United States Patent [19]

Harmon

[11] **3,712,040**

[45] **Jan. 23, 1973**

[54] YARN JOINING ASSEMBLY FOR AUTOMATIC YARN PIECING APPARATUS

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[73] Assignee: **Maremont Corporation**, Chicago, Ill.

[22] Filed: **March 5, 1971**

[21] Appl. No.: **121,351**

[52] **U.S. Cl.** ..... **57/34 R**

[51] **Int. Cl.** **D01h 15/00**

[58] **Field of Search** ..... 57/34 R, 52, 53

[56] **References Cited**

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3,466,862	9/1969	Artamonova et al.	57/34 R
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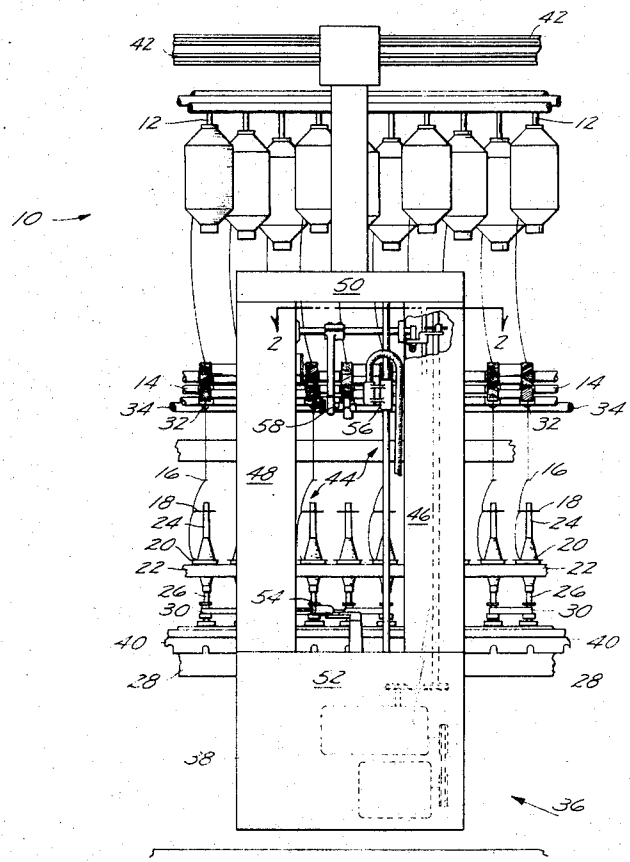
[57] **ABSTRACT**

An improved assembly of the type used in an automatic yarn piecing apparatus for joining yarn issuing from a textile machine's drafting rolls and yarn extending from a bobbin of the machine. The assembly includes a yarn joining roller biased forwardly by a leaf spring element, and means for clamping, cutting and controlling the tension in the yarn, the aforesaid components being so interconnected and arranged as to provide a simplified and readily adjustable assembly affording consistently reliable operation. In an alternative embodiment the assembly and a supporting pivot arm therefor are cammed for alignment purposes parallel to the machine's drafting rolls during their movement toward and away from such rolls.

