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2,863,492

METHOD AND APPARATUS FOR BONDING YARNS AND THREADS

Filed July 14, 1955

6 Sheets-Sheet 1

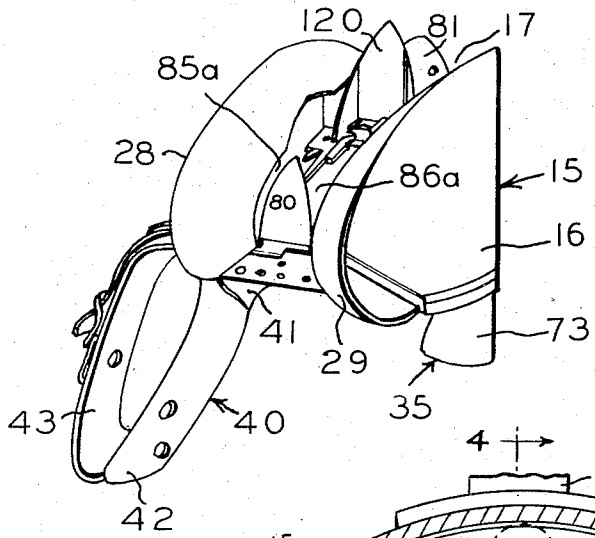


FIG. 1

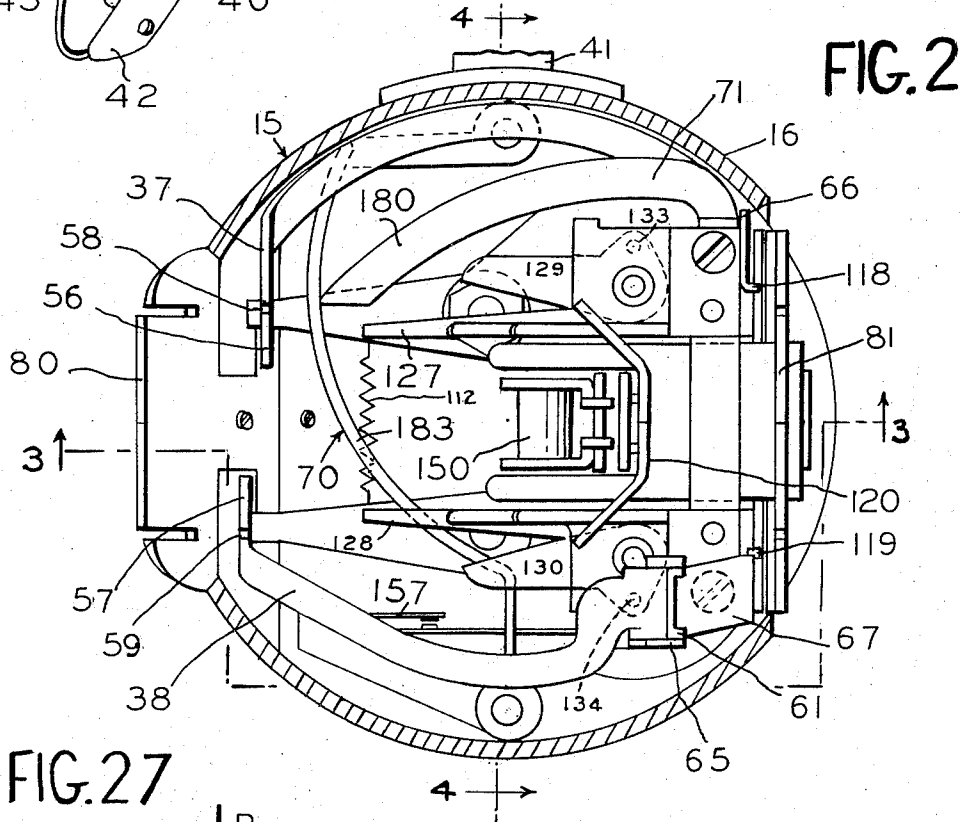
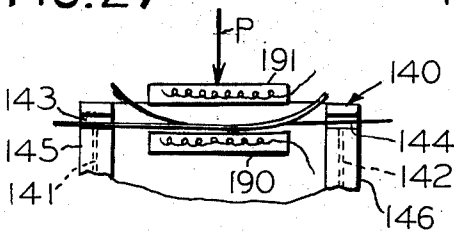


FIG. 2

FIG. 27



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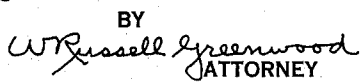
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FIG. 5

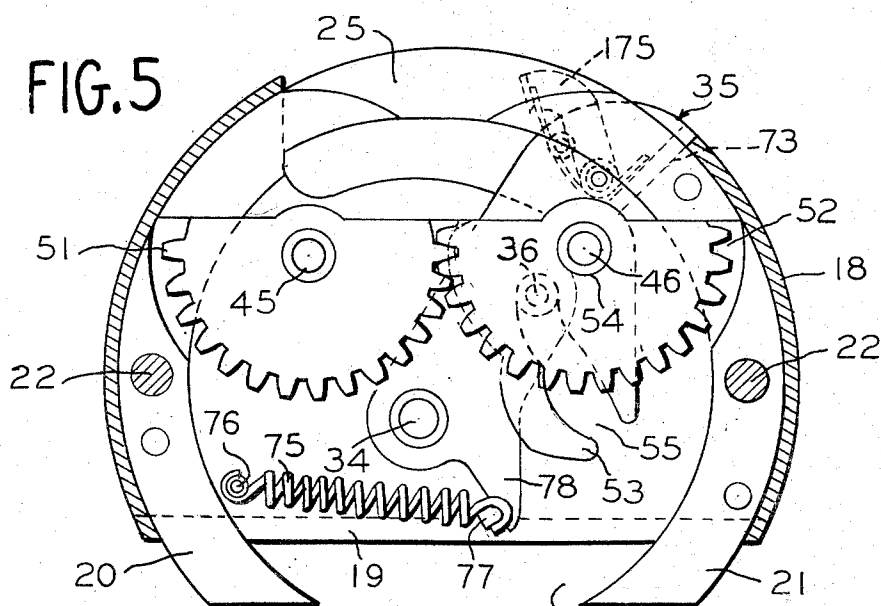


FIG. 6

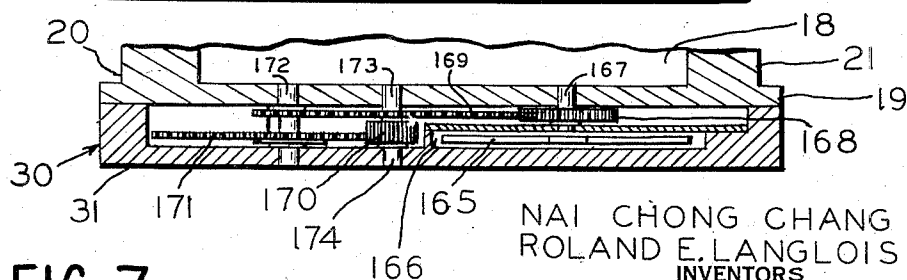
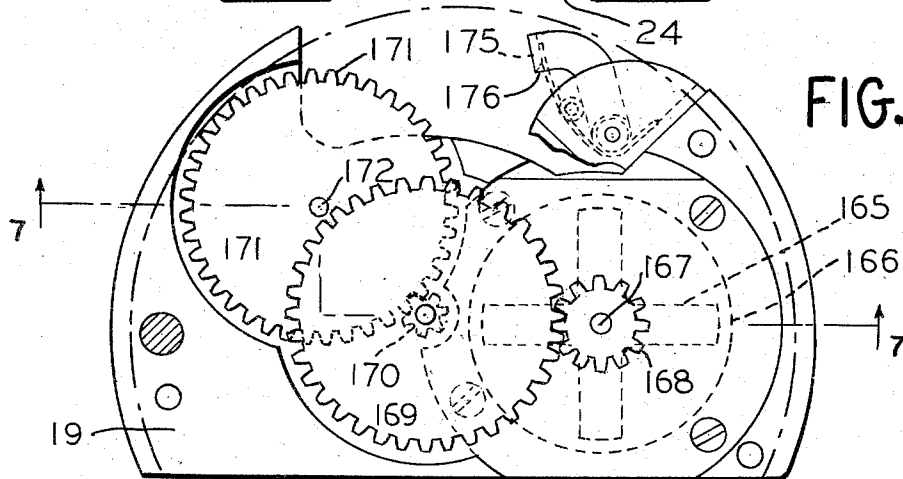


