Dec. 9, 1969 J. JOLY 3,482,294

APPARATUS FOR FLUID TREATING FILAMENTARY MATERIALS

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Fig. 1.

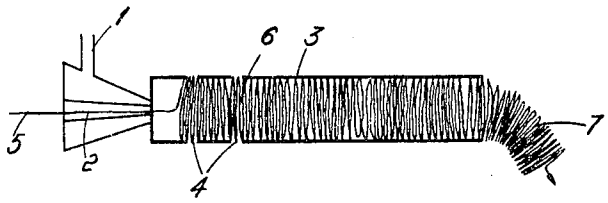
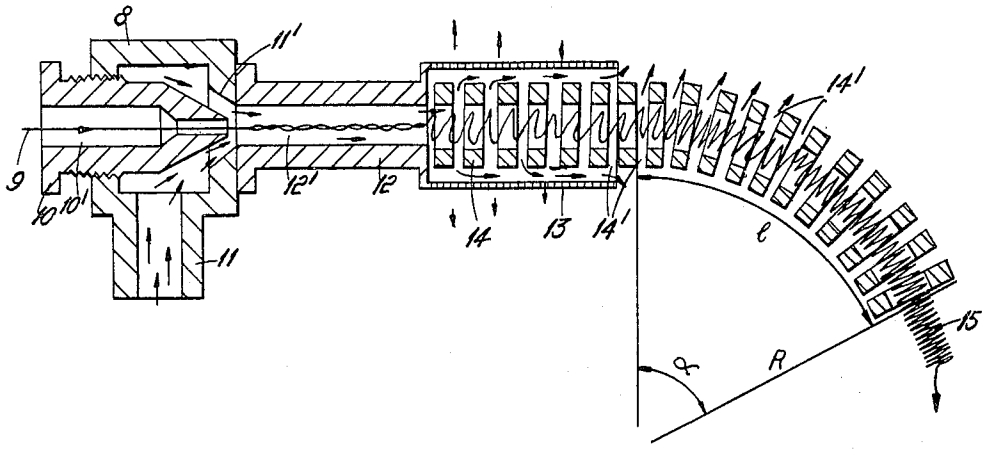



Fig. 2.

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# APPARATUS FOR FLUID TREATING FILAMENTARY MATERIALS

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Continuation-in-part of application Ser. No. 355,379, Mar. 27, 1964. This application Jan. 3, 1968, Ser. No. 695,511

Claims priority, application France, Feb. 8, 1961, 852,055; Dec. 21, 1961, 882,739, 882,740; Mar. 25, 1963, 929,113, 929,115

Int. Cl. D02g 1/16

U.S. Cl. 28—1 8 Claims

## ABSTRACT OF THE DISCLOSURE

The invention relates to an apparatus for the treatment of textile yarns, and more particularly to an apparatus for the stuffer crimping of yarns, comprising an elongated tubular chamber provided at one end with a pneumatic device for the introduction of a yarn and having between its two ends means for partially evacuating the fluid introduced by the pneumatic device.

### Cross-reference to related applications

This application is a continuation-in-part of application Ser. No. 355,379 filed on Mar. 27, 1964, now U.S. Patent 3,373,470, granted Mar. 19, 1968, itself a continuation-in-part of application Ser. No. 171,521 filed Feb. 6, 1962, now abandoned.

### Background of the invention

A known process for the crimping of thermoplastics textile yarns consists in accumulating them under pressure in a crimping chamber provided at its outlet with a wall capable of maintaining the pressure at a predetermined value, the deformations obtained being set by heat treatment, usually within the crimping chamber.

Various types of apparatus may be employed for the practical carrying into effect of such process. In the best known type, the yarn is fed by means of rollers into the crimping chamber wherein it accumulates until its pressure is sufficient to pivot counter-pressure devices opposing emergence of the crimped material from the chamber. As will be appreciated, this apparatus comprises a number of mechanical, moving members, and this is always a disadvantage when it is desirable to operate at high speed.

A simpler known apparatus comprises a pneumatic device for feeding the yarn into the crimping chamber, the wall of such chamber being constituted by a moving belt which maintains the pressure within the chamber and also provides for the advance of the packed yarn.

### Summary of the invention

The present invention relates to apparatus which is even simpler still and does not comprise any moving mechanical elements.

The apparatus of this invention comprises a tubular member defining an elongated laterally confined space, means operative to produce a current of fluid under pressure through said space from one end thereof to the other for introducing filaments to be treated into said one end thereof, and means on said member spaced from said other end of said space effective to controllably release part of said fluid laterally of said space.

The tubular member preferably has the shape of a cylinder and in particular a right circular cylinder, but it may also have the shape of a parallelepipedon. In some cases, and particularly when it is desired to supplement resistance to the passage of the yarn and in this way to



increase the packing effect, it is appropriate to employ a tubular member, the zone of which near the outlet end is inwardly curved. It is also possible to adjust the packing of the yarn by appropriate selection of the material of the inner surface of the tubular member, since the co-efficient of friction between the packed yarn and the tubular member varies in accordance with such material, or by modifying the structure of the said inner surface, for example by means of grooves extending perpendicular to the axis. The said co-efficient of friction may also be influenced by the nature of the fluid utilised.

