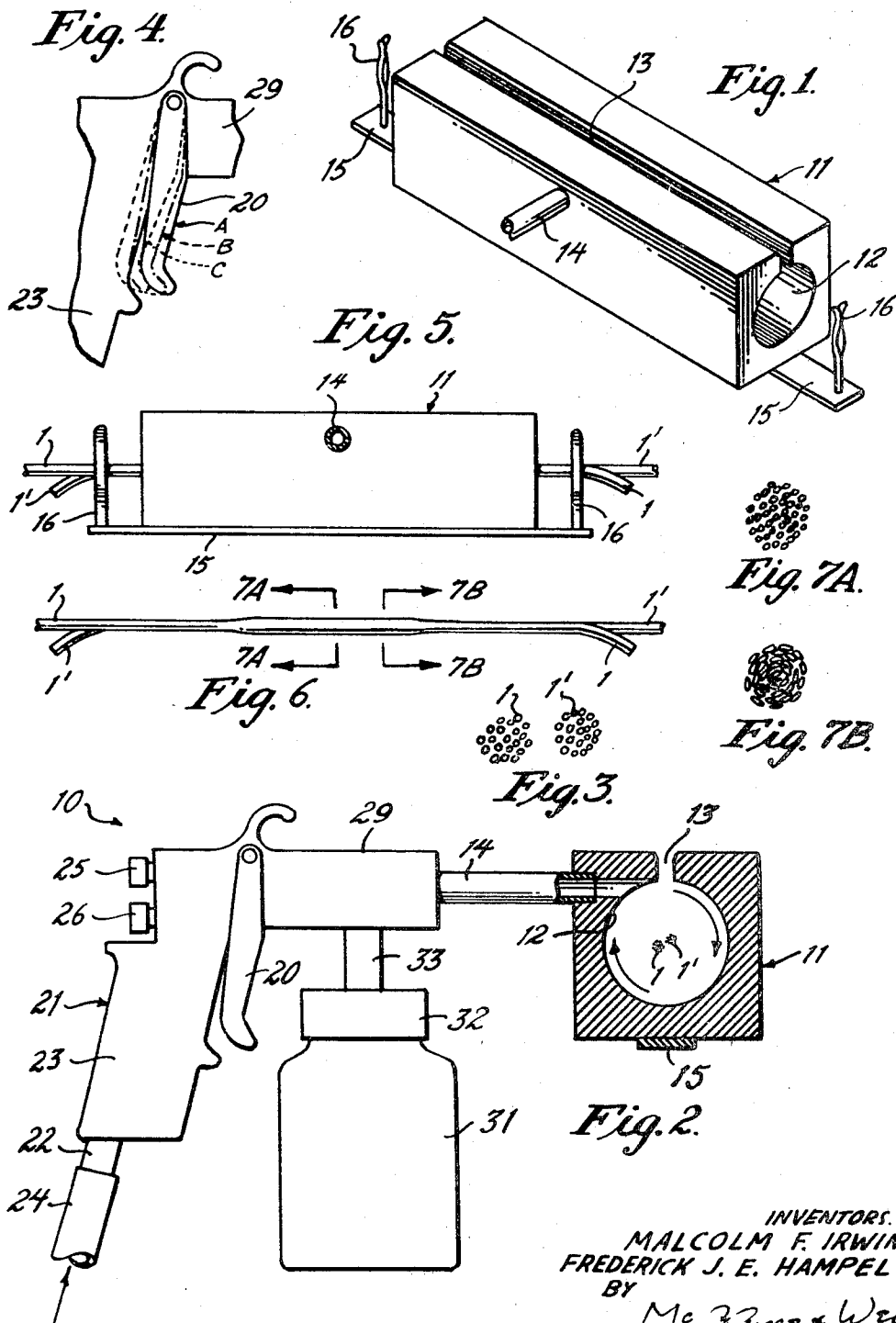


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 SPlicing OF TEXTILE STRANDS
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SPlicing OF TEXTILE STRANDS

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17 Claims

ABSTRACT OF THE DISCLOSURE

Textile strands to be spliced together are overlapped, and the overlapped lengths are subjected to fluid rotating circumferentially thereof, which swirls the component filaments into interengagement so that the strands will not be separated by applied tensions. Gun type apparatus is provided for doing so and for applying an auxiliary adhesive material in like manner.