FIG. 7

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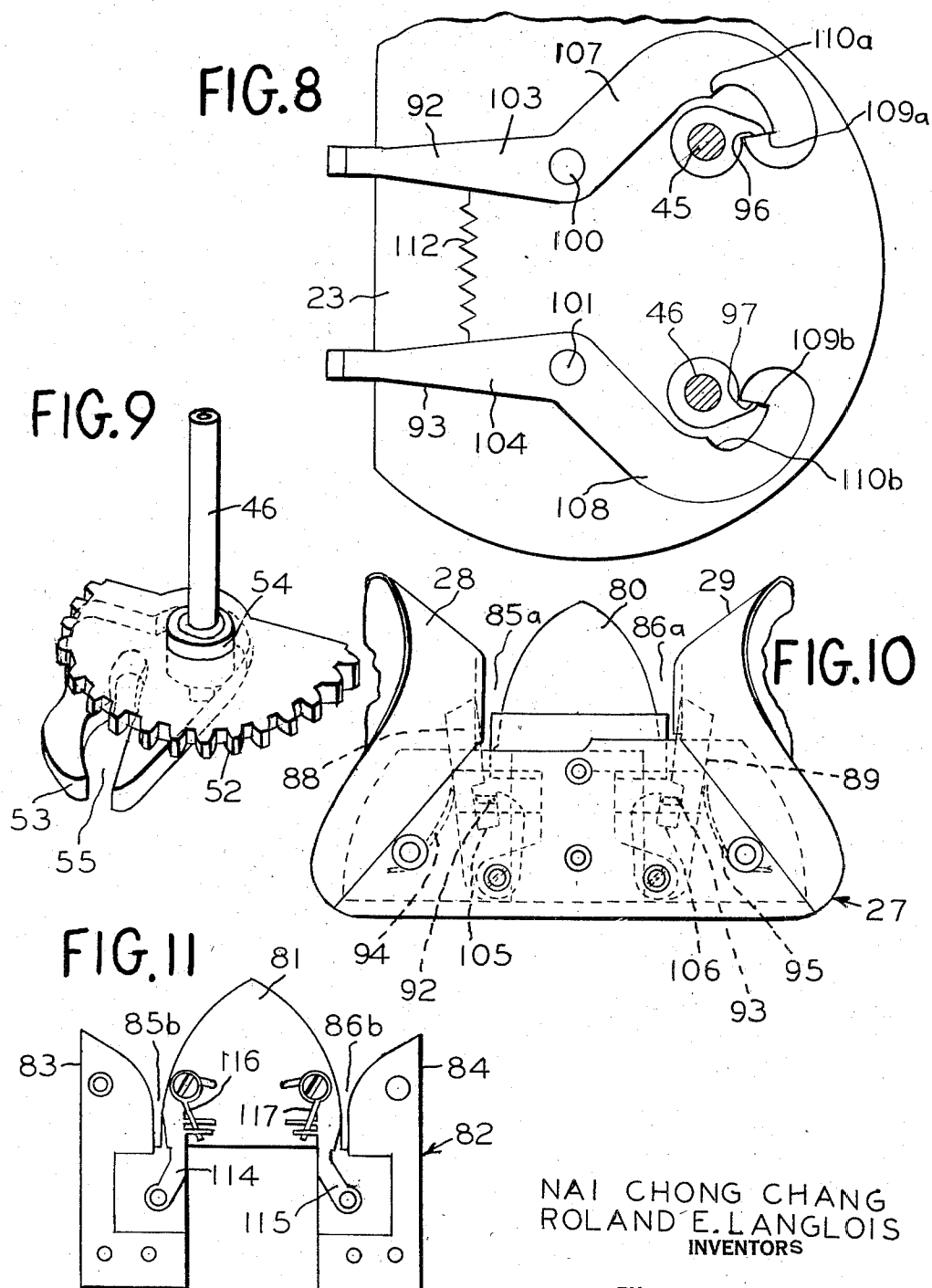
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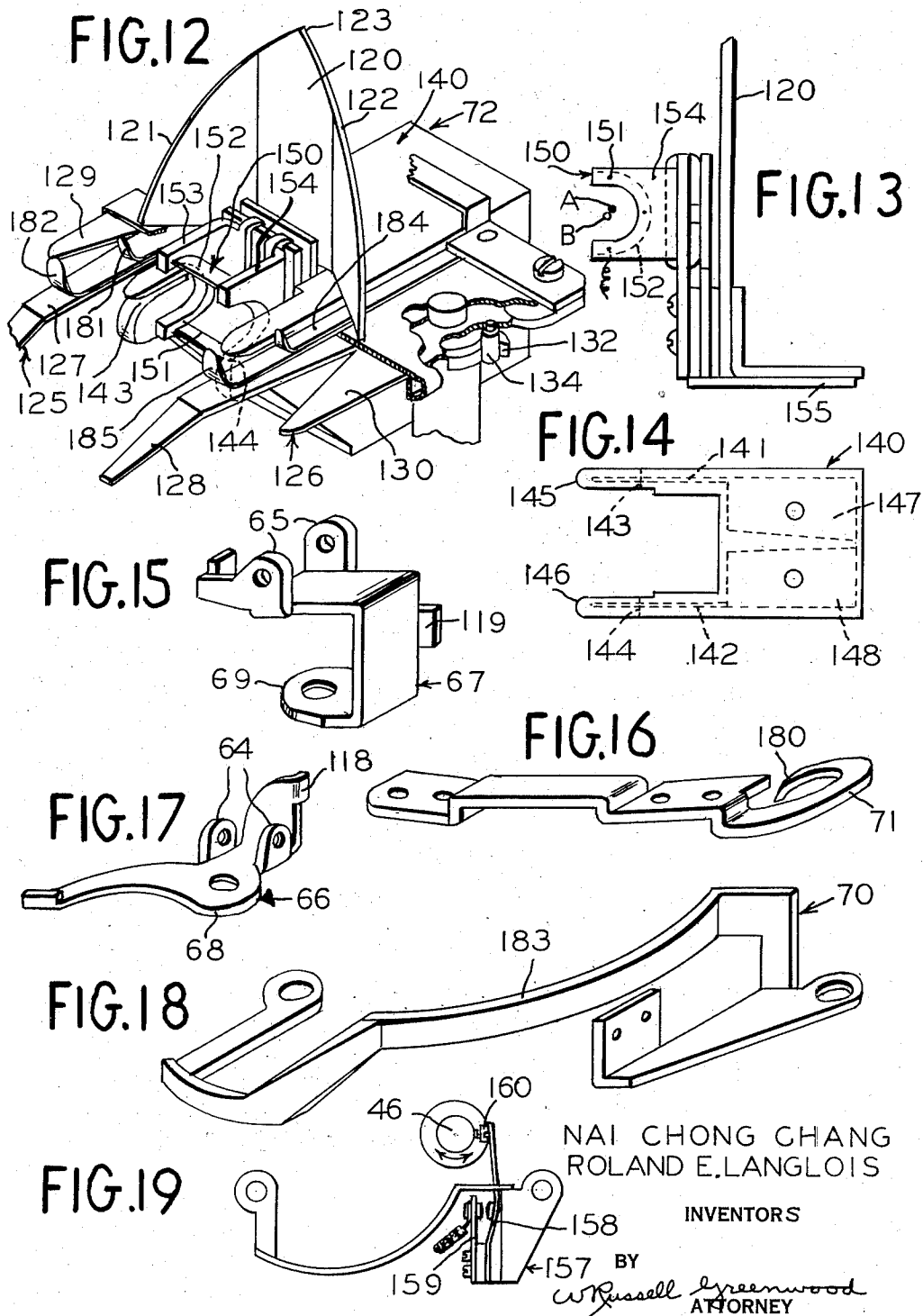
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FIG.20

