Feb. 27, 1962 C. W. PALM ET AL 3,022,563

AIR JET

Filed Dec. 2, 1958 2 Sheets-Sheet 1

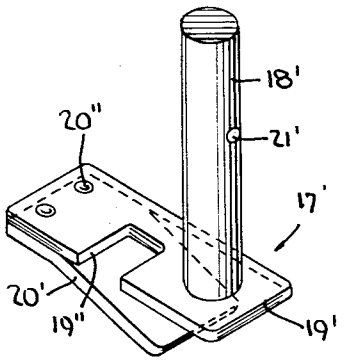


Fig. 5.

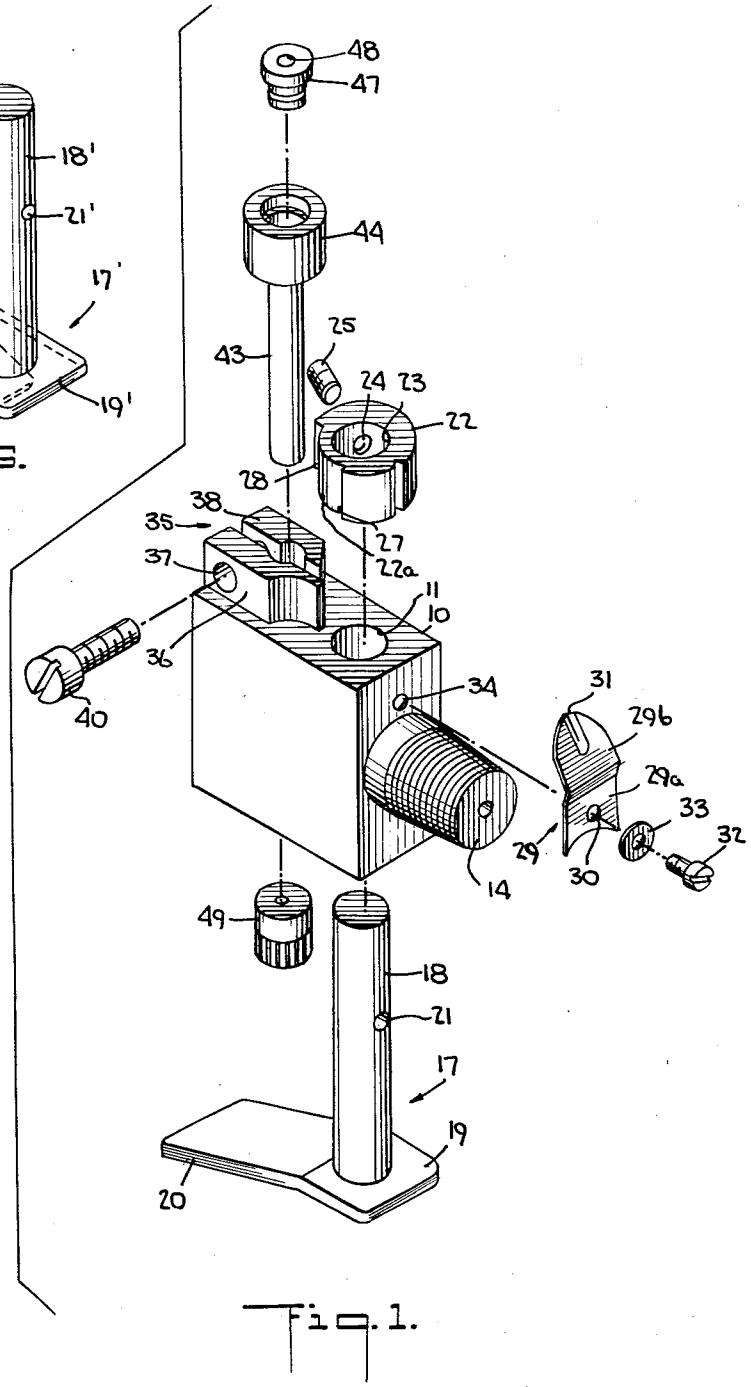


Fig. 1.

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Fig. 2.