This application is a continuation-in-part of out pending application Ser. No. 645,410, filed June 12, 1967, now Patent No. 3,407,583, which was a continuation-in-part of our prior application filed Jan. 16, 1967 and since abandoned.

There is a considerable need for a simple, reliable, and cheap strand-splicing method to replace the old-fashioned method of tying and knotting, which has its own disadvantages, being conducive to snagging and breaking of the strands in ordinary textile processing. Some methods for joining or splicing textile strands together utilize solvents or actually melt component filaments and are limited to thermoplastic strands. Fluid jet methods whereby air or the like is blown at or through textile strands to entangle the component filaments have been devised also. These and other splicing methods are either so complex as to be too costly or are unreliable in their operation or results or produce an undesirable knot-like lump.

A primary object of the present invention is provision of a method for air-splicing textile strands.

A further object is application of an adhesive agent to the spliced strands.

Other objects of the present invention, together with means and methods for attaining the various objects, will be apparent from the following description of a preferred embodiment and the accompanying diagrams.

FIG. 1 is a perspective view of an apparatus component useful according to the present invention;

FIG. 2 is a side elevation, partly in section, of apparatus of this invention including the component apparatus of FIG. 1 (sectioned transversely) and showing two strands therein about to be joined;

FIG. 3 is an end elevation of two such strands on an enlarged scale;

FIG. 4 is a fragmentary side elevation of a portion of the apparatus of FIG. 2, showing part thereof in alternative positions;

FIG. 5 is a front elevation of the apparatus component of FIG. 1 with strands to be joined in place;

FIG. 6 is a side elevation of a resulting splice of textile strands;

FIG. 7A is a sectional elevation through the splice taken at 7A—7A on FIG. 6 on the same scale as FIG. 3; and

FIG. 7B is a sectional elevation therethrough taken at 7B—7B on FIG. 6.

In general, the objects of the present invention are accomplished by juxtaposing two or more filamentary textile strands side by side, rotating fluid circumferentially

of the juxtaposed strand lengths and thereby swirling the component filaments from both of the strands into interengagement to provide an inseparable structure, including applying an adhesive material thereto, preferably in like manner. The invention provides, as means for doing so, splicing apparatus comprising a tubular chamber, open at its opposite ends, with a slot extending from one end to the opposite end and communicating with the exterior and with the chamber interior throughout its length, and having a fluid inlet extending from the exterior to the chamber interior between the ends.

FIG. 1 shows splicing chamber 11 in the form of a rectangular parallelepipedal block having longitudinal bore 12 from end to end and slot 13 extending along the top from end to end and communicating with bore 12 throughout. Tube 14 fits into one side of the block midway of its ends and nearer the slotted top surface of the block than the bottom, terminating essentially tangentially of the cylindrical interior. Affixed to the bottom and extending beyond the opposite ends of the block is strip 15, which has upstanding from each of its ends one of a pair of clips 16 extending past the bore axis.

FIG. 2 shows, in side elevation and partly in section, splicer 10 of this invention including (in transverse section) chamber 11 of FIG. 1 with two similarly sectioned strands 1, 1' shown at approximately the chamber axis. The strands are shown enlarged in FIG. 3, from which it can be seen that each contains numerous individual filaments. The nearer clip holding the strands outside the chamber is ahead of the sectional view in FIG. 2 and, therefore, not seen; the further clip, which normally would be visible at the rear, is omitted in the interest of clarity of the showing.

The splicer includes, in addition to the chamber and its attachments, gun 21 provided with intake fitting 22 at the base of grip 23. Supply hose 24 for air or other first fluid (preferably gaseous) is attached to the intake fitting. Upper adjusting nut 25 limits the inflow thereof, which is initiated by depressing pivotally mounted trigger 20. Also carried by the gun is container 31 for resin solution or other second fluid (preferably liquid) which threads at its top into cap 32 affixed to intake fitting 33 on barrel 29 of the gun. Lower adjusting nut 26 limits the inflow of liquid second fluid from the container to be propelled through and out the barrel by the gaseous first fluid, as by aspiration.