20 Claims, 12 Drawing Figures



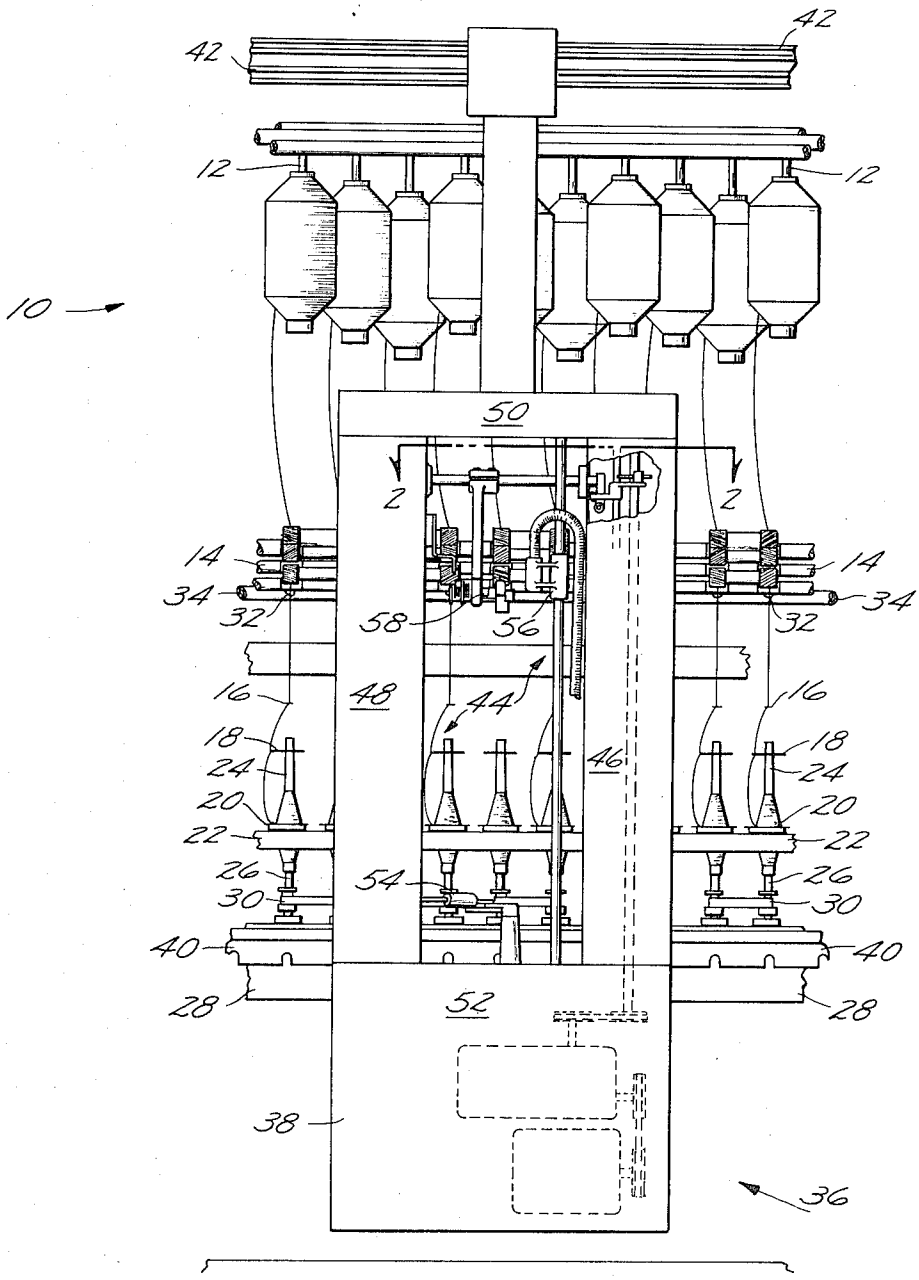


Fig. 1

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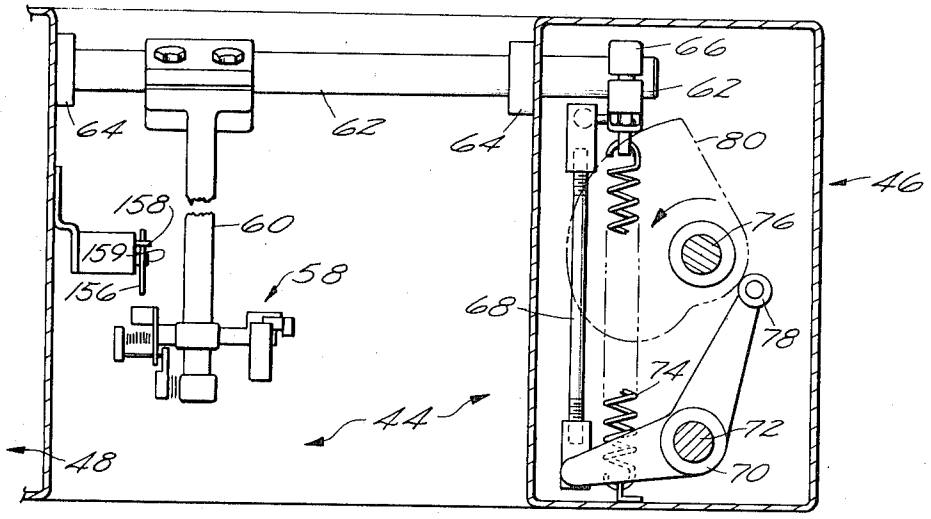