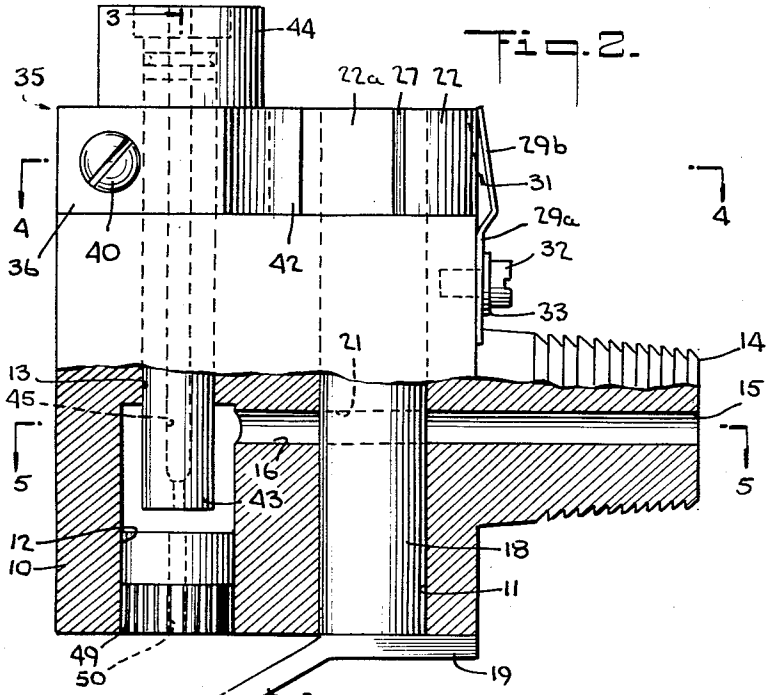


Fig. 4.

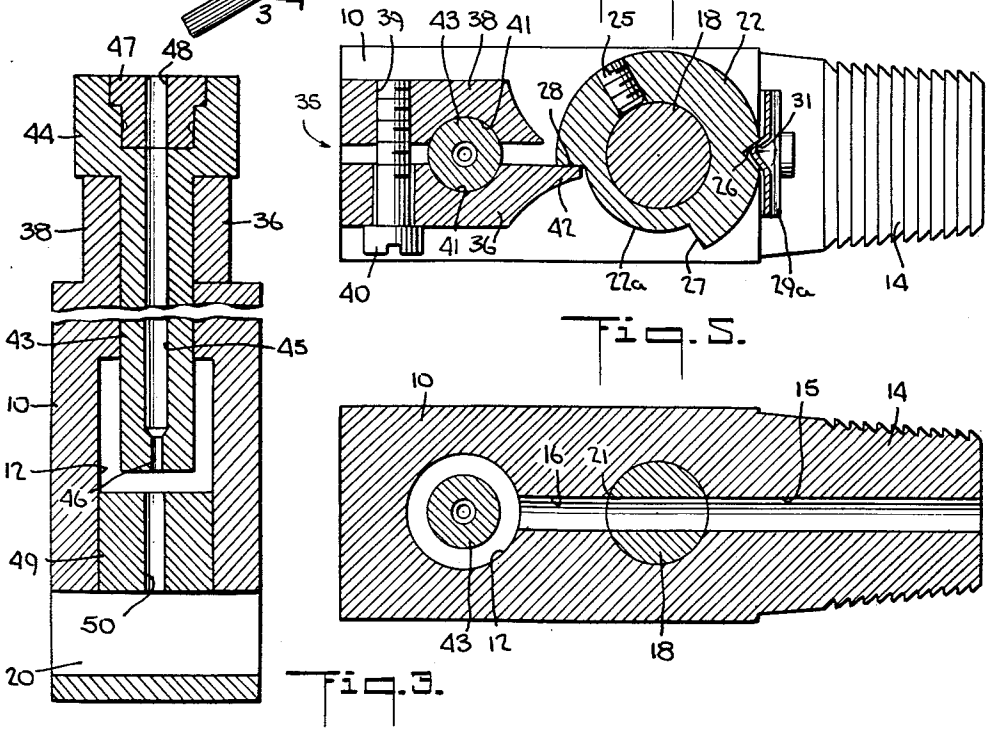


Fig. 5.

Fig. 3.

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AIR JET

Clifford W. Palm, Frostburg, Md., and Russell L. Bragg, Oak Ridge, Tenn., assignors to Celanese Corporation of America, New York, N.Y., a corporation of Delaware

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19 Claims. (Cl. 28—1)

This invention relates to means for bulking synthetic yarn, and more particularly to air jets through which such yarn is passed and in which the yarn is transformed from a straight or linear state into its bulky or loopy state.

