United States Patent

Irwin

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[54] SPLICING OF TEXTILE STRANDS

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[73] Assignee: Techniservice Corporation, North Kennett Square, Pa.

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[21] Appl. No.: 869,581

[52] U.S. Cl. 57/142, 57/159
[51] Int. Cl. D02g 3/00, D01h 13/30
[58] Field of Search 57/142, 159, 22, 23, 144, 153, 57/156, 164; 156/158

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[57] ABSTRACT

Textile strands, including at least one monofilament strand, are spliced together by being overlapped and subjected to fluid rotating circumferentially thereof, which swirls the overlapped component filaments into interengagement so that the strands will not be separated by applied tensions. Gun-type apparatus is provided for applying air or the like as the swirling fluid and for applying an auxiliary adhesive material in like manner.

10 Claims, 8 Drawing Figures

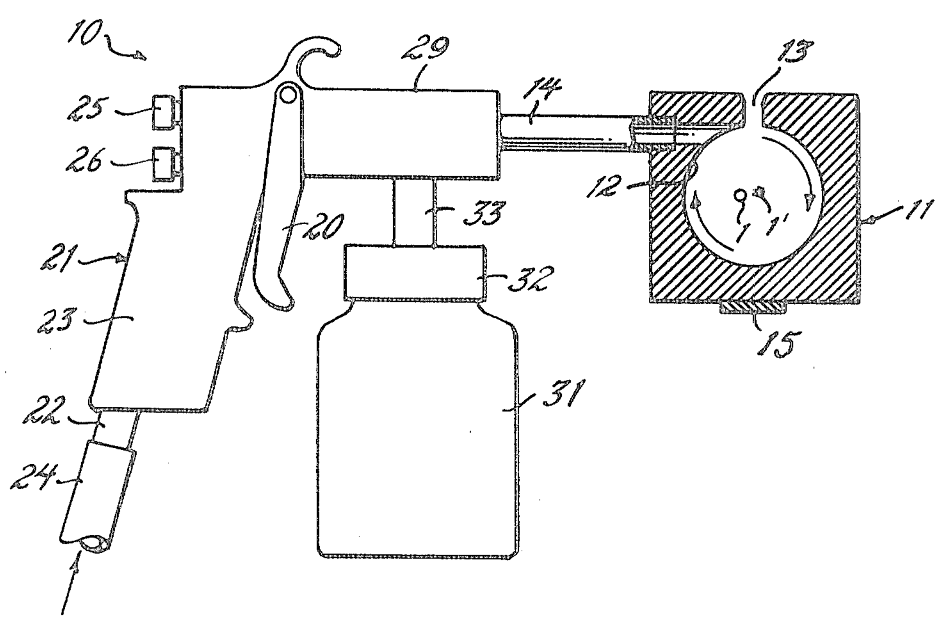
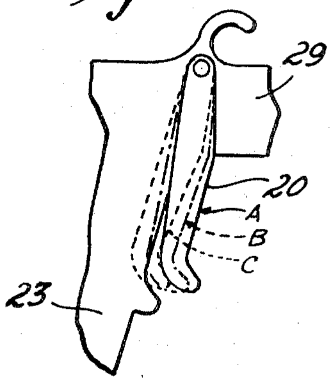


Fig. 4.