Fig. 2

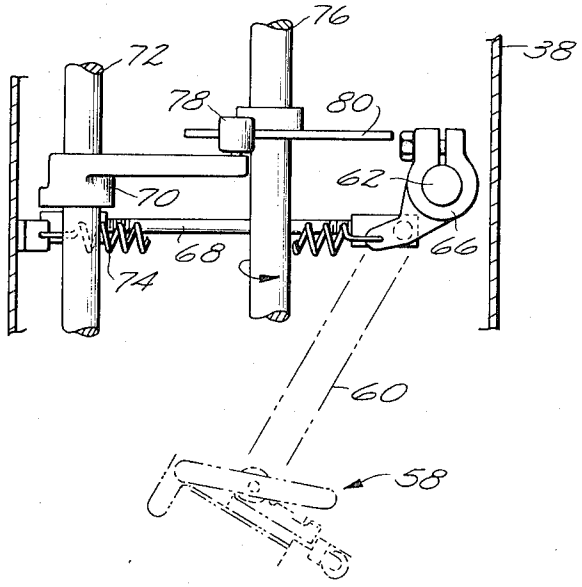

Fig. 3

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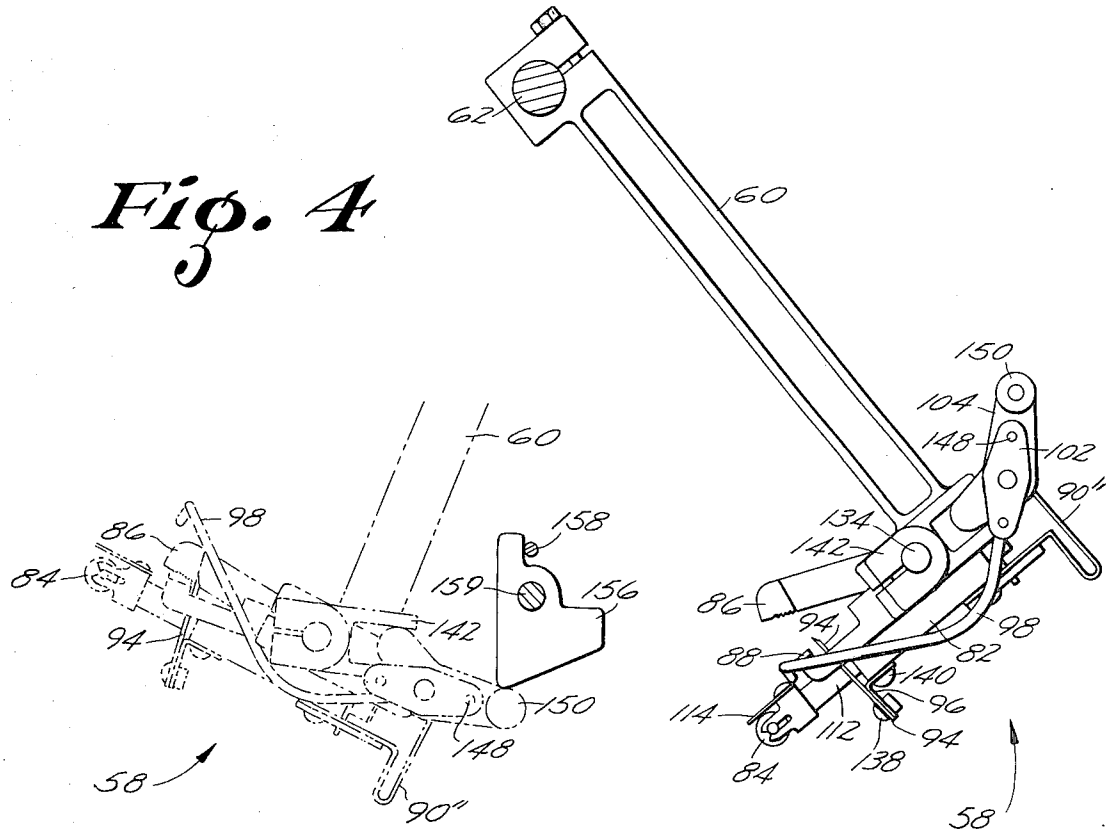
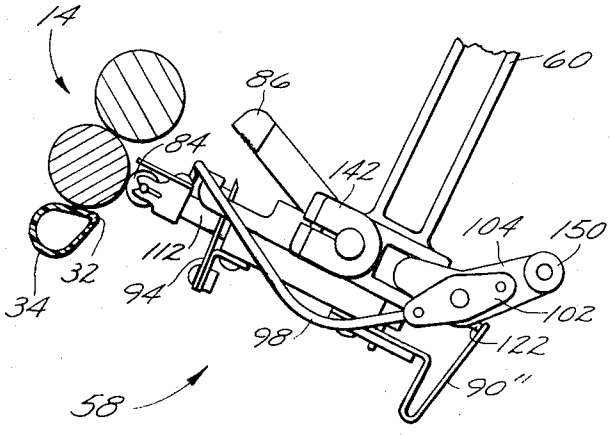
Fig. 4