Furthermore, the length and the cross-section of the enclosed space delimited by the tubular member may vary depending on the count of the yarn to be processed, the effect on the yarn desired, etc. By way of example, it is possible to employ for the crimping of 70 denier yarns a cylindrical tubular member which is 4 cm. long and 0.4 cm. in diameter, and for the crimping of 240,000 deniers roving a tubular member 1 m. long and 5 cm. in diameter. The tubular member may be rigid or deformable.

In order to produce the flow of fluid through the confined space, any pneumatic injector of known type may be employed. Preferably such injector is adapted to introduce the yarn and the fluid axially simultaneously into the tubular member. It may be constituted by a simple tube the cross-section of which is smaller than that of the tubular member, such as for example the apparatus described in French Patent No. 674,578 of Oct. 22, 1929.

The means for laterally evacuating the fluid in a controlled manner may be orifices formed in the wall of the enclosed space and preferably distributed over the entire periphery of a zone of the enclosed space. They may have a surface which is fixed or adjustable, such surface being selected as a function of the rate of flow of the fluid passing through the apparatus. Preferably small-dimension orifices will be utilised, and, if necessary, there will be a large number of such orifices, in order to prevent the fluid laterally entraining the yarn to an excessive degree; if the apparatus is intended for the treatment of tows, the said orifices may, however, have relatively large dimensions.

The zone of the tubular member in which the orifices are formed, is preferably located a short distance from the inlet end of the tubular member.

The orifices may establish communication between the enclosed space delimited by the tubular member and an atmosphere at atmospheric pressure or at a pressure differing from atmospheric pressure. The essential feature in order that the device may function is that the pressure of the said atmosphere shall be less than the pressure of the fluid feeding the injector and equal to or higher than the pressure obtaining at the outlet end.

In order that the invention may more readily be understood, reference will now be made to the accompanying drawings which illustrate, by way of non-limitative example, two forms of apparatus according to the invention. In the drawings:

FIGURE 1 is a diagrammatic sectional view of one embodiment of apparatus according to this invention wherein the tubular member is straight; and

FIGURE 2 is a diagrammatic sectional view of a second embodiment of apparatus according to this invention wherein the tubular member is curved.

Referring to FIGURE 1, the apparatus illustrated comprises a pneumatic injector which has a fluid-feeding means **1** and a passage for the yarn **2** and is fitted at the end of a tube **3** formed with orifices **4** arranged in a number of annular rows, only two of which are illustrated in the drawing.

In one suitable embodiment of the apparatus of FIGURE 1, the tube **3** may be a cylindrical tube which is 12 cm. long and 0.8 cm. in diameter and is provided in a

zone extending from a position 1 cm. from the inlet end to a position 2 cms. from the inlet end with four annular rows of orifices, the orifices being 0.1 cm. in diameter and there being twelve orifices in each row.

This apparatus may be utilised for example for crimping a nylon yarn 5 (50 denier, 17-filaments) introduced into the enclosed space provided by tube **3** at a rate of 40 metres per minute by means of the injector fed with steam at a pressure of 4 kg./cm.$^2$ and at a temperature of 151° C.

In the zone of the enclosed space upstream of the orifices **4**, the fluid is canalised, the flow thereof taking place only with extremely little perturbation which undulates the yarn only to a slight degree.

At the level of the orifices, the greater part of the steam escapes violently in a radial direction. In its lateral movement, the fluid entrains the yarn which no longer follows a substantially rectilinear path but is strongly undulated until it forms a compact mass **6** which is accumulated and packed and progresses in the enclosed space, being recovered in the form of a wad **7**.

The violence with which the fluid escapes through the first row of orifices may be such that it will sometimes entrain the yarn through such orifices; then, however, the pressure of the fluid on the packed yarn increases and causes the yarn to advance, thus once again freeing the orifices.

FIGURE 2 shows a further embodiment of apparatus according to the invention. In this figure, reference numeral **8** designates the injector which comprises a nozzle **10** having therethrough a passage **10'** and a pipe **11** having an end **11'** into which the nozzle is screwed and surrounding the outlet of the passage **10'**. At the outlet of the pipe **11** is located a conduit **12** having a passage **12'** therethrough and an enlarged extension **13** provided with a permeable wall. Fitted within the extension **13** is a metal spring **14** having gaps **14'** between the convolutions thereof. The spring **14** is curved at its outlet end to an arc of radius R, length *l* and having an angle $\alpha$ at the centre. In this device, the tubular member is constituted by the combination of the conduit **12** and the spring **14**.