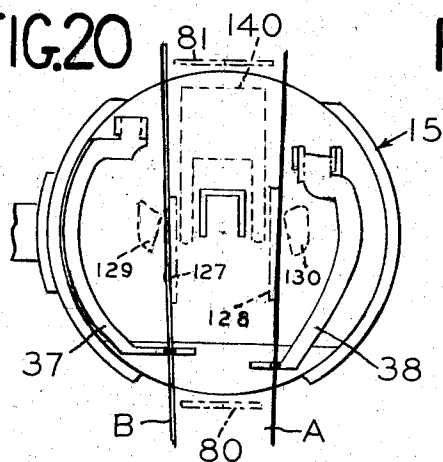


FIG.21

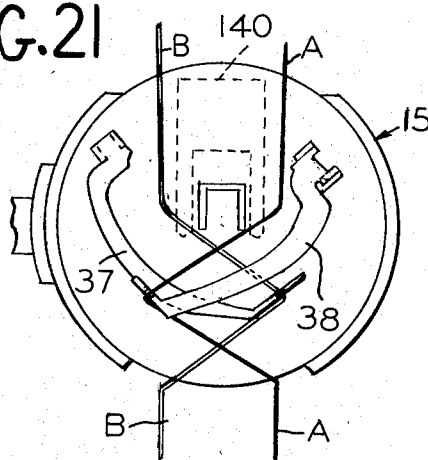


FIG.22

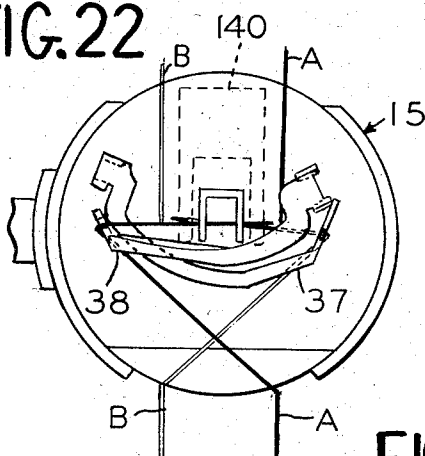


FIG.23

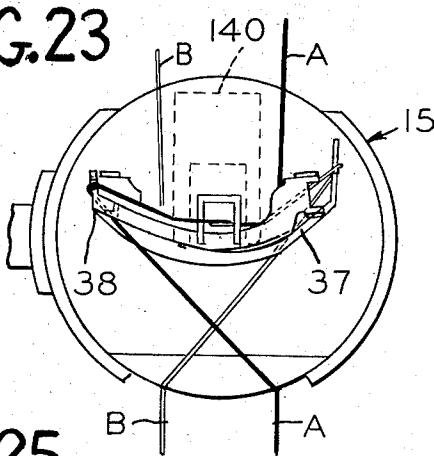


FIG.24

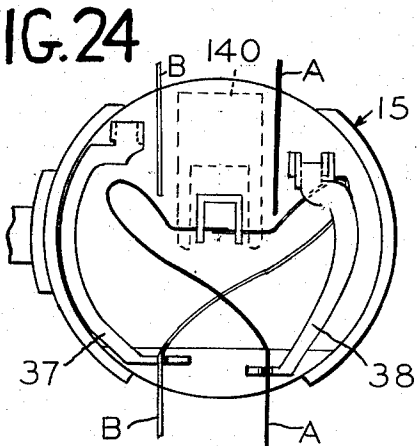


FIG.25

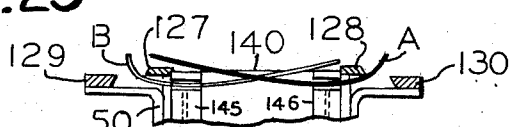
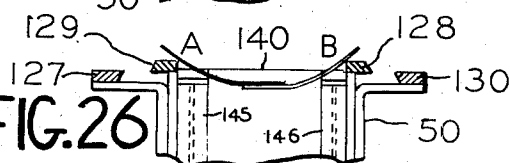


FIG.26



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METHOD AND APPARATUS FOR BONDING YARNS AND THREADS

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Application July 14, 1955, Serial No. 521,980

29 Claims. (Cl. 154—1.7)

This invention relates to a novel and improved process of and apparatus for bonding together the ends of two yarns, threads, or other textile strands in which such ends are united by means of various bonding materials applicable thereto in a fluent state, such as an adhesive or a synthetic resin of a type settable with or without applied heat, or a polymerizable resin with or without a catalyst present.

This invention also constitutes an improvement upon the method and the portable yarn bonding device which is disclosed and set forth in our copending application for patent, Serial No. 435,404, filed June 9, 1954, now U. S. Patent No. 2,812,795, granted November 12, 1957, for adhesively joining or uniting textile yarns, threads or other strands.

The particular form of yarn bonding device disclosed in the copending application above-identified, now U. S. Patent No. 2,812,795, is arranged to be strapped to an operator's left hand and actuated by a thumb lever which the operator moves by his left thumb. In the use of such a device, the operator picks up the end portions of a pair of yarns or threads with his right hand, loads them into the device through a slotted cover opening thereof past upright separators, and lays them into their respective supporting portions of two pivoted transfer arms and also into guide notches of aligned front and rear spring clamps which hold them in spaced substantially parallel relation in readiness for the operation of the device. Subsequent depression of the thumb lever by the operator operates the mechanism of the device to actuate the transfer arms which swing across each other to transfer and cross portions of the yarn or thread ends and bring them into close linear disposition to each other to form a lap for bonding. Adhesive-applying means in the form of vertically opposed relatively movable jaw members are provided, one or both of which being operatively arranged to apply a settable flowable adhesive onto the thus-linearly disposed portions of the yarn or thread ends which become said lap and form an integral joint at the lap when set. After the bonded joint is completed the united yarn or thread ends are cleared from the device by being lifted therefrom by the operator's right hand after the thumb lever has been restored automatically to its starting position. In this prior copending application, the device there-described also includes a rockable or angularly movable frame carrying vertically arranged cutters for severing the tails of said yarns or threads a predetermined linear extent to provide lapped end portions of predetermined length in the bonding region. Means are carried by this rockable frame to effect the operation of the above-mentioned cutters and also cause the jaw members to apply adhesive onto the severed end portions of said yarns or threads immediately following their transfer into the region of the lap.

The present invention relates to certain improvements in this class of device over the method and the constructional arrangement described and set forth in our copending application above-identified, now U. S. Patent

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No. 2,812,795, and comprises the provision of novel applicator means for separately coating the end portions of the yarns or threads which are to form the joint, one or both with a fluent bonding material which may be either an adhesive or a polymerizable resin, or one with a resin and the other with a catalyst, thereby eliminating the opposed pad carrying jaws which characterized our previous device.

In its preferred form, the invention further utilizes cams and a hinged mounting arrangement for the yarn or thread transfer arms whereby they will be caused to move up and down as they swing back and forth across each other so as to bring the portions of the yarn or thread ends to be joined in proper alignment within the coating-applying region of the device thereby eliminating the rockable frame of our prior device. Another important feature resides in the rearrangement of the tail severing cutters for horizontal operation instead of their previous vertical disposition, thereby greatly facilitating the dropping of the yarn or thread ends between the open cutting blades during their loading into the device.

A further important feature is the provision of heating means which is arranged to form a heating area situated in the region where bonding of the two yarns or threads is effected for producing rapid setting or curing of the fluent bonding material joining the lapped end portions before the completed joint is removed from the region where it is effected whereby an integral bonded union of the yarn or thread ends is accomplished. In one form of the invention herein disclosed, heating is carried out by a built-in radiant type heating means while another arrangement has been disclosed in which heating is carried out by means of opposed relatively movable heated press platens. The applicator means above-mentioned may be arranged in proximity to the heating area to apply a binder forming material to one of two yarn or thread ends required to be united as the joint forming portions thereof are introduced into the heating area.

With the above-mentioned improvements of this invention over the construction of our previously filed application above-identified, which has now matured in U. S. Patent No. 2,812,975, it has been possible to effect a 25% decrease in both the overall height and weight of the device. By the elimination of the movable jaw members carrying on one or both a reservoir for the adhesive substance together with a pad applicator therefor, an improved bonding device of rigid and simple construction is obtained having fewer parts and affording greater facility in the mounting of the parts during fabrication of the device.

In the accompanying drawings there is shown for the purposes of illustration only a yarn bonding device embodying the improvements and features which are the object of this invention:

Fig. 1 is a perspective view of one form of a yarn bonding device constructed in accordance with the improvements of the present invention;

Fig. 2 is an enlarged plan view of the improved yarn bonding device shown in Fig. 1 with the cowl plates removed and showing the various parts of the bonder mechanism with the yarn or thread transfer arms disposed in their initial positions preparatory for receiving a pair of yarn or thread ends to be united;

Fig. 3 is a vertical sectional view taken substantially on the line 3—3 of Fig. 2 looking in the direction of the arrows;

Fig. 4 is a vertical sectional view taken substantially on the line 4—4 of Fig. 2 looking in the direction of the arrows;

Fig. 5 is a sectional view taken substantially on the line 5—5 of Fig. 3 looking in the direction of the arrows

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and showing the lever and gearing arrangement of the thumb lever for actuating the yarn transfer arms;

Fig. 6 is a sectional view taken substantially on the line 6—6 of Fig. 3 looking in the direction of the arrows and showing the gearing arrangement of the timer

Fig. 7 is a vertical section taken substantially on the line 7—7 of Fig. 6 looking in the direction of the arrows;

Fig. 8 is a section taken substantially on the line 8—8 of Fig. 4 showing a detail of the cam and lever mechanism which operates the front clamp unit for the two yarns or threads;