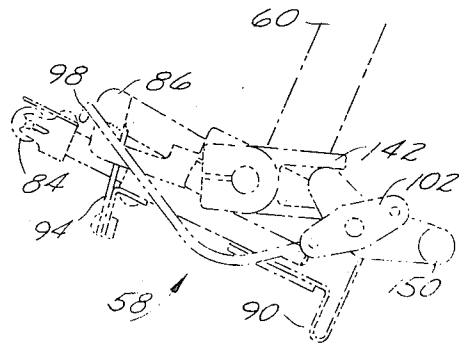


Fig. 5

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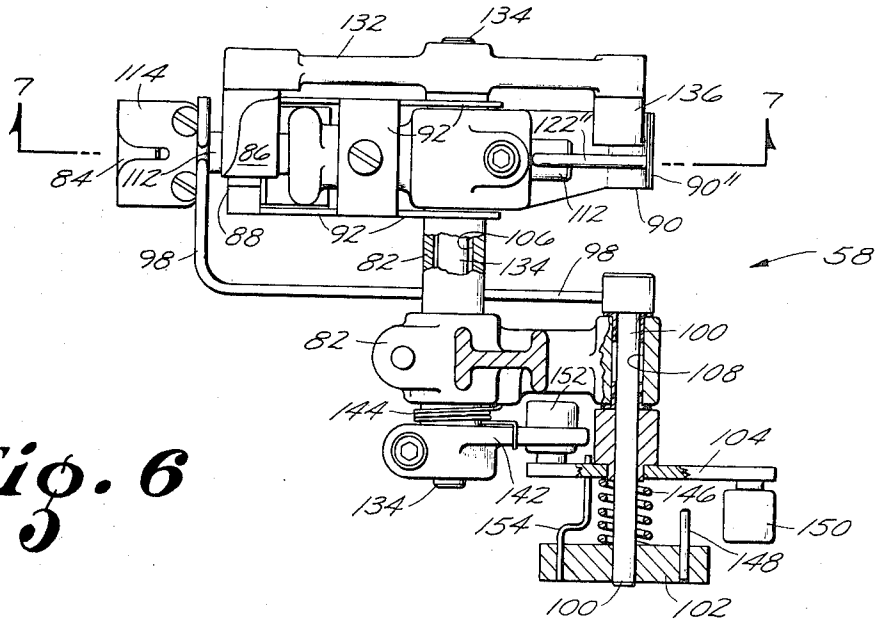

