit weight, i.e., a one denier yarn is a yarn which requires 9,000 meters to equal one gram weight. Thus, percent loft can also be expressed in terms of yarn length before and after lofting as follows:

$$\text{Percent loft} = \frac{\text{original length} - \text{lofted length}}{\text{original length}} \times 100$$

or using symbols:

$$L = 100 \frac{S_1 - S_2}{S_1}$$

where S is length in yds.

Inserting the time factor to give yarn velocities, then the formula can be further modified as follows:

$$L = 100 \frac{V_1 - V_2}{V_1}$$

where V is speed in yards/minute.

Now if the rate of input and output of yarn were exactly constant, the velocities would be absolute values. However, in actual practice backlash in gears, yarn slippage on the rolls, elasticity of the yarn, sag of the yarn between rolls and jet, yarn vibration in the jet, and other miscellaneous factors all cause variations in the yarn velocity.

So the formula now assumes a form to account for the effect of these variations on the percent loft.

$$L + \Delta L = 100 \frac{(V_1 + \Delta V_{D1} + \Delta V_{S1} + V_{E1} + \Delta L_1 + \Delta V_{M1}) - (V_2 + \Delta V_{D2} + \Delta V_{S2} + \Delta V_{E2} + \Delta V_{L2} + \Delta V_{M2})}{(V_1 + \Delta V_{D1} + \Delta V_{S1} + \Delta V_{E1} + \Delta V_{L1} + \Delta V_{M1})}$$

where

ΔV_{D1} represents changes due to fluctuations in the drive mechanism due to gear back lash and non-uniformities in the yarn feed drives

ΔV_{S1} represents yarn slippage on the rolls

ΔV_{E1} represents changes in velocity due to yarn stretch or elasticity

ΔV_{L1} represents changes in velocity due to yarn vibration, sag, etc., and

ΔV_{M1} represents other velocity changes due to miscellaneous reasons.

The subscript "2" applies to similar classes of variations in the yarn output velocity.

Now the sum total of all these variations is reflected in the ΔL or variation in percent loft. Thus, the problem is to eliminate or reduce the variables in yarn input and output velocity to reduce the ΔL . The common drive roll eliminates ΔV_{D1} and ΔV_{D2} since there are no belts to slip, no gear backlash, no drive-shaft torsion, and no chain drive backlash to cause variations in the relative surface speeds of two separate yarn rolls having two separate drive connections. Thus, any fluctuation in drive speed effects both peripheral speeds equally and the relative rate remains constant. Placing the common drive in close proximity to the jet minimizes the effects of ΔV_{E1} , ΔV_{E2} , ΔV_{L1} , ΔV_{L2} , and ΔV_{M1} , and ΔV_{M2} . That is, if the length of yarn between the jet and rolls is very small, the actual stretch or changes in length of the yarn will be small. The effect of sag, vibration and tracking of the yarn back and forth on the rolls will be very small also. By proper selection of the roll surface the ΔV_{S1} and ΔV_{S2} because of yarn slippage will be held at a low

value. In effect the formula now is approaching a form where ΔL will be very small

$$L + \Delta L = \frac{(V_1 + \Delta L_{M1}) - (V_2 + \Delta L_{M2})}{(V_1 + \Delta L_{M1})} 100$$

and the only variations will be due to miscellaneous factors of relatively small magnitude.

The resultant yarn will then be uniform and commercially acceptable.

Since the passage of multifilament yarn to and through a jet for the conversion thereof into bulk yarn is further described in my companion patents, further description thereof at this point does not seem to be required. In addition, the description of the several examples which follow will further explain the production of bulk yarn in accordance with the present invention.

FIG. 4 shows on an enlarged scale a sectional view taken on the line A—A of FIG. 1 of the shroud member which may be used to encase the jet 6. This encasement structure is in accordance with the over-all external structure shown in FIG. 1. That is, the over-all shroud 7 is made up of the upper portion 21 and the lower portion 22. Flange construction 43 and 44 or other suitable construction may be provided for conveniently assembling and disassembling these two parts. The yarn enters at 35 and is withdrawn at 36 as in the other devices which have just been described. A suitable opening is provided at 26 for permitting the withdrawal of the bulked yarn from the jet to a point outside of the shroud. The interior of this shroud is lined with bonded glass fiber or the like sound absorbing material similar to the sound absorbing material described above. A gasketing material 27 may be present between the two parts as between the flange and groove arrangement for providing a suitable air seal.