Fig. 9 is a pictorial view of the pin-operated lever and gear assembly employed in the gearing arrangement of the thumb lever as shown in Fig. 5;

Fig. 10 is a front elevational view of the front clamp unit for the two yarn or thread ends;

Fig. 11 is a front elevational view of the rear clamp unit for the two yarn or thread ends;

Fig. 12 is a fragmental pictorial view of the heater and bonder assemblies including the applicator means and the reservoir unit for supplying fluent coating material as well as the cutters for severing the yarn tails;

Fig. 13 is a side elevational view of the heater assembly without the bonder reservoir unit;

Fig. 14 is a top plan view of the bonder reservoir unit;

Fig. 15 is a perspective view of the pivot support for the right yarn transfer arm;

Fig. 16 is a perspective view of the cam member for the right yarn transfer arm;

Fig. 17 is a perspective view of the pivot support for the left yarn transfer arm;

Fig. 18 is a perspective view of the cam member for the left yarn transfer arm;

Fig. 19 is a detail view of the electric switch assembly for controlling the duration of energization of the heating element and shown in operating relation to one of the yarn transfer arm shafts by which the switch is operated;

Figs. 20 to 24 inclusive, are schematic views depicting the different positions of the yarn or thread transfer arms and a pair of yarns or threads in the successive stages in the operation of the device from start to completion of the operating cycle of the device;

Fig. 25 is a fragmentary diagrammatic view, partly in section showing the orientation of the end portions of the two yarns or threads in the bonding region and in place preparatory to receiving the fluent coatings and before severing of their tails;

Fig. 26 is a fragmentary diagrammatic view, partly in section, showing the completed bonded joint after the severed yarn or thread ends have been drawn through the applicator means and fall with their wet coatings into the bonding region where they are subjected to the action of the heating means; and

Fig. 27 is a diagrammatic view depicting an alternative form of the present invention showing our novel applicator means for fluent bonding material in conjunction with a pair of opposed, relatively movable, heated, press platens.

Referring to the drawings, and first to Fig. 1, the invention is there shown as applied to a hand-supported device which generally is designated by reference numeral 15 having a case 16 of partially cylindrical form and of a size adapted to be held conveniently in one hand by an operator. Running through the case 16 from front to back thereof is an open inclined channel 17 which facilitates loading of the two yarn or thread ends which are to be united and affords ready access to the various operating parts of the device, accommodated within the interior of the case, for holding and working upon the yarn or thread ends to be bonded. The case 16 comprises a hollow base member 18 having a flat bottom portion 19 from which extend upwardly opposed side wall members 20 and 21 of arcuate form over which is suitably attached as by screws 22 a cover plate 23, the opposing terminal

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ends of these arcuate wall members being spaced from each other to provide front and rear openings 24 and 25 (see Figs. 4 and 5). Extending across the front opening 24 is an upwardly inclined plate member 26 which carries the front clamp assembly generally designated 27 (see Fig. 10) and hereinafter to be described in detail, for gripping the forward extensions of the two yarn or thread ends to be bonded. Upstanding from the base 18 and attached to the arcuate wall members 20 and 21 respectively are a pair of cowl-like portions 28 and 29 (see Figs. 1, 4 and 10) which are curved in a compound fashion to cylindrically encase the upper mechanism of the device 15 and also provide the inclined top and downward deflecting side walls of the above-mentioned channel 17. Each of these cowl portions may be made either in detachable sections or in a one-piece construction, as desired. The case 16 is completed by the attachment to the under side of the base 18 of a timer device 30 the mechanism of which is housed within a separate hollow compartment member 31 and details and purpose of which will be hereinafter described.

The base 18 and the cover plate 23 constitute the bearing supports for a pivot shaft 34 of a thumb lever 35 and its associated actuator pin 36 which provide the motive means for actuating the lever and gearing mechanism shown in Fig. 5 for operating a pair of yarn or thread transfer arms 37 and 38 of the device 15 for transferring, crossing and placing portions of the yarn or thread ends in crossed relation in the bonding region of the device as hereinafter will be described.

A handle member 40 consisting of a rigid angular metal arm 41 is suitably secured to the part 31 of the timer 30 in depending relation thereto and is provided with a leather cover 42 and an adjustable hand strap 43 of leather or the like, adapted to secure the device upon the hand of the operator while the handle member 40 is grasped in the palm of the operator's left hand during use of the device.

The assembly thus far described and as illustrated in Fig. 1 constitutes the entire casing structure and affiliated parts of the device and presents a completely smooth streamlined exterior which is devoid of any surfaces or projections to catch or break fine yarns or threads or cause them to hang up on the device as it is used.

Journalled in the bottom portion 19 of the base 18 are two upright pivot shafts 45 and 46 (see Fig. 4) which support and swing the yarn transfer arms 37 and 38 respectively. The upper ends of the pivot shafts 45 and 46 are suitably journaled in the oppositely directed tip portions 47 and 48 respectively of the prong portions of a U-shaped bracket 50. Sector gears 51 and 52 fast to the pivot shafts 45 and 46 respectively and meshing with each other in a 1:1 ratio serve to rotate the shafts together in opposite directions whenever the pivot shaft 46 is turned by a camming lever 53 affixed to the shaft 46 and actuated by the actuator pin 36 of the thumb lever 35 (see Fig. 5). The camming lever 53 is attached at one end to shaft 46 by means of a hub 54 and its opposite free end is provided with an inwardly extending slot indicated at 55, the opposite walls of which are so shaped as to translate a curvilinear motion of the actuator pin 36 lengthwise of the slot 55 into rotative movement of the camming lever 53 and its associated pivot shaft 46.

The yarn transfer arms 37 and 38 are provided at one end with laterally disposed fingers 56 and 57 respectively which are formed with notches 58 and 59 for supporting and locating the yarn or thread ends during their transfer from their initially loaded positions into the coating applying and bonding zones or regions of the device. The yarn transfer arms 37 and 38 are provided at the other end with pairs of spaced ears 60 and 61 which are pivotally mounted by means of horizontal pivot pins 62 and 63 to pivot ears 64 and 65 of the left and right pivot support members 66 and 67 respectively (see Figs. 2, 15 and 17). The pivot support members 66 and 67 are suitably at-

tached by their hubs 68 and 69 to the upper ends of the pivot shafts 45 and 46 so that the arms 37 and 38 oscillate or turn therewith laterally of the device and also partake of vertical pivotal movement thereon up and down by having pivotal connection back of their associated pivot supports 66 and 67 respectively in order to permit them to ride on two cam track units 70 and 71 respectively which raise the yarn transfer arms as they swing past each other so as to bring the yarns or threads into proper alignment with and introduce them within spaced slotted coating applying parts of a reservoir member of the bonder assembly generally indicated at 72, as will be hereinafter described. The thumb lever 35 with its associated pad extension 73 has limited oscillatory movement to-and-fro in the slotted rear opening 25 of the base member 18. A coil spring 75 having one end secured to an upright pin 76 fixed to the bottom portion 19 of the base 18 and the other end attached to an upright lug 77 on an arm extension 78 of the thumb lever 35 normally holds the thumb lever at the forward limit of its movement in the slot 25, as shown in Fig. 5.

At each end of the channel 17 through which the yarn or thread ends required to be united are loaded into the device 15, there is provided an upstanding prong or divider element, the one at the end of the channel 17 facing the operator as ordinarily held in the hand and as shown in Fig. 1, being designated by the numeral 80 and being carried by the first clamp assembly 27, and the other being located at 81 and situated at the further side from the operator or at the back end of the channel 17 and is carried by the rear clamp assembly 82 (see Fig. 11).

As illustrated in Figs. 10 and 11, it will be noted that the pointed ends of both prongs or divider elements 80 and 81 project upwardly well above the upper deflecting parts of the cowl portions 28 and 29 and that the curved side edges of the respective prongs define with the adjacent cowl parts in the case of the front clamp assembly 27, and with confronting curved portions of plate extensions 83 and 84 of the rear clamp assembly 82, deep guide notches 85a and 86a and 85b and 86b of the respective clamp assemblies for receiving and maintaining the separation of the two yarn or thread ends required to be joined together after being initially laid parallel to each other in these notches during loading into the device 15. This is pictorially shown in Fig. 1 and diagrammatically indicated in Fig. 20 wherein the end extremity of the channel 17 nearest the operator's wrist presents the two guide notches 85a and 86a which are separated by the central intervening prong 80, while the distal end of the channel 17 is provided with the guide notches 85b and 86b in axial alignment with the notches 85a and 86a respectively and separated by the central intervening prong 81.