Fig. 6

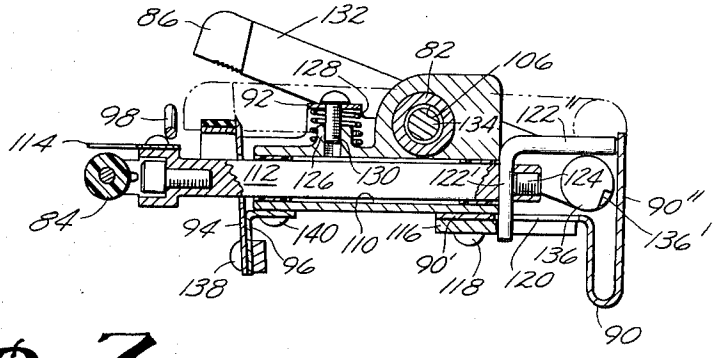

Fig. 7

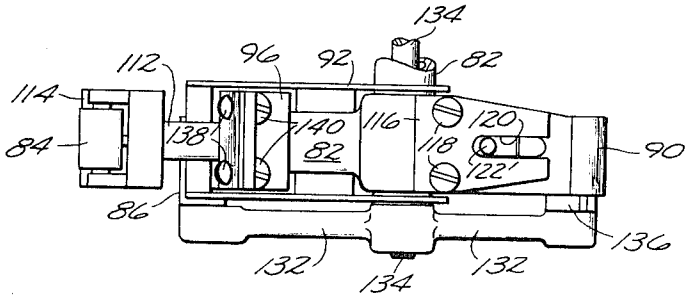

Fig. 8

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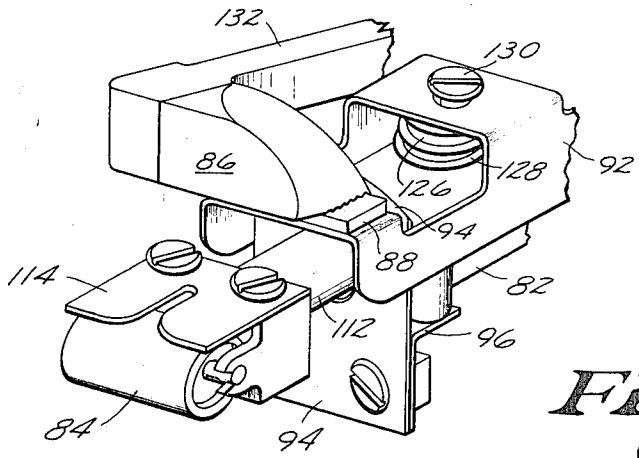