As disclosed in a copending application of Clifford W. Palm, Serial No. 356,349, filed May 21, 1953, now Patent No. 2,942,402, if it is desired to impart to synthetic yarn composed of a bundle of continuous filaments the feel of a spun yarn made of staple fibers, the synthetic yarn is fed through an air jet in an inner chamber of which the yarn is subjected to the influence of a turbulent stream of compressed air which leads to the formation of a multitude of loops and curls in the individual straight filaments of the yarn. The so deformed yarn then leaves the jet and impinges against a preferably slanted and smooth-surfaced plate or board which tends to make the loops uniform in size as well as to increase the frequency of the loops.

It is an object of the present invention to provide a novel air jet structure for use in treating synthetic yarn in the manner disclosed in the above identified copending application.

It is another object of the present invention to provide a yarn-bulking air jet which is extremely simple in construction and devoid of any screw-threaded connections, whereby it is less expensive to manufacture and repair than heretofore known and presently commercially available air jets.

It is still another object of the present invention to provide an air jet of the aforesaid type which has incorporated therein a replaceable or interchangeable valve structure for controlling the flow of air to the bulking chamber in such a manner that such flow of air is permitted only when the impingement board is properly positioned relative to the outlet aperture of the bulking chamber.

Briefly, the present invention contemplates the provision of an air jet characterized by a valve and impingement board unit which is so constructed that the valve part of the unit controls, i.e., opens and closes, the air inlet passageway leading to the bulking (plenum) chamber, while the impingement board is connected with the valve part of the unit in such a manner that only when the board is located in its proper position opposite the outlet passageway from the chamber will the valve be open. In accordance with the invention, furthermore, the bulking chamber and the inlet passageway are formed in a unitary housing or body in which is also provided a bore intersecting the inlet passageway and adapted to receive the valve part of the valve and impingement board unit. The unit may be removed from the body and replaced by another unit having its impingement board oriented at a different angle or direction of slant relative to the axis of the outlet passageway, which outlet passageway is formed in a plug or like member inserted into the chamber-defining recess in the body. The path along which the source yarn is fed to the bulking chamber is defined by an axially bored inlet tube which projects into the chamber, the outlet end of the inlet tube bore being located at a level intermediate the junctions, with the chamber, of the air inlet and outlet passageways. Neither the valve nor the yarn inlet tube is screw-threaded or

otherwise permanently affixed to the body, as has heretofore been the practice in this art. Rather, both of these elements are merely slid into the body and retained therein by suitable clamping or like fastening means, the fastening means which retain the valve within its bore in a rotatable but axially non-displaceable condition being further associated with resilient means for aligning and releasably locking the valve in its operative, inlet passageway-opening position.

The foregoing and other objects, characteristics and advantages of the present invention will be more fully understood from the following detailed description thereof when read in conjunction with the accompanying drawings, in which:

FIG. 1 is an exploded, perspective view of an air jet constructed in accordance with the principles of the present invention;

FIG. 2 is a partly sectional, side elevational view of the air jet in assembled condition;

FIG. 3 is a sectional view taken along the line 3—3 in FIG. 2;

FIG. 4 is a sectional view taken along the line 4—4 in FIG. 2;

FIG. 5 is a sectional view taken along the line 5—5 in FIG. 2; and

FIG. 6 is a perspective view of a modified type of valve and impingement board unit to be employed with the jet of the present invention.

Referring now more particularly to FIGS. 1 to 5, it will be seen that the air jet according to the present invention comprises a main body 10 shaped essentially as a rectangular prism, although other shapes may be employed, extending through the body 10 from the top to the bottom thereof and adjacent one side is a bore 11 of substantially uniform diameter. Provided adjacent the other side of the body 10 and extending upwardly from the bottom of the body is a bore or chamber 12 of relatively large diameter which communicates at its upper end with a somewhat narrower bore 13 extending to the top of the body. At its front end, the body 10 is provided with a nipple 14 adapted to have an air hose connected thereto, and through the nipple extends an air inlet passageway 15 the inner end of which terminates at and communicates with the bore 11. In its interior, the body 10 is provided with a short passageway 16 aligned with the passageway 15 and establishing communication between the bores 11 and 12 substantially at the upper end of the latter.