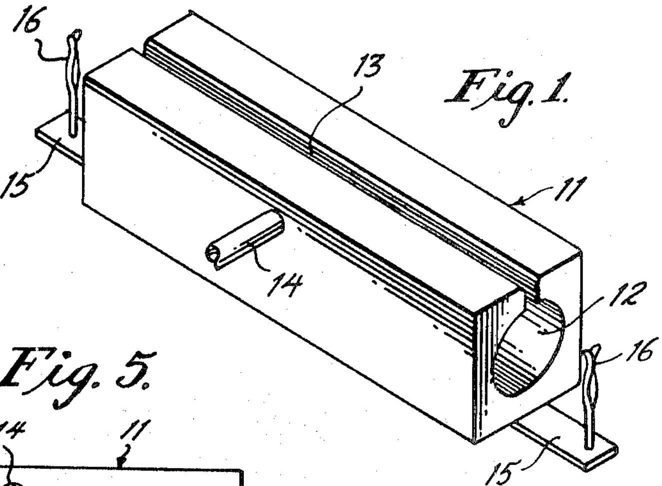
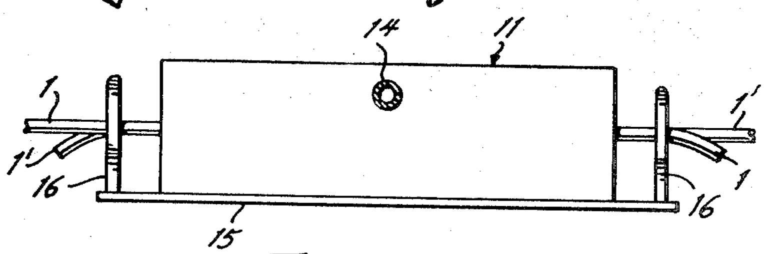


Fig. 1.

Fig. 5.



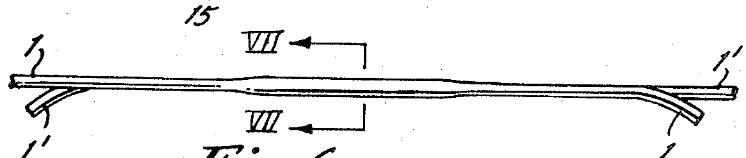


Fig. 6.

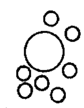


Fig. 7A.

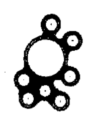


Fig. 7B.

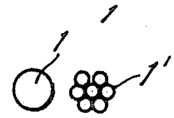


Fig. 3.

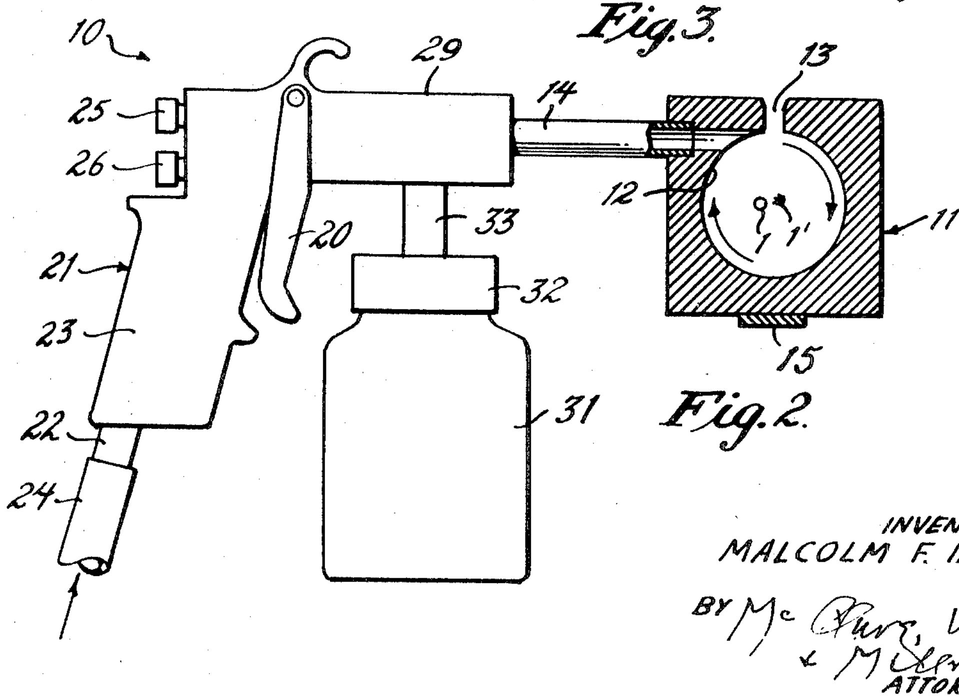


Fig. 2.