Fig. 9

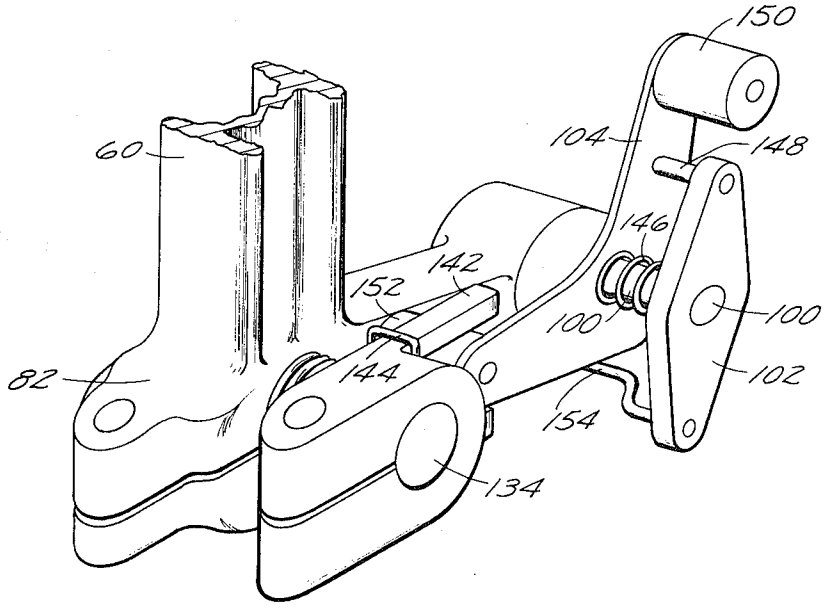

Fig. 10

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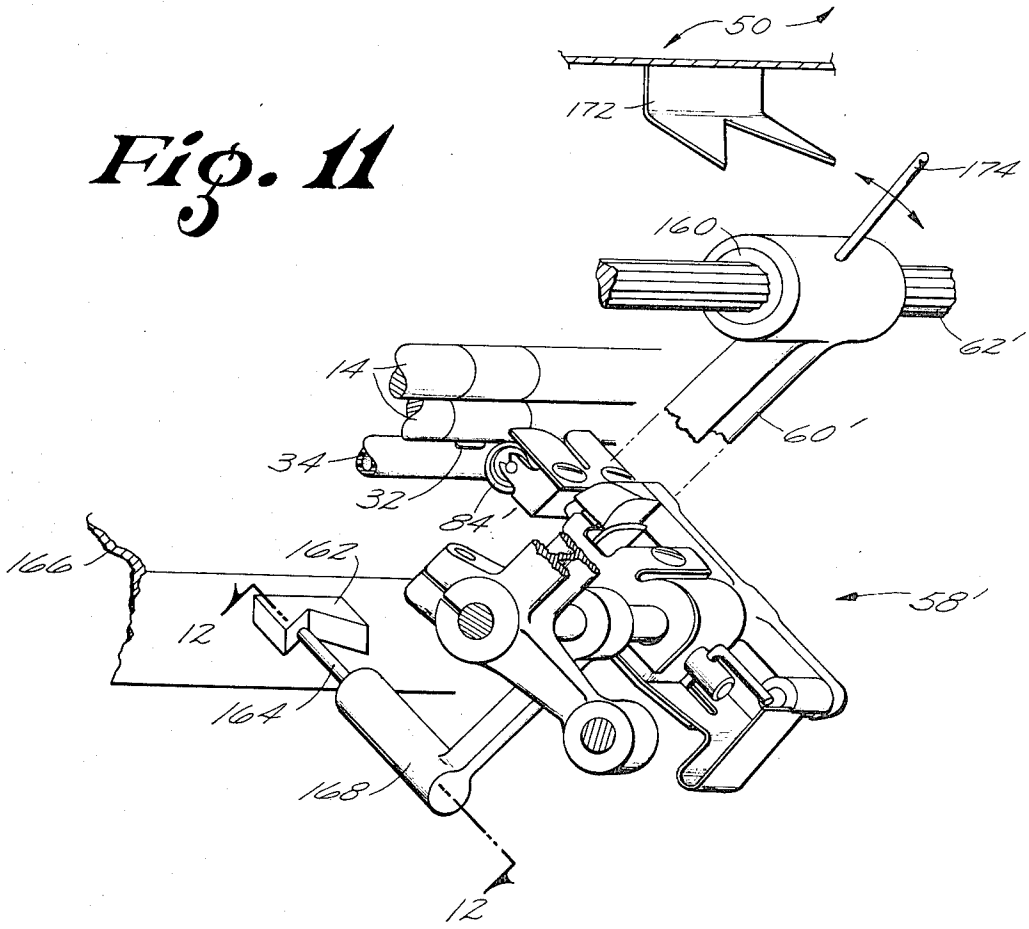
Fig. 11



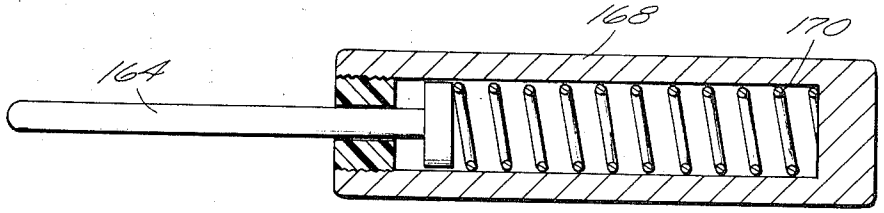


Fig. 12

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YARN JOINING ASSEMBLY FOR AUTOMATIC YARN PIECING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to automatic yarn piecing apparatuses for textile spinning frames and like machines, and more particularly relates to an improved yarn joining assembly for such an apparatus.

One heretofore known type of yarn joining assembly is disclosed in U. S. Pat. application Ser. No. 812,054, now U.S. Pat. 3,619,999 filed 1 Apr. 1969 by Roberto Escursell-Prat. Such assembly includes a frame movable toward the drafting rolls of the textile machine being serviced by the piecing apparatus along a path of travel intersecting yarn extended upwardly from a bobbin of the machine. The frame supports a forwardly-biased yarn joining roller, a tension control arm, and clamping and cutting means which respectively entrain, clamp and cut the bobbin yarn as the frame moves toward the drafting rolls. Continued forward movement of the frame brings the joining roller and the bobbin yarn entrained thereabout into abutment with one of the machine's drafting rolls and the drafted yarn issuing therefrom. Such abutment and the ensuring rearward movement of the roller relative to the frame effects disengagement of the clamping means and allows the bobbin yarn to join with the yarn issuing from the drafting rolls, effecting repair of the yarn discontinuity.