The valve and impingement board unit 17, employed according to one embodiment of the invention, comprises a cylindrical shaft or like member 18 affixed at its lower end to a small platform 19 from one side of which extends a smooth-surfaced plate 20 at an angle of about 15°, although this angle may be as small as 10° and as large as 45°, depending on the operating conditions and ultimate yarn characteristics desired. The shaft 18 is somewhat longer than the bore 11, and its diameter is only slightly less than that of the bore 11 so that it may be slidably inserted into the latter.

Intermediate its ends the shaft or member 18 is provided with a transverse passageway 21 which is so positioned that when the shaft 18 is inserted into the bore 11, the passageway 21 is located in the same plane as the passageways 15 and 16. As will be readily understood, whenever the passageway 21 is aligned with the passageways 15 and 16, the bore 15 will be in communication with the bore 12, while if the passageway 21 is out of alignment with the passageways 16 and 15, the latter will be out of communication with the bore 12. In essence, therefore, the shaft or member 18 constitutes

a valve for controlling the flow of air into the bore or bulking chamber 12.

In order to retain the valve shaft 18 in the bore 11, there is provided an annular head element 22 slidably mounted atop the body 10 and provided with a central axial bore 23 sufficiently large in diameter to receive the uppermost end portion of the shaft 18, the head element 22 being further provided with a radial threaded bore 24 through which extends a small set screw 25 for locking the head element to the valve shaft. At one portion of its outer periphery, the head element 22 is provided with a substantially V-shaped notch 26, and the head element is normally so fixed to the shaft 18 that the notch 26 is disposed in the same axial plane as the passageway 21. The head 22 is also cut away over a further portion 22*a* of its outer periphery to provide a pair of circumferentially spaced abutment shoulders 27 and 28, the purpose of which will become more fully clear presently. Thus it will be seen that when the head 22 is tightly connected with the upper end of the valve shaft 18, the latter is prevented from falling out of the bore 11, although its rotation is in no way hindered.

Means are provided, according to the invention, for releasably locking or securing the head element 22 and therewith the valve shaft 18 in an operative position, in which the passageway 21 is aligned with the passageways 15 and 16. These means comprise a member 29, the lower and mounting portion 29*a* of which is provided with an aperture 30, and the upper, locking portion 29*b* of which is resiliently prestressed into an angular orientation relative to the portion 29*a* and provided with a ridge or tongue 31 of substantially V-shaped cross-section. The member 29 is affixed to the body 10 above the nipple 14 by means of a screw 32 extending through a washer 33 and the aperture 30 of the mounting portion 29*a* into a threaded bore 34 provided in the body, the lower edge of the mounting portion 29*a* being arcuately shaped in order to fit over the innermost end of the nipple 14. The angular orientation of the resilient locking portion 29*b* of the member 29 is so predetermined that the tongue or ridge 31 is always biased into contact with the head element 22, so as to ensure that the tongue, when the head element is rotated to align the notch 26 with the central vertical plane of the body 10, is snapped into the notch to lock the head element and therewith the valve shaft 18 in operative position. As can best be seen in FIG. 4, a manually initiated clockwise rotation of the head element 22 (which may, of course, be effected by a corresponding displacement of the impingement board 20) will cause the tongue 31 to be cammed out of the notch 26, permitting the passageway 21 to be moved out of registry with the passageways 15 and 16 to interrupt the flow of air to the chamber 12.

Arranged on the top of the body 10 adjacent the rear end thereof is a clamping structure 35 including a stationary clamp member 36 through which extends a bore 37, and a movable clamp member 38 provided with a threaded bore 39, and a screw or bolt 40 extending through the bore 37 into the bore 39. Rotation of the screw 40 thus either separates the clamp members 36 and 38 or brings them closer together. Both the members 36 and 38 are provided intermediate their ends with arc-shaped recesses 41. The fixed clamp member 36 is somewhat longer than the movable member 38, and its end 42 remote from the screw 37 extends into the cut out portion 22*a* of the alignment head element 22 in such a manner as to provide a movement-limiting abutment or stop for the shoulders 27 and 28. As will be readily understood from FIGS. 1 and 4, the shoulders 27 and 28 are so spaced that the latter abuts against the stop 42 when the valve shaft 18 is in its operative position, while the former abuts against the stop when the valve shaft is in its inoperative position.