The air inlet is at 32. Part 22 connects with a flexible member such as hose 8 of FIG. 1 in order to provide for the air exhaust.

Referring now to FIG. 2 wherein an alternate form of jet and muffler shroud assembly are shown on a larger scale, the jet 6 is provided with the air inlet pipe 32 already referred to. The lower end, namely the exhaust end, of jet 6 is provided with a shroud or housing device 16. This device is preferably a cylinder of rigid sound absorbing material exemplified by glass fibers. Member 16 is hinged at 17 to muffler cap 15 which encircles jet 6. This muffler cap at 41 is lined with bonded glass fibers or the like sound absorbing material. As apparent from FIG. 1, the multifilament yarn to be bulked enters the jet at 35 and is withdrawn at 36. A suitable opening 14 is provided in the side of the shroud 16 to permit the withdrawal of the bulked yarn. In this particular assembly no provision is made for exhausting the air into a duct. The assembly serves only as a noise muffler and lint trap in this form.

Referring now to FIG. 3 in which the corresponding parts have been indicated by the same numerals, it will be observed that the shroud member may be rotated about hinge 17 in order to open up the device and obtain access thereto in order to thread the jet or carry out other operations within the shroud.

The functioning of the various parts described above in connection with the several figures will be further apparent from the following brief description and will be still further apparent from the examples which are set forth hereinafter.

In general the operation of my process in accordance with the present invention is similar to that described in detail in companion patent application Serial No. 330,778, now U.S. Patent No. 2,884,756 of May 5, 1959. As I have stated in this patent, the air should be free of condensation and trash.

This is accomplished in the present invention by feeding air drawn in from the outside atmosphere through filters 1 and 2 and the compressor 3 into heater 4. In heater 4 the air is heated, in accordance with my pre-

ferred embodiment, to about 120° F. However, as apparent from the preceding discussion depending upon the relative humidity of air and the like factors, a temperature of 100° F. or even somewhat lower will have utility. The heating may be accomplished by any suitable type of heater which may be heated with steam coils, hot oil, by electric current or otherwise. The exact manner of applying the heat to the air is not a limitation on the present application.

After the air is heated, it is then given a further filtering at 5 and then by passage through conduits 31 and 32 goes into the jet in the usual manner. The pressure of the air used may be in accordance with the disclosure of my patents or may be of other values, depending upon the particular yarn being processed, the nature of the bulking desired and the like factors. In general, however, the air pressure which I prefer to use would be within the range of 3 p.s.i.g. to 60 p.s.i.g.

While in the examples herein I have described the processing of multifilament yarn comprised of cellulose acetate, any of the well-known man-made multifilament yarns either in the form of one end of yarn or a plurality of ends of yarn may be fed through my apparatus for bulking purposes. It will be observed that I prefer to feed the multifilament yarn into the jet at an angle and to withdraw the bulked yarn at an angle. The arrangement of rolls 34 and 37 is such that the yarn may be fed at a faster rate than the bulk yarn is withdrawn. The speed differential assists in obtaining the desired bulking action on the yarn.

The exhaust air from jet 6, by means of parts 7, 8 and 9, is controlled so as not to contaminate the finished bulk yarn with lint, oil and the like as will be further apparent as the description proceeds. Also, by this arrangement the noise from the exhaust air is reduced to a minimum by the construction of the present invention. Moreover, the heat of the exhaust air is vented to duct 9, which in turn is coupled to an exhaust fan 10 which maintains a negative pressure in the duct 9 as measured relative to the outside atmosphere.

A further understanding of my invention will be had from a consideration of the following examples which are set forth for illustrating certain preferred embodiments.

Example I

In accordance with this example a bulky acetate rug yarn was made under the following conditions in an apparatus in accordance with FIG. 1:

Supply yarn.....	1942 denier, 16 D/F, semidull luster.
Yarn input speed.....	80 y.p.m.
Percent theoretical bulk.....	32.0.
Percent actual bulk.....	18.1.
Average air temperature.....	230° F.
Air pressure.....	22 p.s.i.
Specific volume.....	118.4 cu. in./lb.