Movable clamping levers 88 and 89 are pivotally mounted as indicated at 90 and 91 on the inclined plate member 26 of the front clamp assembly 27 for reciprocatory movement laterally into the notches 85a and 86a respectively when actuated by the ends of levers 92 and 93 respectively (see Figs. 8 and 10) so as to gently seize and hold the end portions of the yarns or threads placed in such notches whereby they may be drawn or pulled longitudinally thereof in the first part of the cycle during transferring, crossing and positioning of portions of the yarns in the bonding region of the device 15 and to positively seize and tightly hold them against movement during the part of the operating cycle of the device during which the cutters close and the bond forming operations are being carried out, as will be hereinafter described. The clamping levers 88 and 89 are normally spring-biased as by springs 94 and 95 into yarn gripping position upon slight movement of the thumb lever 35 from its inactive position shown in Fig. 1, but they are held in a normally retracted position initially during loading of the yarns into the device, as depicted in Fig. 10, by engagement and movement of the levers 92 and 93 by suitable cam stops

96 and 97 affixed by hubs 98 and 99 to the pivot shafts 45 and 46.

The levers 92 and 93 are shaped generally in a form resembling a question mark and are pivotally mounted intermediate their ends by pivot pins 100 and 101 to the cover plate 23 whereby these levers oscillate across the upper face of said cover plate when actuated by the cam stops 96 and 97. The front opening 24 in the base 18 accommodates lateral oscillatory movements of the projecting straight arm portions 103 and 104 of the levers 92 and 93, the outermost ends of such projected portions being bent downwardly, as depicted in Fig. 3, for operative connection within notches 105 and 106 provided in the clamping levers 88 and 89 respectively. The curved arm portions 107 and 108 of the levers 92 and 93 are provided at corresponding locations thereof with spaced abutment surfaces 109a and 110a and 109b and 110b respectively, which alternately are engaged by the cam stops 96 and 97.

A tension spring 112 interposed between and having its ends suitably connected to the straight arms 103 and 104 of the levers 92 and 93 normally holds these levers in the position shown in Fig. 8 with the abutment surfaces 109a and 109b in engagement with the cam stops 96 and 97 respectively.

When the thumb lever 35 is in retracted position and at rest, the spring 75 augments the action of the spring 112 to hold the camming surfaces 109a and 109b against the cam stops 96 and 97 respectively and with the straight arm portions 103 and 104 of the levers 92 and 93 in their position as shown in Fig. 8, retain the clamping levers 88 and 89 in retracted position as shown in Fig. 10 against the action of their respective springs 94 and 95 to present open guide notches 85a and 86a for initial reception of the yarn or thread ends to be bonded. Shortly after depression of the thumb lever 35, this reaction of the spring 75 is lessened and the force of the spring 112 is overcome by the stronger force of the springs 94 and 95 which automatically move the clamping levers 88 and 89 into gentle gripping contact with the yarn or thread ends accommodated within the notches 85a and 86a. As the thumb lever 35 is further depressed in effecting continued movement of the transfer arms 37 and 38, by their pivot shafts 45 and 46, the latter in turn swing the cam stops 96 and 97 until they finally engage the camming surfaces 110a and 110b of the levers 92 and 93. When this occurs, the cutters hereinafter to be described, close and continued rotation of the pivot shafts 45 and 46 produces outward movement of the curved arm portions 107 and 108 and attendant inward movement of the projected arm extensions 103 and 104 thereof to apply a positive clamping force by the clamping levers 88 and 89 to the end portions of the yarns or threads already gently gripped by them in the notches 85a and 86a by the action of the springs 94 and 95 in combination with the action of spring 112. The forward end extensions of the yarn or thread thus are maintained firmly and positively clamped as just described during the subsequent stages of the operating cycle of the device until such time as the cam stops 96 and 97 are revolved in the opposite direction to release the levers 92 and 93 whereby the reverse spring action may ensue and the thumb lever 35 is returned automatically to its starting position. Working space for swinging movement of the thumb lever 35 is provided by the rear opening 25 in the base 18.

Pivotally mounted clamping levers 114 and 115 also are provided in conjunction with the rear clamp assembly 82, these levers being normally biased to close the guide notches 85b and 86b by means of springs 116 and 117 to positively seize and firmly clamp the yarn or thread ends therein immediately following initial actuation of the thumb lever 35. Prior to actuation and movement of the thumb lever 35, the levers 114 and 115 are held in retracted position, as shown in Fig. 11, by means of suitable lugs 118 and 119 respectively which are carried by the pivot supports 66 and 67 for the transfer arms 37

and 38 and these lugs are brought to bear against the sides of the levers 114 and 115 when the transfer arms occupy the position shown in Fig. 2. The lugs 118 and 119 are moved out of contact with the levers 114 and 115 by rotation of the pivot shafts 45 and 46 as they swing the transfer arms 37 and 38 away from their starting position and the lugs thereafter reengage these levers only on completion of the return stroke of the arms.

An upstanding separator member 120 having curved side wings 121 and 122 and terminating in a pointed center portion 123, projects upwardly in the back part of the device 15 with the pointed portion 123 of the separator 120 extending well above the prong elements 80 and 81 and exteriorly of the channel 17 where it serves to deflect the pair of yarn or thread end portions A and B required to be united away from each other as they are loaded into the device 15 whereby they properly may be introduced into the scissor or cutter assemblies presently to be described as the yarn or thread ends are brought down to the bottoms of the respective guide notches 85a, 85b and 86a, 86b in being laid or dropped therein through the channel 17. Mounted on the prong portions 47 and 48 of the U-shaped bracket 50 which supports the upper ends of the pivot shafts 45 and 46 are the scissor or cutter assemblies 125 and 126 for cutting the yarn or thread ends in conjunction with the bonding cycle (see Figs. 4 and 12). As depicted in Figs. 2, 12, 25 and 26, the stationary blades of the respective cutter assemblies are indicated at 127 and 128 and the movable blades thereof by the reference numerals 129 and 130. The movable blades of the scissors are operated by dogs 131 and 132 (see Figs. 4 and 12) which are affixed to the pivot shafts 45 and 46 respectively to turn therewith and engage pins 133 and 134 (see Figs. 2 and 12) depending from the blades 129 and 130 whereby the cutting operation is synchronized with the thread manipulating operation in the bonding region.

Between the cutter assemblies 125 and 126 is located the bonder assembly generally designated 72 and includes a removable reservoir unit 140 (see Fig. 14) which is a closed, two-compartment type supply holder for the fluent coating or binder-forming materials to be applied to the joint forming end portions of the two yarns or threads and arranged to feed them by capillary passages 141 and 142 to two forward slots 143 and 144 which are individual to horns 145 and 146 on the reservoir 140 and are fed independently, each from its own compartment 147 and 148 respectively by capillary action similar to that in a fountain pen. It is these two forward slots 143 and 144 which apply either an adhesive or a resin solution to each end of the yarns or threads A and B as they are drawn through the slots, or apply a resin solution to one yarn end and a catalyst to the other yarn end as they are pulled through the slots in the bonding region after the cutting operation. Again, similar to a fountain pen, there is no leakage from the capillary passages except when the yarns or threads are actually taking away some of the bonding material.

Located between the horns 145 and 146 of the reservoir unit 140 is a radiant heater 150 containing several electrical resistance wires 151 disposed in a semi-circular arrangement with respect to a semi-cylindrical reflector 152 and through whose center pass the transferred crossed end portions of the yarns or threads A and B which are to be bonded and at which center the actual bond thereof is effected. This heater 150 is supported by the spaced semi-circularly cut-out members 153 and 154 which are carried at the upper part of a bracket 155 to which is affixed the vertical separator 120. The heating elements 151 of the heater 150 are preferably, but not necessarily, operable from a battery power supply (not shown) which may either be incorporated in the handle 40 of the device 15 or mounted on a belt on the hip of the operator and from which a suitable thin

wire lead may be electrically connected to the wires 151 of the heater 150. Associated with the heater 150 is an intermittent switch generally designated 157 (see Fig. 19) having a movable contact 158 which cooperates with a fixed contact 159 and is actuated by a projection, such as screw 160, that revolves with the pivot shaft 46 to close and open the electric circuit to the heater 150 whereby the latter will be energized shortly after the thumb lever 35 is depressed and will remain energized until the thumb lever 35 is restored to its starting position at the end of the operation of the device 15.