The means providing access for the source yarn to the bulking chamber 12 comprise an inlet tube 43 extending snugly into and through the bore 13 and having an enlarged head 44 by means of which it is seated on the upper surface of the clamping structure 35, the tube being clamped between the recesses 41 of the members 36 and 38. The inlet tube 43 is sufficiently long to extend well into the chamber 12 and is provided with a central bore 45 which is somewhat narrowed at its lowermost end as shown at 46. Mounted within the enlarged head 44 is a small eyelet 47 of abrasion resistant material having a low coefficient of friction, e.g. aluminum magnesium silicate, nylon, hardened steel, or the like, provided with a central bore 48 having substantially the same diameter as the bore 45 of the tube 43 and adapted to guide the source yarn into the bore 45.

The lowermost end of the chamber 12 is obturated by an abrasion resistant orifice plug 49 which is knurled over a portion of its outer periphery and is provided with a central bore 50, offset slightly, e.g. 0.010 inch, relative to bore 46 of the inlet tube, the remaining portion of the plug 49 being smooth surfaced and adapted to be tightly fitted into the bore 12. The plug 49 thus defines the exit for both the bulked yarn and the used air from the chamber 12. Should it be desired to employ an outlet passageway of different diameter, it is merely necessary to replace the plug 49 by another one.

In operation, the valve shaft or member 18 is turned, by suitable manipulation of the impingement board 20 or the head element 22, until the tongue 31 of the resilient element 29*b* of the locking member 29 snaps into the notch 26 in the head element 22, at which time the shoulder 28 will abut against the stop end 42 of the clamp member 36, while the passageway 21 will be aligned with passageways 15 and 16. As long as the members are in these positions, compressed air may be admitted into the bulking chamber 12, and the flow of air within the chamber will be sufficiently turbulent to impart a great number of loops and curls to the synthetic source yarn entering the chamber via the bore 45—46 of the inlet tube 43. The bulky yarn will then leave the chamber 12 through the outlet bore 50 of the plug 49, being forced therethrough by the compressed air, whereupon the bulky yarn will be impinged against the board 20 which tends to make the loops more uniform in size as well as to increase the frequency of the loops. Inasmuch as the actual loop forming action and the subsequent twisting or other treatments of the bulked yarn constitute no part of the present invention, however, a detailed description thereof is not included in this application.

It is, of course, possible that in some cases the layout of the yarn-treating plant will be such that a deflection of the bulked yarn by the impingement board rearwardly of the air jet is not feasible or desirable. This would render the assembly shown in FIG. 1 substantially inutile. To overcome this potential difficulty, the present invention contemplates the provision of a plurality of interchangeable replacement valve and impingement board units. One of such replacement units 17′ is show in FIG. 6 and comprises a cylindrical valve shaft or member 18′ affixed at its lower end to a mounting plate 19′ provided in its central region and at one side thereof with a relatively large recess 19″, an impingement board 20′ being affixed to the mounting plate by means of rivets, screws or like fastenter elements 20″ at the end of the plate remote from the valve shaft 18′ and slanting past the recess 19″. The valve shaft is provided intermediate its ends with a transverse passageway 21′ and is longer than the bore 11 of the jet body 10 in the same manner as the valve shaft 18 shown in FIGS. 1 to 5.

Thus it will be seen that if the unit 17 were to be removed from the body 10 upon loosening of the set screw 25 in the aligning head element 22, the unit 17′ could be substituted for the unit 17 without difficulty and would, in view of the fact that the recess 19″ is so positioned in the plate 19′ as to underlie the bore 50 of the orifice plug 49 when the valve shaft 18′ is located within the

bore 11 and locked in operative position by the tongue 31 of the resilient portion 29a of the member 29, ensure that any bulked yarn leaving the chamber 12 and impinging on the board 20' is deflected forwardly of the jet toward any suitable take-up means which may be located there. Still other units, of course, may be provided in which the impinging board slants laterally of the jet body rather than forwardly or rearwardly thereof.

As has been stated hereinabove, the body 10 may be made of any suitable, inexpensive construction material. This is true also of such other elements of the jet as will not be subjected to any considerable wear during use, for example, the valve shaft, the head element 22, the clamping structure 35 and the inlet tube 43. It will be readily understood, however, that both the yarn guide eyelet 47 and the orifice plug 49 will be subjected to considerable abrasive action of the moving yarn, and these elements, therefore, are preferably made of hardened steel or like abrasion-resistant material. Should either of these elements deteriorate to such an extent as to become unusable, it will merely be necessary to replace it with a fresh element of the same type.