The yarn produced under the foregoing conditions was 3-ply and tubed into a 31.55 oz./sq. yd. loop-pile carpet with $\frac{3}{16}$ " pile height. After a stairway wear-test of 43,500 footsteps, this sample had a ranking of 6.25 among a group of 19 carpets representing various bulking speeds and air temperatures. A similar carpet made with yarn bulked at 80° F. had a ranking of 15.5 among the same group of carpets. The ratings were made on the basis of wear and appearance with a rank of 1 being the best. It was necessary to bulk this yarn at only 60 y.p.m. with the 80° F. air to obtain quality equal to that obtained with the 230° F. air. A speed increase of 33 $\frac{1}{3}$ % was made possible by the use of warmed air in accordance with the present invention without a loss in yarn quality.

Another important improvement of this invention is the use of high removal filters in the air lines to assure the cleanliness of the yarn product. FIG. 1 as pointed out

above shows the location of filters 1, 2 and 5. Filter 1 is a bank of 2" thick spun glass batts which are used to remove coarse dirt and act as a prefilter for the absolute filter 2. Atmospheric air enters the system through the prefilter. The absolute filter is a high quality commercial paper filter designed to remove 99.5% of all particles above 0.3 micron in diameter. Downstream from the compressor 3 and the heater 4 is an additional filter 5 to remove particles larger than 2 microns. This last filter serves to remove oil particles and dirt which may originate in the compressor. The degree of filtration as described above is particularly desirable if natural or white yarns are being bulked for the textile trade. Under extreme conditions of atmospheric contamination, even this system will not prevent some rejects due to dirty yarn, and it may be desirable to resort to electrostatic precipitation or the like to remove all contamination from the air.

There is often a noise problem associated with the use of a large number of bulking jets, especially the large jets required to bulk heavy denier yarns. In some cases the noise level far exceeds the desirable limits for unprotected ears. Another improvement in the bulking process which this invention provides is an effective noise muffler which may be used without disturbing the operation of the bulking jet. This muffler effect will be apparent with the aid of the sectional view in FIG. 2. The muffler body 16 is a cylinder of rigid, sound absorbing material such as bonded glass fiber. The body is hinged at 17 to the muffler cap 15 which is lined with sound absorbing material. The unbulked yarn 11 is shown entering the jet and the bulked yarn 13 is shown leaving the jet and passing through the slotted guide 14 in the body of the muffler. FIG. 3 shows the muffler body in the open position to allow yarn thread-up. The following example will illustrate the effectiveness of the muffler.

Example II

A bank of rug yarn lofting jets operating at 20 p.s.i.g. air pressure were producing a noise level of 110 decibels in the operating area. A muffler in accordance with FIGS. 2 and 3 2 $\frac{3}{8}$ " in diameter and 4" long was installed on each of these jets, and the noise level was reduced to 99 decibels which is equivalent to a 92% reduction in noise energy. Reference may be made to "Acoustics," by Leo L. Bernak, McGraw-Hill, 1954.

Porous materials other than glass fiber may be used, but the material should be uniform and rigid enough to prevent channeling of the exhaust air. At least 3 square inches of muffler wall space should be provided for each cubic foot per minute of free air exhausting from the jet. The end of the muffler body 18 against which the jet exhausts, should be not less than 1" distance from the jet venturi exit and preferably 2" or more.

Another problem already mentioned above and associated with the exhaust of the bulking jets is the disposal of the lint and oil which is blown from the yarn during the bulking process. When yarn of different colors is being processed on adjacent machines, care must be taken to prevent the lint from the different colors from being mixed with the finished yarn. Fine particles of oil are often blown from the yarn during bulking, and these particles suspended in the room air present problems. When heated air is used for bulking, there is a heavy load placed on the cooling system of air-conditioned buildings. This additional load could even exceed the cooling capacity in the operating area. For these reasons it is desirable to remove the bulking air from the production area. This invention provides a means for removing the exhaust air without disturbing the operation of the bulking jet. The exhaust system which is shown in FIG. 1 also provides effective noise muffling for the jets. The compressed air is conveyed by suitable pipes and tubes from the filter 5 to the lofting jet 6. The two-piece shroud 7 encloses the jet and directs the exhaust air through the flexible tube 8

and into the exhaust header 9. The lower portion of the shroud is hinged to the upper portion so that it may be swung clear to allow thread-up. The flexible tube permits the lower portion of the shroud to be moved. The yarn enters the top of the jet as usual and passes out of the shroud through a slotted guide at the parting line of the two portions of the shroud. The preferred angles of approach and exit of the yarn are not changed by the use of the exhaust system.