As previously stated, a timer device 30 is provided to control the duration of the heating period of the joint to insure a satisfactory bond and this is effected by regulating the return time or rate of movement of the thumb lever 35 from its farthest depressed position back to its starting point. To this end the mechanism of the timer device 30 herein devised is arranged to set up a retarding action on the return movement of the thumb lever 35 immediately after it starts back from its farthest depressed position at which point heating of the bonded joint is started, and this retarding action continues at a predetermined rate until the thumb lever is about midway of its return stroke, whereupon it is free to fly back to its starting position at a faster rate under the influence of the spring 75 because of removal of the retarding force. As shown in Figs. 6 and 7, the timer mechanism 30 comprises a four-bladed vane member 165 which is submerged in a suitable liquid contained within a closed leak-proof chamber 166 in the hollow compartment 31. The vane member 165 is attached to a shaft 167 which carries a pinion 168 driven by gear 169, which in turn is driven by a gear train consisting of a pinion 170 and gear 171. The gear 171 is attached to a pivot shaft 172, the ends of which are journaled in the bottom portion 19 of the base member 18 and the bottom of the compartment 31. The gear 169 and a pinion 170 are mounted on a common shaft which also is journaled at 173 and 174 respectively on the bottom portion 19 of the base member 18 and the bottom wall of the compartment member 31. Pivotaly mounted behind the pad extension 73 of the thumb lever 35 is a spring-biased latch arm 175 having a beveled catch portion 176 for latching between two adjacent teeth of the gear 171 when the thumb lever 35 is swung into its farthest depressed position so that as the thumb lever commences and continues its return stroke, the latch arm 175 operates to revolve the gear 171 and its associated gearing above-mentioned to rotate the vane member 165 in the liquid in the chamber 166 thereby delaying the return stroke of the thumb lever until such time that it has moved to a point where the beveled catch portion 176 can slide out from between the gear teeth in their revolved position and release the latch arm 175 permitting the thumb lever 35 to fly back under normal spring action.

The operation of the device may be summarized as follows: The device 15 is attached to and held in the left hand by the operator inserting his fingers through the handle member 40 and the strap 43 and is so arranged on the hand that when the left forearm is extended horizontally from his body with the palm of the hand held vertically, thumb up, the device 15 will be well back of the last joint of the first finger of the operator's hand with the case 16 facing in the general direction shown in Fig. 1, and the pad extension 73 of the thumb lever 35 being close to and in position to be engaged by the operator's left thumb. With the left hand holding the device 15 so arranged, it sits with the channel 17 upward and the operator picks up with his right hand the end portions of the two yarns or threads A and B required to be bonded and with an upward and outward sweeping motion of the right hand away from his body brings them forward together and up from beneath and up the side nearest his body within the curve of his left arm and over the channel 17 through which they are dropped or laid

into their respective notches 85a, 85b and 86a, 86b and initially positioned therein in horizontal substantially parallel relationship preparatory to having portions thereof oriented into contiguous linear crossed relationship with each other to define a lapped region of connection in which the joint is made by the bonder 72. During the loading of the two yarns or threads A and B into the device 15, both front and back clamp assemblies 27 and 82 respectively are in wide open positions permitting the free dropping of the yarns or threads A and B into the notches 85a, 85b and 86a and 86b, thereof, and also into the notches 58 and 59 of the transfer arms 37 and 38, without any force or tension on the yarns or threads as they are introduced therein. The correct generally parallel initial orientation of the two extended ends of the yarns or threads A and B is insured during such loading operation by the prong dividers 80 and 81. As the yarn or thread ends A and B are separately brought down through channel 17 in being laid into the notches of the front and rear clamp assemblies 27 and 82, they are simultaneously deflected away from each other by the upstanding separator member 120 so that they are properly introduced into the gaps between the respective open cutter assemblies 125 and 126 which, as previously described, include the left stationary horizontal blade 127, the left movable horizontal blade 129, the right stationary horizontal blade 128, and the right movable horizontal blade 130.

At the beginning of the operating cycle, when the thumb lever 35 is first depressed a slight amount from its forwardmost position, the clamping levers 92 and 93 are moved laterally toward each other by the cam stops 96 and 97 to release the front clamp assembly 27, permitting the levers 88 and 89 to close by the expansive action of the springs 94 and 95 which thereafter holds the levers 92 and 93 gently closed upon the yarns A and B with a small controlled tension thereon. Also at this time the rear clamping levers 114 and 115 positively close due to the action of springs 116 and 117 upon the portions of the yarns A and B passing through the rear clamp assembly 82. This rear clamp operation is accomplished by revolving the lugs 118 and 119 out of contact with the levers 114 and 115 by rotation of the pivot shafts 45 and 46 of the respective transfer arms 37 and 38 thereby releasing the clamping levers 114 and 115 for movement by their springs 116 and 117 in a direction to firmly clasp the yarn or thread ends A and B with a controlled tension. As the thumb lever 35 is further depressed, it rocks about the pivot shaft 34 and in a direction toward the left as viewed in Fig. 5, during which movement the actuator pin 36 moves from its most inward position as thereshown outwardly toward the entrance of the camming slot 55 of the lever 53 thereby forcing the lever sidewise toward the left from the position thereshown and producing partial rotation of the pivot shaft 46 and gear 52 which in turn rotates gear 51 and simultaneously therewith the pivot shaft 45, thereby swinging both yarn or thread transfer arms 37 and 38 from their initial outstretched position shown in Fig. 20 in opposite directions crosswise over one another and rearwardly into the successive positions shown in Figs. 21, 22 and 23. During this swinging and crossing movement of the transfer arms, the arm 38 supporting the righthand yarn or thread A transfers it from its initial position depicted in Fig. 20 in an arc to the left and to the rear, crossing it in front of the bonder assembly 72 in the course of which movement the arm 38 rides on the cam track 180 (see Figs. 2 and 16) and moves upwardly as it swings so as to bring the transferred portions of the yarn or thread end A in proper alignment with and introduce it between a pair of spring clamp elements 181 and 182 and into the coating applying slot 144 forwardly disposed in the right horn 146 of the bonder reservoir unit 140. During this crosswise movement of the transfer arm 38, the yarn or thread end A is pulled through the open righthand cutter assem-

bly 126 as its length is extended between the front and rear clamp assemblies 27 and 82 in being drawn through the rear clamp only against the spring tension thereof. At this point in the cycle, as depicted in Figs. 22 and 25, the righthand cutter assembly 126 is open and the yarn or thread end A passes around and under the cutting edge of the stationary cutter blade 128 and extends through the forward slot 144 in the reservoir unit 140 thence axially of the radiant heater 150, and outwardly to the eye or notch 58 of the transfer arm 38 from which it extends obliquely forwardly of the bonder to the righthand notches 86a of the front clamp assembly 27. This orients the yarn or thread end A in the bonder assembly 72. At the same time that the transfer arm 38 has operated as just described, the other transfer arm 37 which is attached to the upper end of its pivot shaft describes a similar and opposite arc to the right, transferring and crossing portions of the lefthand yarn or thread end B transversely under the yarn end A and across to the right side of the device 15 during which it rides on the cam track 183 (see Figs. 2 and 17) and moves upwardly as it swings so as to insert the laterally bent straight run of the thread in between a pair of spring clamp elements 184 and 185 at the right side of the bonder assembly 72 and also to bring the transferred portions of the yarn or thread end B in proper alignment with and introduce it into the coating applying slot 143 forwardly disposed in the left horn 145 of the bonder reservoir 140 (see Figs. 22 and 25). At this time, the lefthand cutter assembly 125 is open and the yarn or thread end B extends from the slot 143 of the bonder 72 axially across the heater 150 and thence under and up around the cutting edge of the stationary blade 127 of the left cutter assembly. In this position, the two yarn or thread ends A and B are placed in a vertically crossed relationship, as shown in Figs. 22 and 25. Further depression of the thumb lever 35 beyond this position operates the movable cutter blades 130 and 129 of the right and left cutter assemblies 126 and 125 respectively to cut the respective tails of the yarn or thread ends A and B to a predetermined length. Simultaneously with this cutting operation, the transfer arms 37 and 38 swing further rearwardly as indicated in Fig. 23 upon continued depression of the thumb lever 35 in the course of which movement they pull the severed end portions of the two yarns or threads through the applicator slots 143 and 144 of the bonder reservoir 140 and draw them across the respective capillary passages 141 and 142 feeding such slots during which each solution from the compartments 147 and 148 of the bonder reservoir 140 is picked up by one end of the yarns or threads B and A. This final swinging movement of the transfer arms 37 and 38 also withdraws the coated ends of the yarns or threads endwise in substantially opposite directions from the slots 143 and 144 and moves them substantially through the center of the semi-circular radiant heater 150 where the two slightly vertically crossed yarn or thread end portions falling together freely and having a wetness sufficient to adhere to each other collide and stick together with the two coatings blending so that under radiant heating by the heater 150 setting or curing of the binder coating occurs to produce an insoluble unitary bond at the joint thus-formed.