The air jet according to the present invention is both less expensive to manufacture and possessed of a greater useful life than any jets heretofore employed in yarn bulking operations. This is primarily due not only to the use of materials which are cheaper, yet fully as durable as those employed in the known jets, but also to the manner of construction and joining of the various elements of the jet as disclosed herein. Specifically, the elimination of ail screw threads between the inlet tube 43 and the body, as well as between the valve shaft 18 and the body, and the substitution of clamping means for such screw threads, ensure that the various elements of the jet are not subjected to the considerable stresses and strains heretofore encountered in assembling or adjusting the known jets. In accordance with the present invention, if it be desired to adjust the spacing between the outlet end of the bore 46 in the inlet tube 43 and the top of the orifice plug 49, it is merely necessary to displace the latter either inwardly or outwardly of the chamber 12, or to raise inlet tube 44 possibly using a feeler gauge or by placing one or more shims or spacer plates between the lower surface of the inlet tube head 44 and the upper surface of the clamping structure 35.

It is to be understood that the foregoing detailed description is given merely by way of illustration and that many variations may be made therein without departing from the spirit of our invention.

Having described our invention what we desire to secure by Letters Patent is:

1. In a jet for bulking synthetic yarn and having a bulking chamber through which said yarn is fed; the improvement comprising a valve and impingement board unit, the valve part of which is operable to control the inlet for bulking fluid to said chamber, and the board part of which is so connected with said valve part as to be operatively positioned relative to the outlet of said chamber only in the fluid flow-permitting state of said valve part.

2. In a jet according to claim 1, resilient means for releasably locking said unit in position with said valve part thereof in its fluid flow-permtiting state and with said board part in the operative position thereof.

3. In a jet assembly for bulking synthetic yarn and having a bulking chamber through which said yarn is fed; the improvement comprising a plurality of different and interchangeable valve and impingement board units, the valve part of each of said units being operable to control the inlet for bulking fluid to said chamber, and the board part of each unit being so connected with the associated valve part as to assume a respective operative position relative to the outlet for said chamber only in the fluid flow-permitting state of said associated valve part.

4. A jet for bulking synthetic yarn, comprising housing means defining a bulking chamber having a pair of inlets for yarn and bulking fluid, respectively, and an outlet for bulked yarn and used fluid, and a removable valve and impingement board unit carried by said housing means, the valve part of said unit being operable to control the bulking fluid inlet, and the board part of said unit being so connected with said valve part as to be operatively positioned relative to said outlet upon operation of said valve part to open said fluid inlet.

5. A jet according to claim 4, further comprising a bored tube mounted on said housing means and constituting the yarn inlet to said chamber, and clamp means carried by said housing means for engaging said tube and immobilizing the latter relative to said housing means.

6. A jet according to claim 5, the discharge end of said tube being located within the confines of said chamber and intermediate said fluid inlet and said outlet.

7. A jet according to claim 4, further comprising a hardened steel plug carried by said housing means and provided with a bore constituting said outlet of said chamber.

8. A jet according to claim 4, further comprising means for connecting said valve unit to said housing means so as to permit displacement of said unit to and fro between its operative and inoperative positions while inhibiting removal of said unit from said housing means.

9. A jet according to claim 8, further comprising stop means on said housing means, said connecting means being displaceable with said unit and provided with a pair of spaced abutments engageable with said stop means, to thereby define the end limits of the displacement of said unit corresponding to said operative and inoperative positions thereof, and resilient means mounted on said housing means and engageable with said connecting means for releasably locking the same and therewith said unit in said operative position of the latter.

10. A jet according to claim 4, said valve part of said valve and impingement board unit comprising a member extending rotatably through said housing means and across said fluid inlet, said member being provided with a transverse fluid-passing aperture adapted to be placed into and out of communication with said fluid inlet in accordance with rotation of said member to one or the other of two predetermined positions thereof.

11. A jet according to claim 10, said board part of said valve and impingement board unit including a flat, smooth-surfaced plate operatively connected to one end of said member for rotation therewith and oriented at an obtuse angle to the axis of rotation of said member.

12. A jet according to claim 11, said board part further comprising a small platform affixed to said member, said plate being attached to said platform and extending in a direction away from said member.

13. A jet according to claim 11, said board part further comprising an elongated platform affixed at one end to said member and provided intermediate its ends with a recess adapted to be juxtaposed to said outlet of said chamber when said fluid-passing aperture of said member is in communication with said fluid inlet of said chamber, said plate being attached to said platform at the other end thereof and on the side thereof remote from said member and extending past said recess in the direction of said member.