FIG. 4 shows trigger 20 of the splicer gun in three successive alternative positions: A (solid line), B (dot-dashed line), and C (broken line) corresponding, respectively, to the OFF position (no gas or liquid flowing), the BLOW position (gas only flowing), and the JET position (gas plus liquid flowing). Although the interior of the gun is not shown, a conventional paint-spray gun may be used, in which the desired action and control are obtained by means of sliding valve elements which progressively move valve pistons (not shown) to uncover internal valves in the gas and liquid intake lines successively, the degree thereof being determined by the setting of the respective adjusting nuts, which vary the position or effective length of the valve pistons.

In the practice of this invention, as will be apparent, a plurality (usually two but more can be used) of strands are juxtaposed by being overlapped for a length of at least as great as the spacing between clips 16 and are inserted through slot 13 in the top of the block comprising chamber 11 until they are received by the clips, which hold the overlapped strand lengths along substantially the axis of bore 12, as in FIG. 5. With the strands thus in place the trigger is depressed from position A (OFF) to position B (BLOW) for a short time (such as a few seconds) whereupon air (or other suitable gas, such as car-

bon dioxide or nitrogen) under pressure is injected into the chamber from gun barrel 29 through interconnecting tube 14. Rotated by the blast of gas so injected into the chamber, the juxtaposed strand lengths are swirled about to such an extent that filaments of each become interengaged with filaments of the other, with the result shown in FIG. 6.

The resulting strand structure is unitary along most of the length of the chamber bore inasmuch as so much interengagement of filaments occurs that the original strand identity is lost there. Thus, FIG. 7A shows (in somewhat stylized form) a representative transverse cross-section through the splice at a location midway of the chamber ends, showing the component filaments sectioned essentially end-on. The central plane, in which this view is taken, as indicated on the view of the spliced structure in FIG. 3, is also the locus of maximum rotation by the jet. At this location the structure is somewhat looser than elsewhere in the splice, except at the ends, probably attributable to the fact that the induced twist (more properly "false" twist) in the strand reverses midway. The interstices at this central location are especially amenable to take-up and retention of adhesive when used. In FIG. 7B, which represents (similarly stylized) a representative transverse cross-section through the splice at a location intermediate the central position and the end, the structure is generally similar to that shown in FIG. 7A but differs therefrom in reduced interfilament spacing, attributable at least in part to twist and interengagement of the component filaments. Thus, while many and perhaps most of the filaments at this location are also sectioned essentially end-on, many of them are sectioned along an angle other than perpendicular to the longitudinal filament axis, resulting in more elongated or elliptical sections.

Further manual depression of the trigger to position C (JET) causes liquid resin or similar adhesive to be atomized from container 31 and to be propelled into the chamber by the flow of air or other gas and onto the filaments, where it solidifies to retain them in their spliced configuration. If desired, heat may be applied by any suitable means, as by a heating coil in the chamber, to cure the resin after application. Suitable resins will be apparent to those persons having ordinary skill in the art. They may set in part through evaporation of a solvent or dispersant or through catalytic action and in either event may utilize heat to do so, whether or not of types usually called "thermosetting." Examples include readily available melamine-formaldehyde, urea-formaldehyde, and epoxy types, as well as numerous natural resins.

The splice should be retained in place with the air turned off or nearly so to avoid disturbance of the filament configuration during curing or setting of the resin. Heated air may be so applied at a reduced rate, corresponding to slight depression of the trigger from position A (OFF) to position B (BLOW), thereby enhancing adhesion without disruption of the splice.

Use of liquid adhesive is especially recommended where one or more monofilaments (i.e., strands consisting of a single filament each) are being spliced with one or more multifilament strands, or where several monofilaments are being spliced together. It can prove useful also where the component filaments have relatively high bending and torsional moduli.

The splice is removed from the chamber through the slot, and the unspliced ends or "tails" preferably are eliminated by cutting them off near their junction with the body of the splice. No special precautions are necessary in handling the spliced strand during performance of normal textile operations. The splicing process is quick and easy, and if desired the splicing apparatus can be provided with automatic timing means (not shown), which may be adjustable for different splicing periods as

for strands of different composition, total denier, denier per filament, tension, or twist.

Unlike air-splicing methods of the prior art, the present invention is especially useful in joining strands having appreciable twist therein, i.e., more than one turn and as much as several turns per inch, as the twist is backed out at least partially on one side from the central plane, and although it is tightened somewhat on the other side therefrom a good, though perhaps unsymmetrical, splice results. Of course, it works as well or better on strands having little or no initial twist. Nor is it necessary to increase or reduce tension in the strands to be joined, as untensioned strands may be treated at low fluid pressures or resulting velocities, and the flow may be increased in accordance with increasing strand tension. It often is desirable to start the fluid flow at a low pressure or rate and to increase it markedly during the formation of each splice as the swirling action takes place.