With the forming of the bonded joint as just described, the extreme limit of the depressed movement or stroke of the thumb lever 35 has been reached. On its reverse or retracting movement the following takes place: Thread transfer arms 37 and 38 reverse their motion, swing forward, and are restored to their original positions indicated in Fig. 24 as the thumb lever 35 controlled by the timer 30 is released back to its starting position. The united yarns then are cleared from the device by the operator with his right hand.

In the constructional form diagrammatically represented in Fig. 27, the apparatus thereshown comprises a heating area constituted by a pair of opposed relatively

movable electrically-heated press platens 190 and 191 in association with applicator means for applying fluent coating material to one or both yarn or thread ends and disposed at either side of the platens, preferably but not necessarily, in proximity thereto. The applicator means may comprise separate units or it may be the bonder reservoir unit 140 above set forth with its two forward slots 143 and 144 in the respective horns 145 and 146 for feeding and applying by capillary passages 141 and 142 to the respective slots either an adhesive or a resin solution to each end of the yarns or threads A and B as they are drawn endwise through the slots 143 and 144, or to apply a resin solution to the end portion of one yarn or thread and a catalyst to the end portion of the other yarn or thread as they are pulled in substantially opposite directions into the bonding region and introduced together in the heating area formed by the platens to come together into contiguous relation to form a joint. Pressure P may be applied by suitable means such as by a spring or by a suitable hydraulic or pneumatic operated piston and cylinder device to close the platens upon the adhering yarn or thread end portions during heating thereof to effect curing or setting of the coating material and form a strong joint in which the bond integrally unites the two yarns or threads. The yarn or thread ends to be united may be placed manually in an initially crossed relation in the heating area with an end portion of one yarn in place in the slot 143 and the end portion of the other yarn within the slot 144 of the bond reservoir 140, or they may be mechanically oriented and introduced therein.

In the foregoing description and in the claims the term "yarn" has been used in a generic sense to include all analogous materials such as thread, strands, etc.

Although the method herein disclosed of bonding two yarns has been illustrated as being carried out with a device of the type which is intended to be manually supported and thumb operated, it should be understood that the process of the present invention and the structure shown and described in the present application is not limited to a hand-supported device but also may be carried out with various other instrumentalities which may be either hand or power operated.

It should be understood that the present disclosure is for the purpose of illustration only and that this invention includes all modifications and equivalents which fall within the scope of the appended claims.

What is claimed is:

1. The method of connecting the ends of two yarns by a process of bonding together both yarn strands comprising the steps of coating the ends of the strands with a fluent bonding material by drawing them across an applicator element, guiding and orienting the ends thus coated to dispose them into contiguous lapped positions, and setting the bonding material while the coated ends are so positioned.

2. The method of connecting the ends of two yarns by a process of bonding together both yarn strands comprising the steps of coating the ends of the strands with adhesive by drawing them under yielding pressure across an adhesive-applying element, guiding the ends thus-coated and bringing them together into contiguous lapped positions, and setting the adhesive by heating the coated ends while so positioned.

3. The method of connecting the ends of two yarns by a process of bonding together both yarn strands comprising the steps of coating the ends of the strands with a polymerizable resin by drawing them across an applicator element, guiding the ends thus coated and bringing them together into contiguous lapped positions, and causing polymerization of the resin by heating the coated ends while so positioned.

4. The method of connecting the ends of two yarns by a process of bonding together both yarn strands comprising the steps of coating the end of one strand with a

polymerizable resin and the end of the other strand with a catalyst, and bringing the coated ends together into contiguous lapped positions and, by catalysis, thereby causing polymerization of the resin while the coated ends are so positioned.

5. A bonding device for connecting the ends of two yarns comprising electrical heating means arranged to form a heating area, and means in proximity to said heating area arranged to apply a fluent bond forming material to one of the joint forming portions of the two yarn ends required to be united as both of said joint forming portions thereof are placed together in the heating area.

6. A yarn bonder comprising electrically heated means operatively arranged to form a heating area, and means arranged to apply a separate fluent bond forming material to a joint forming portion of each of the two end portions of the yarns required to be united as both of said joint forming portions thereof are caused to contact said fluid applying means as they are brought together in the heating area.

7. A yarn bonder comprising electrically heated means arranged to form a heating area, and means in proximity to said heating area operatively arranged to apply a separate fluent bond forming material to a joint forming portion of each of the two end portions of the yarns required to be united as both of said joint forming portions thereof are caused to contact said fluid applying means as they are brought together in the heating area.

8. A yarn bonder structure as claimed in claim 6 in which the electrically heated means forming the heating area consists of a radiant type heater with resistance wires and a reflector element.

9. A yarn bonder structure as claimed in claim 6 in which the electrically heated means forming the heating area consists of a pair of opposed relatively movable electrically heated press platens.

10. A yarn bonder comprising electrical heating means arranged to form a heating area, mechanism arranged for movement in a direction to orient and introduce portions of two yarn ends in a lapped relationship into said heating area, means arranged to apply a coating of a fluent bond forming material onto the joint forming portions of the two yarn ends as both of said joint forming portions thereof are introduced and brought together in a lapped relationship by said mechanism into the heating area.

11. A yarn bonder structure as set forth in claim 10 in which there further is provided electrical switch means operatively connectable with said mechanism and actuated by the latter immediately following the bringing together of the two coated yarn ends into lapped relationship and the subjection of the joint thus-formed to heating by said heating means in which said switch means is arranged to control the duration of the heating of the joint to accomplish setting of the bond coatings thereof, and thereafter being disconnected from said mechanism upon movement of the latter in a direction to restore it to its starting position.

12. A yarn bonder structure as set forth in claim 10 in which there further is provided means for supporting each of the yarn end portions while the fluid carrying joint forming portions thereof are subjected to heating in the heating area to set the fluent coating material into an integral bond.

13. A yarn bonder structure as set forth in claim 10 in which there is further provided cutter means flanking said heating area and operatively arranged for severing the tails of the yarn ends simultaneously with the application of the fluent bond forming material to the joint forming portions of each of the two yarn ends, and spring clamp means for supporting each of the yarn end portions while the coated joint forming portions thereof are disposed in said lapped relationship and subjected to

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heating in the heating area to set the coatings into an integral bond.

14. A bonding device for uniting a pair of textile yarns comprising applicator means in opposed relation defining a bond forming region therebetween and arranged to apply fluent bond forming material separately to one, of a pair of yarn ends required to be bonded, electrical heating means associated with said bonding region and through which region the joint forming portions of the yarn ends carrying applied bond forming material are extended, cutter means flanking said applicator means and operatively arranged for severing the tails of the yarns to provide joint forming portions thereof of predetermined length, and means operatively arranged for moving across said applicator means and in contact therewith the said severed end portions to apply fluent bond forming material to the joint forming portions thereof and also to bring the last-named portions into a lapped relationship in the bond forming region for heat-setting of the coatings of the lapped joint to produce an integral bond.

15. A bonding device for uniting a pair of textile yarns comprising, in combination, a pair of movable yarn transfer members pivotally arranged to move from one position for transferring and crossing portions of a pair of yarn ends from an initially spaced substantially parallel relationship and bring them into a second position with the transferred portions in close linear relationship laterally of their former position for application of a fluent bond forming material to the joint forming portions of the yarn ends, a demountable closed reservoir unit including dual opposed integral applicator means individually arranged for applying a coating of fluent bond forming material to one of said joint forming yarn end portions as they are drawn thereover and in an amount sufficient to cause them to adhere together when brought into contact with each other and to unite them when set, and electrical heating means in proximity to said applicator means and arranged to form a heating area for accelerating setting of the ultimate joint as produced when said joint forming portions of the yarn ends carrying the coatings are caused to come together in the vicinity of said heating means.

16. A bonding device for uniting a pair of textile yarns comprising, in combination, a pair of movable yarn transfer members pivotally arranged to move from one position for transferring and crossing portions of a pair of yarn ends from an initial spaced parallel relationship and bring them into a second position with the transferred portions in close linear relationship laterally of their former position for the application of a fluent bond forming material to the joint forming portions of the yarn ends, a reservoir device including a closed chamber and dual integral opposed applicator means each being independently operable and each having separate fluid communication with the interior of said chamber and operatively arranged for applying by capillary action a coating of fluent bond forming material to said joint forming yarn end portions in an amount sufficient to cause them to adhere together and to unite when set, and heating means in proximity to said applicator means and arranged to form a heating area for heat-setting the joint when said joint forming portions of the yarn ends carrying the coatings are joined in the vicinity of said heating means.