14. A jet for bulking synthetic yarn, comprising a body provided with a bulking chamber and with a fluid inlet passageway communicating with said chamber, valve means operable to open and close said inlet passageway to permit and interrupt flow of fluid therethrough, respectively, means connected with said body and defining an outlet passageway from said chamber, a yarn inlet tube extending into said chamber and terminating at a location intermediate said outlet and inlet passageways, and an impingement board displaceable between a posi-

tion opposite said outlet passageway and a position remote therefrom, said board being connected with said valve means so that when the latter is disposed so as to maintain the inlet passageway open said board is opposite said outlet passageway, operation of said valve means to close said inlet passageway simultaneously displacing said board to said remote position by virtue of the connection between said valve means and said board.

15. An air jet for bulking synthetic yarn, comprising a body provided with a bulking chamber and with an air inlet passageway communicating with said chamber, valve means having an operative and an inoperative position for controlling said inlet passageway to permit and interrupt flow of air therethrough, respectively, abrasion-resistant means mounted in said body and defining an outlet passageway from said chamber for bulked yarn and used air, an impingement board connected with said valve means and arranged to be located opposite said outlet passageway upon disposition of said valve means in said operative position thereof, means for releasably locking said valve means in said operative position thereof, and a yarn inlet tube clamped to said body and extending into said chamber, said yarn inlet tube being provided with a bore permitting passage of yarn into said chamber and terminating at a level intermediate said outlet and inlet passageways.

16. An air jet for bulking synthetic yarn, comprising a body provided with a bulking chamber, with an air inlet passageway and a first bore communicating at spaced locations with said chamber, and with a second bore intersecting said inlet passageway, a valve shaft extending rotatably and axially slidably through said second bore and having one of its ends projecting outwardly of said body at one end of said second bore, a support member attached to the other end of said valve shaft and bearing against said body adjacent the other end of said second bore, an impingement board attached to said support member and oriented at an obtuse angle to the axis of rotation of said valve shaft, an annular head member releasably connected to said one end of said valve shaft and bearing against said body about said one end of said second bore, whereby axial displacement of said valve shaft relative to said body is inhibited while rotation is not, said valve shaft being provided intermediate said ends thereof with a transverse bore adapted to be brought into and out of alignment with said inlet passageway to permit and interrupt flow of air therethrough, respectively, a hardened steel plug mounted in said body and defining an outlet passageway from said chamber for used air and bulked yarn, spring means engageable with a portion of said head member for releasably locking the same and thus said valve shaft in that position of the latter in which said transverse bore is aligned with said inlet passageway, said impingement board being so attached to said support member as to be disposed opposite said outlet passageway when said valve shaft is locked in position by said spring means, a yarn inlet tube extending through said first bore and into said chamber, the discharge end of said tube being disposed intermediate the junctions of said chamber with said inlet and outlet passageways, and clamp means mounted on said body about said first bore for gripping engagement with said inlet tube.

17. A jet for bulking synthetic yarn, comprising housing means defining a bulking chamber having a pair of inlets for yarn and bulking fluid, respectively, and an outlet for bulked yarn and used fluid, a valve controlling said bulking fluid inlet and extending into said housing means, a bored tube mounted on said housing means and constituting the yarn inlet to said chamber, clamp means carried by said housing means for engaging said tube and immobilizing the latter relative to said housing means, and a displaceable element connected to said valve by means of which said valve can be moved from inoperative to operative position, displacement of said element in both of two directions being limited by said clamp means, one of said limiting positions corresponding to the open state of said valve and the other corresponding to the closed state.

18. A jet according to claim 17, wherein said element is displaceable by rotation, said element including a generally cylindrical surface portion provided with a pair of spaced abutments, said clamp means including a nose extending into the space between said abutments.

19. A jet for bulking synthetic yarns, comprising housing means defining a bulking chamber having a pair of inlets for yarn and bulking fluid, respectively, and an outlet for bulked yarn and used fluid, a valve controlling said bulking fluid inlet and extending into said housing means, a bored tube mounted on said housing means and constituting the yarn inlet to said chamber, clamp means carried by said housing means for engaging said tube and immobilizing the latter relative to said housing means, and resilient means for releasably locking said valve in its fluid flow-permitting state.

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