Other advantages and benefits of practicing the present invention in accordance with the disclosure of a preferred embodiment and modifications therein, as suggested, will be apparent. The respective starting strands cannot be reconstructed manually from the spliced structure because of the combined effect of interengagement and adhesion. Ordinary textile processing tensions will not separate it into the two (or more) original strands either. Excessive tensions may break individual filaments or even all the filaments before separation of the splice itself.

Some modifications have been suggested above, and others may be made to the process of this invention, or to apparatus for carrying it out, as by adding, combining, or subdividing parts or steps, while retaining advantages and benefits of the invention, which itself is defined as follows.

What is claimed:

1. Method of splicing a plurality of filamentary textile strands together comprising juxtaposing lengths of the respective strands side by side, rotating a first fluid circumferentially of the juxtaposed strand lengths, and thereby swirling component filaments from each of the strands together into an interengaged structure, and applying thereto a second fluid comprising adhesive material.

2. The method of claim 1, including the step of heating the resulting structure.

3. The method of claim 2 wherein the heating is accomplished by applying hot gas after application of the adhesive material.

4. The method of claim 2, wherein the adhesive material comprises a natural or synthetic resin, and the heating is of sufficient duration and intensity to cure or set the resin.

5. The method of claim 1, wherein the fluid comprising the adhesive material is also applied circumferentially.

6. The method of claim 5 wherein the first fluid comprises hot air and is applied circumferentially for a given period of time, and the second fluid comprising the adhesive material is applied for only a portion of the time the hot air is applied.

7. The method of claim 6 wherein the adhesive material comprises a thermosetting resin, and the application of hot air is continued after completion of the application of the resin.

8. In the air-splicing of a plurality of filamentary textile strands, the improvement comprising applying air rotating circumferentially about lengths of the respective strands juxtaposed side by side, thereby swirling the component filaments into interengagement, and applying adhesive material to the interengaged filaments.

9. Air-splicing improvement according to claim 8, wherein the adhesive material is aspirated onto the filaments by the air used to swirl the filaments into interengagement.

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10. Air-splicing improvement according to claim 9, including separately controlling the application of air and the aspiration of adhesive material by the air, so as to cause the aspiration of adhesive material to occur during only part of the period during which the air is applied.

11. Air-splicing improvement according to claim 10, wherein the aspiration is controlled to begin after an initial period of air application sufficient to have swirled the component filaments into interengagement and to end before a terminal period of air application.

12. Method of splicing a plurality of multifilament textile strands together comprising juxtaposing lengths of the respective strands side by side, rotating fluid circumferentially of the juxtaposed strand lengths, and thereby swirling component filaments from each of the strands together into an inseparable structure having a twist-reversal portion intermediate the ends of the overlapped strand portions, and including applying an adhesive resin thereto in liquid form.

13. The method of claim 12 including the step of heating the resulting splice and thereby curing the resin therein.

14. The method of claim 13 wherein the splice is heated by infrared radiation.

15. The method of claim 1 wherein the splice is heated by application of hot air at a velocity insufficient to disturb the filament configuration during curing of the resin.

16. The method of claim 15 wherein hot air is jetted

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circumferentially of the juxtaposed strand lengths for a given period of time, and thermosetting resin is so jetted for only a portion of the time the hot air is so jetted.

17. Textile strand splice comprising a plurality of multifilament textile strands extending in opposite directions from portions of each strand constituting the splice, with an intermediate portion of the splice being characterized by filaments of the respective strands extending substantially straight and parallel to one another, and with portions of the splice flanking the intermediate portion being characterized by filaments of each strand interengaged with filaments of each other strand, and wherein the intermediate portion has impregnated therein an adhesive resin.

References Cited

UNITED STATES PATENTS

3,262,179	7/1966	Sparling	57—34 XR
3,333,313	8/1967	Gilmore et al.	57—34 XR
3,353,344	11/1967	Glendening	57—34
3,380,135	4/1968	Wood et al.	57—22 XR

FOREIGN PATENTS

824,742	12/1959	Great Britain.
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