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SPLICING OF TEXTILE STRANDS

Reference is made to my copending application Ser. No. 756,885 filed Sept. 3, 1968, filed jointly with a coinventor and scheduled to issue as U.S. Pat. No. 3,474,615, the contents of which insofar as not set forth below are incorporated herein by this reference thereto.

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 knotlike lump. The difficulties are accentuated when at least one of the splice constituents is a monofilament strand.

A primary object of the present invention is provision of a method for air-splicing textile strands, especially including one or more monofilament 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 transversely through the splice taken at VII—VII on FIG. 6 before application of adhesive thereto; and

FIG. 7B is a sectional elevation therethrough at the same location after application of adhesive thereto.

In general, the objects of the present invention are accomplished by juxtaposing side by side two or more filamentary textile strands, including at least one monofilament strand, rotating fluid circumferentially of the juxtaposed strand lengths and thereby swirling the component filaments from both of the strands into interengagement to provide a spliced structure, preferably including applying an adhesive material thereto in like manner.

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 strand 1 is a monofilament strand while strand 1′ contains several individual filaments approximating in total denier that of the monofilament. 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, at least one of which is a monofilament strand, are juxtaposed by being overlapped for a length 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. If either strand is drawable to increased length, the overlapped end thereof may be predrawn (before overlapping) for greater security of the resulting splice. With the overlapped 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 carbon 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 the component filaments thereof become interengaged.

The resulting spliced strand structure is unitary along much or 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. 6 shows (in somewhat stylized form, without attempting to depict individual filaments, twist, etc.) a representative splice extending in opposite directions from a location midway of the chamber ends about halfway to each end, having uniform thickness greater than the thickness of the component strands. At each end of the splice there is a tapered transition portion that terminates in the individual strands lying side by side (unspliced) until reaching the clip location, where one or the other strand terminates in a "tail" end. The central longitudinal plane, in which this view is taken contains midway thereof the locus of maximum rotation by the jet. At this intermediate location the structure is somewhat looser than elsewhere in the splice, probably attributable to the fact that the induced twist (more properly "false" twist) in the strand reverses midway. The interstices at this location are especially amenable to takeup and retention of adhesive when used.

FIG. 7A represents a transverse section midway of the resulting splice, without (or before) application of adhesive thereto, and FIG. 7B is a like view after such application of adhesive (depicted by a line encircling the component filaments). It will be understood that such depiction is stylized for simplicity and that adhesive may be present to much lesser extent and still reinforce the splice substantially. The adhesive does not enlarge the splice, which remains essentially constant in cross section from one end to the other.

The adhesive is applied conveniently through further manual depression of the trigger to position C (JET), which 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 help 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.

After application of adhesive the splice should be retained in place at least momentarily, preferably 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, where several monofilaments are being spliced together, or where fibrillated filaments or strands having staple fiber components are involved. 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.

The claimed invention is:

1. Method of splicing a plurality of filamentary textile strands together, including at least one monofilament strand, 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 the strands together into an interengaged structure, and applying thereto a second fluid comprising adhesive material.

2. 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, including at least one monofilament strand, thereby swirling the component filaments into interengagement, and applying adhesive material to the interengaged filaments.

3. Method of splicing a plurality of monofilament textile strands together comprising juxtaposing lengths of the respective strands side by side, rotating fluid circumferentially of the juxtaposed strand lengths, and thereby swirling the strands together into a spliced structure, and including applying an adhesive resin thereto in liquid form and so retaining the spliced strands together until the adhesive sets.

4. Textile strand splice comprising a plurality of textile strands extending in opposite directions from portions of each strand swirled together and constituting the splice, including at least one monofilament strand, and wherein an intermediate portion thereof has impregnated therein an adhesive resin.

5. Splicing method according to claim **1**, wherein at least one of the filaments is fibrillated.

6. Splicing method according to claim **1**, wherein at least an included monofilament is fibrillated.

7. Splicing method according to claim **1**, wherein all the filaments are fibrillated.

8. Splice according to claim **4**, wherein at least one of the filaments is fibrillated.

9. Splice according to claim **4**, wherein at least an included monofilament is fibrillated.

10. Splice according to claim **4**, wherein all the filaments are fibrillated.

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