In a suitable embodiment of the apparatus of FIGURE 2 for crimping an 840 denier, 60-filaments yarn **9** introduced at 200 metres per minute into the conduit **12** by steam fed to the injector at a rate of 2 kg./cm.$^2$ and at a temperature of 165° C., the passage **10'** has an inner diameter which is 10 mm. at the inlet and 2 mm. in its downstream portion where the outer wall of the nozzle **10** has the shape of a frustum of a cone, the apex angle of which is 53°. The outlet orifice of the injector has an inner diameter of 3 mm. and the inner wall of the injector has, in its downstream portion, the shape of a frustum of a cone, the apex angle of which is 66°.

The length of the conduit **12** is 10 mm., and the diameter is 10 mm. The spring **14** has an internal diameter of 10 mm. and a length of 110 mm. The angle $\alpha$, as shown in FIGURE 2, is approximately 40° and *l* is approximately 80 mm.

The wall **7** which is diametrally and longitudinally permeable canalises the vapour escaping through the first convolutions of the spring, thus contributing to increasing the temperature of the packed yarn.

The mode of functioning of this apparatus is identical with that previously described and the packed yarn is recovered in the form of a wad **15** from which the crimped yarn is extracted.

I claim:

**1.** Fiber stuffing apparatus comprising a tubular member defining an elongated laterally confined space, means operative to produce a current of fluid under pressure through said space from one end thereof to the other for introducing filaments to be treated into said one end thereof, and means on said member spaced from said other end of said space effective to controllably release part of said fluid laterally of said space.

**2.** Stuffer crimping apparatus comprising a tubular member defining an elongate laterally confined space, means operative to produce a current of heated fluid under pressure through said space from one end thereof to the other for introducing filaments to be crimped into said one end thereof, and means on said member spaced from said other end of said space effective to controllably release part of said fluid laterally of said space.

**3.** Stuffer crimping apparatus comprising an injector having therethrough a passage for filaments; a tubular wall defining an elongate confining crimping chamber having an inlet end communicating with said injector and having an outlet end; a central portion at least of said wall spaced from said outlet end of the chamber having orifices therein constructed such that fluid passing into said inlet end of the chamber will be released through said orifices; and means for supplying heated fluid under pressure to said injector and in a direction to entrain filaments in said passage and cause such filaments to pass into the inlet end of said chamber and be packed therein by lateral release of fluid through said orifices and the packed filaments forced through the chamber to the outlet end thereof.

**4.** Stuffer crimping apparatus comprising a pipe having a bore therethrough; an enlargement of said pipe having an outlet orifice communicating with said bore; a nozzle mounted in said pipe enlargement and having an outlet within and aligned with said outlet orifice of the pipe enlargement; a tube mounted adjacent said pipe enlargement and having a passage therethrough; a permeable extension to said tube; a coil spring mounted within said extension and projecting outwardly thereof, coils of said spring within said extension being spaced apart; and means for supplying heated fluid under pressure through said pipe.

**5.** The stuffer crimping apparatus specified in claim **4**, in which the said coil spring has a part projecting from said tube extension of curved form.

**6.** Stuffer crimping apparatus comprising an injector having therethrough a passage for filaments; a tubular wall defining an elongate confining crimping chamber having an inlet end communicating with said injector and having a curved outlet end; a central portion at least of said wall spaced from said outlet end of the chamber having orifices therein constructed such that fluid passing into said inlet end of the chamber will be released through said orifices; and means for supplying heated fluid under pressure to said injector and in a direction to entrain filaments in said passage and cause such filaments to pass into the inlet end of said chamber and be packed therein by lateral release of fluid through said orifices and the packed filaments forced through the chamber to the outlet end thereof.

**7.** Stuffer crimping apparatus comprising an injector having therethrough a passage for filaments; a tubular wall defining an elongate confining crimping chamber having an inlet end communicating with said injector and having an outlet end; a coil spring forming at least the outlet end of said crimping chamber; a central portion at least of said wall spaced from said outlet end of the chamber having orifices therein constructed such that fluid passing into said inlet end of the chamber will be released through said orifices; and means for supplying heated fluid under pressure to said injector and in a direction to entrain filaments in said passage and cause such filaments to pass into the inlet end of said chamber and be packed therein by lateral release of fluid through said orifices and the packed filaments forced through the chamber to the outlet end thereof.

**8.** Stuffer crimping apparatus comprising an injector having therethrough a passage for filaments; a tubular wall defining an elongate confining crimping chamber having an inlet end communicating with said injector, an outlet section and a central section between said inlet end and outlet section, a coil spring forming at least the central section and outlet section of said chamber, the coil spring at least at the central section being extended to open the coils of the spring to provide orifices such that fluid passing

into said inlet end of the chamber will be released through said orifices; and means for supplying heated fluid under pressure to said injector and in a direction to entrain filaments in said passage and cause such filaments to pass into the inlet end of said chamber and be packed therein by lateral release of fluid through said orifices and the packed filaments forced through the chamber to the outlet section section thereof.



**References Cited**

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