FIG. 4 which is an enlarged sectional view of the shroud shows the jet 6 and the slotted guide 26 for the yarn exit. The upper portion 21 is connected to the lower portion 22 by the parts 43 and 44. The flange and groove engagement at 27 acts as an air seal and aids in supporting the lower portion in its closed position. It is beneficial for noise reduction to line the interior of the shroud with a sound absorbing material such as bonded glass fiber as shown in FIG. 4, part 24 and as discussed above. The following examples will show the muffling effect of the exhaust system.

Example III

Sound measurements were made near a single rug yarn lofting jet which was being supplied with air at 20 p.s.i.g. These measurements showed that the shroud as shown in FIGS. 1 and 4 reduced the noise level by 10 decibels over that of the bare unmuffled jet. This significant advantage is in addition to the more obvious advantages of cleanliness and heat removal which the total exhaust system offers.

Example IV

Two banks of 40 jets each were equipped with the exhaust system as shown in FIG. 1. When operating at 20 p.s.i.g. the noise level between these banks of jets was 98 decibels. These same jets created a noise level of 107 decibels when operated at 20 p.s.i.g. without mufflers. The reduction of 9 decibels was a significant improvement over the noise of the bare jets.

It is believed apparent from the foregoing examples and description concerning my improved process and apparatus that superior bulked yarn may be obtained at relatively favorable production rates. This is accomplished by the proper control of the air composition and the other factors of the present invention. That is, as described above, by suitably clearing the air to a substantial extent of moisture, oil droplets and other contaminants, as well as the heating of the air to a suitable temperature, there is achieved the accomplishment of several new and unobvious results.

The invention has been described in detail with particular reference to preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described hereinabove and as defined in the appended claims.

I claim:

1. An apparatus for the production of blown yarn, a gas jet adapted to receive the multifilament yarn to be converted into said blown yarn, means for withdrawing the blown yarn from the jet, a conduit for supplying gas to the jet, the improvement features which include means in association with said gas conduit comprising in series a prefilter, an absolute filter, a compressor, a heater and a final filter for improving the gas before it enters the jet, and an exhaust system at least substantially completely enclosing the exit from said jet, said exhaust system including an opening through which the blown yarn may be withdrawn.

2. An apparatus for the production of yarn blown with a gas, a jet adapted to receive the multifilament yarn to be blown with said gas, means for withdrawing the blown yarn from the jet, a conduit for supplying gas to the jet,

means in association with said conduit comprising at least one filter and one heater for improving the gas before it enters said jet, and an exhaust system substantially completely enclosing the exit from said jet, said system comprising a shroud means connected at one end of the jet and at the other end being connected by means of a flexible coupling to an exhaust conduit.

3. An improved jet assembly for use in the manufacture of blown yarn comprised of a gas jet adapted to have multifilament dry yarn fed into one part of the jet and the blown yarn removed from another part of the jet, a gas supply to the jet, a shroud means substantially completely enclosing the portion of the jet from which the blown yarn is removed, and a flexible tube member connecting the shroud with an exhaust conduit.

4. The jet assembly of claim 3 wherein the shroud means at least in part is constructed of sound absorbing material.

5. The jet assembly of claim 3 wherein the shroud means is made up of at least one part affixed to the jet and another part associated with the part affixed to the jet, which latter part may be moved open in a manner for threading said jet with said multifilament yarn.

6. An improved method of making an air blown multifilament yarn of improved uniformity and cleanliness which comprises feeding a multifilament yarn to be thus processed into an air blowing zone for the yarn wherein the air treating method takes place, the improvement which consists of supplying to said air blowing zone air which contains substantially no dirt particles of a size greater than two microns and air which has a relative humidity of not greater than 30 percent, which air is at a temperature in excess of 90° F., directing and confining said air in contact with the multifilament yarn in said blowing zone, and exhausting the heated air from the blowing zone through a flexible tube member connected to an exhaust conduit whereby the used heated air is exhausted to an area remote to said blowing zone.

7. A method of making gas blown yarn by a procedure which includes feeding dry multifilament yarn through a gas jet at a certain rate of feed and withdrawing blown yarn at another rate, the improvement features which comprise supplying to the jet a gas which has been filtered and heated to a temperature in excess of 90° F. but at a temperature insufficient to render said multifilament yarn plastic, said filtering and heating being sufficient so that any dirt and oil in the gas have been removed and the moisture content of the gas and the electrical conductivity of the yarn filaments are both reduced so that upon expansion of the gas in the jet in contact with the multifilament yarn there is no moisture precipitation upon said yarn, and exhausting the heated gas from the jet through a flexible coupling to an exhaust conduit.

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