17. A bonding device for uniting a pair of textile yarns, as set forth in preceding claim 16 in which the pivotal yarn transfer members are arranged for lateral swinging movement across each other and to move upwardly as they swing so as to place the transferred yarn end portions in proper alignment and in operative relationship with the coating applicator means so as to become coated thereby upon movement thereacross, and cam tracks for effecting upward movement of said yarn

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transfer members as the latter are caused to swing during operation of the device.

18. A bonding device for uniting a pair of textile yarns comprising bonder means including a reservoir unit having a closed chamber for supplying a fluent bond forming medium and a pair of slotted applicator members in fixed spaced relationship on said reservoir unit each having fluid communication with said chamber and arranged for separately coating by capillary action one end of a pair of yarns to be bonded as they move in contact therewith through said slots, said applicator members defining between them a bonding region where the coated ends of a pair of yarns as they leave the applicator means and are permitted to come together become bonded into an integral joint, a pair of yarn transfer means one being arranged for introducing the tail portion of one of the two yarns to be bonded into the slotted part of one of the applicator members and the other for introducing the tail portion of the second yarn into the slotted part of the other applicator member for being separately coated thereby as they are withdrawn upon further movement of said yarn transfer means and drawn thereby to pull the tail portions of both yarns linearly in opposite directions and bring them together in the region where the joint is to be formed, cutter means in juxtaposition to said fluid applicator members and operatively arranged for severing the tails of the two yarns to a predetermined length as they are pulled through the slotted parts of the applicator members in being coated thereby, and means including an electrical heating element operatively disposed in the zone between said pair of applicator members for setting the coatings at the joint formed as the wetted ends come together in being withdrawn from the applicator members.

19. A device for yarn bonding purposes comprising a support, movable clamp means on said support arranged for receiving and positioning initially in spaced linear substantially parallel relationship the end portions of a pair of yarns which are to be joined together, and mechanism carried by said support for the purpose of bringing portions of the ends of two yarns from spaced linear substantially parallel positions when initially loaded into the device into crossed contiguous linear relationship relative to each other for forming a lapped joint to be united integrally by a coating of bond forming material, said mechanism including means for mechanically operating said clamp means for securing therein the end portions of the pair of yarns immediately upon operation of said mechanism at the beginning and substantially throughout its main operating cycle, oscillatable transfer arms movable to cross and transfer portions of said yarns intervening said clamp means to place them at opposite sides of the device and bring portions thereof into close linear proximity to each other in a bonding region for forming a lapped joint when severed and moved linearly in opposite directions into contact with each other, means including a thumb lever for manually actuating said transfer means, means for severing the end portions of the yarns to form severed portions of a predetermined length in the bonding region in close linear proximity for lapping, applicator means operatively disposed to apply a coating of fluent bond forming material onto the end portions thus-disposed which become the lap and effected upon further movement of said transfer means, and heating means disposed in the region of the lap operatively arranged to effect rapid setting of the coatings applied onto the ends of the yarns forming the lap to produce an integrally bonded union of the joined yarn end portions.

20. A device for yarn bonding purposes comprising a support, movable clamp means on said support arranged for receiving and positioning initially in spaced linear substantially parallel relationship the end portions of a pair of yarns which are to be joined together, and mechanism carried by said support for the purpose of bringing

portions of the ends of two yarns from spaced linear substantially parallel positions when initially loaded into the device into crossed contiguous linear relationship relative to each other for forming a lapped joint to be joined integrally by a coating of bond forming material, said mechanism including means for mechanically operating said clamp means for securing therein the end portions of the pair of yarns immediately upon operation of said mechanism at the beginning and substantially throughout its main operating cycle, oscillatable transfer arms movable to cross and transfer portions of said yarns intervening said clamp means to place them at opposite sides of the device and bring portions thereof into close linear proximity to each other in a bonding region for forming a lapped joint when severed and moved linearly in opposite directions into contact with each other, means including a thumb lever for manually actuating said transfer means, means for severing the end portions of the yarns to form the severed portions of a predetermined length in the bonding region in close linear proximity for lapping, applicator means operatively disposed to apply a coating of fluent bond forming material onto the end portions thus-disposed which become the lap and effected upon further movement of said transfer means in the same direction, and heating means including an electrical heating element disposed in the region of the lap operatively arranged to effect rapid setting or curing of the coatings applied onto the ends of the yarns forming the lap to produce an integrally bonded union of the joined yarn end portions.

21. A device for yarn bonding purposes as set forth in preceding claim 20, in which electric switch means are provided operatively arranged in timed relation with the movements of the oscillatable transfer arms whereby the heating means will become energized shortly after the yarn transfer arms have begun their transferring movements and will remain energized during all movement of the transfer arms in that direction and on the return thereof to a point just short of the starting position.

22. A device for yarn bonding purposes as set forth in preceding claim 20, in which the means for severing the tails of said end portions of the yarns consist of horizontally movable cutters one pair of which being disposed in proximity to the coating applying means.

23. A device for yarn bonding purposes as set forth in preceding claim 20, in which there is further provided a timing means actuatable by said thumb lever at the commencement of its return stroke and operatively arranged to delay for a slight time interval the return movement of the yarn transfer arms to their starting position while heat-setting of the binder is being effected.

24. As a new article of manufacture for use in a bonding device for two textile yarns, a reservoir unit for supplying a fluent bond forming material comprising a closed hollow body having exteriorly thereof a pair of slotted applicator means for said fluent material in fixed spaced relationship to each other and each having fluid communication with the interior of said hollow body and arranged for individually applying said coating by capillary action one end of one of the two yarns to be bonded upon movement thereof through said respective slots, said slotted applicator means defining between them a bonding region where the wet coated yarn ends as they leave the applicator means come together to become bonded into an integral joint.

25. As a new article of manufacture, a reservoir unit for use in a bonding device for uniting together the ends of two yarns comprising a hollow box-like body constructed to form a closed compartment for holding a supply of fluent coating material, and carrying thereon external applicator means for discharging therethrough onto the yarn ends such fluent material from said compartment, said applicator means comprising a pair of laterally spaced members integral with said reservoir body portion and projecting forwardly thereof in which the forward end of each of said projecting members is slotted

to receive, guide and support the end portion of a strand of yarn which is required to be coated with fluent material from said compartment, each of said projecting members having therethrough a capillary passage communicating at one end with said compartment for conducting fluent material therefrom and having a discharge orifice at the other end arranged within said slot, said capillary passages being effective to apply fluent material onto separate end portions of the strands of yarn upon the latter being drawn through said slots and across said discharge orifices therein in a direction so that they will come together and the wet coatings will adherently unite both yarn ends.

26. As a new article of manufacture, a reservoir unit as constructed in accordance with the structure claimed in preceding claim 25 in which said closed compartment is further characterized by being divided into two separate chambers which are non-communicating and are to hold a supply of two different fluent coating materials, and in which the capillary passage of one of the projecting applicator members communicates with one of said chambers for conducting fluent material therefrom, and applying it onto one yarn end while the capillary passage of the second projecting applicator member communicates with the second chamber for conducting fluent material therefrom and applying it onto the second yarn end.

27. In a device of the class described, the combination with two spaced applicator means operatively arranged to apply fluent bond forming materials, of means to orient and position a pair of yarn ends from opposite directions into contiguous relation for bonding prior to operation of said applicator means, said applicator means being disposed to apply fluent bond forming materials onto the separate yarn ends as they are pulled therethrough in opposite directions so as to come together with the fluid carrying portions of the two yarns in contact and forming a lapped joint.

28. The combination with two spaced slotted applicator means operatively arranged to apply fluent bond forming materials, of means to orient a yarn end and introduce it into the slotted portion of one of said applicator means, and means to orient a second yarn and introduce it into the slotted portion of the other of said applicator means, said applicator means being fixed and so disposed as to apply fluent bond forming materials onto the separate yarn ends as they are moved through the slotted portions of their respective applicator means so as to come together with the fluid carrying portions of the two yarn ends in contact and forming a lapped joint.

29. In a device of the class described, the combination with two spaced applicator means operatively arranged to apply fluent substances which conjointly produce a high-strength bonding material for joining together two yarns, of means for engaging, guiding and positioning a pair of yarn ends to be joined in parallel lapped relationship to each other for receiving on the separate yarn ends a coating of one of the fluent agents, said applicator means being disposed to apply a coating of one of the fluent agents to one of the yarn ends and a coating of the other of said fluent agents to the other yarn end as both yarn ends are pulled in opposite directions by said second-named means so as to position them together with the coated portions of the yarn ends in contact and forming a lapped joint.

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