An assembly of the aforesaid type has many benefits, but its successful operation under all operating conditions requires precise interaction between and adjustment of its various components. The positions at which the clamping and cutting means engage the bobbin yarn are of considerable importance, and may require adjustment for differing operating conditions. The relative movements of the clamping means, the yarn joining roller and the tension control means, assuming the latter is also provided, must be extremely well coordinated and at the same time in no way obstructive of one another. By way of example in the latter regard, if the disengagement of the clamping means significantly impedes the yielding rearward movement of the yarn joining roller, upon its abutment with the machine's drafting roll, the yarn joining operation will likely fail.

Successful use of the assembly also requires that the same be properly aligned during each piecing operation with the yarn issuing from the machine's drafting rolls. Otherwise the joining roller of the assembly will not engage such yarn during movement of the assembly toward the drafting rolls. In that event the yarn discontinuity of course cannot and will not be eliminated.

SUMMARY OF THE INVENTION

The present invention provides an improved yarn joining assembly, of the described type associated with an automatic yarn piecing apparatus, having its components so constructed and arranged as to permit the adjustments and provide the coordinated movements necessary for uniformly successful operation under virtually all operating conditions. A spring element biasing the joining roller of the assembly forwardly also releasably maintains the clamping means of the assembly in an engaged condition. The arrangement permits rearward movement of the piecing roller under desired force conditions, without binding or the like, while insuring disengagement of the clamping means in coordinated response to such movement. A bifurcate spring-biased bracket mounts one of a pair of clamping jaws of the assembly for convenient and precise adjustment of its position relative to the other of such jaws. The cutting means of the assembly comprises a substantially rigid blade element mounted by a resilient spring clip for precise positional adjustment relative to the aforesaid clamping jaws and particularly a cooperating terminal edge of one of such jaws. A pair of cam levers and associated follower elements are mounted upon a control shaft of the assembly for sequential engagement with and actuation by a single cam element during movement of the assembly toward the drafting rolls. The cam levers effect coordinated operation of the clamping means and an arm carried by the control shaft and forming part of the tension control means of the assembly. In the event of failure of the piecing operation, pin means extending from one and toward the other of the cam levers insures restoration of the tension control arm to a position of readiness for another piecing attempt.

In an alternative embodiment of the invention, the assembly and the means supporting the same upon the carriage of the piecing apparatus are movable not only toward and away from the drafting rolls of the textile machine, but also parallel to such rolls, if and as might be required for alignment purposes. Suitable cam means are provided for the purpose of effecting the latter movement of the assembly and its support means.

DESCRIPTION OF THE DRAWINGS

The foregoing and other features of the invention will be apparent from the following description of illustrative embodiments thereof, which should be read in conjunction with the accompanying drawings, in which:

FIG. 1 is a rear elevational view of an automatic yarn piecing apparatus, partially broken away to reveal interior details, mounting a yarn joining assembly in accordance with the invention and servicing a fragmentarily-shown textile spinning machine;

FIG. 2 is an enlarged fragmentary horizontal section taken substantially along line 2—2 through the carriage of the piecing apparatus of FIG. 1 and showing in top plan the means mounting the assembly for movement toward and away from the textile machine;

FIG. 3 is a fragmentary side elevational view of the components shown in FIG. 2;

FIG. 4 is an enlarged side elevational view showing the yarn joining assembly and its support arm in solid lines in a rearward retracted position, and showing the same components in phantom lines during movement thereof toward the spinning machine and past a cam element mounted upon the carriage of the piecing apparatus;

FIG. 5 is a side elevational view similar to FIG. 4 but showing the assembly in solid lines in a forwardly extended position adjacent the drafting rolls of the spinning machine, and showing the assembly in phantom lines in a preceding position intermediate its solid-line position of FIG. 5 and its phantom-line position of FIG. 4;

FIG. 6 is an enlarged top plan view of the yarn joining assembly, partially broken away to reveal details of construction;

FIG. 7 is a vertical section taken substantially along line 7—7 through the assembly of FIG. 6, showing the clamping means of the assembly in disengaged condition in solid lines and in engaged condition in phantom lines;

FIG. 8 is a fragmentary bottom plan view of a portion of the assembly of FIG. 6;

FIGS. 9 and 10 are enlarged fragmentary front perspective views of portions of the assembly of FIG. 6, but with the clamping means being shown in engaged condition in FIG. 9;

FIG. 11 is a rear perspective view showing, in accordance with an alternative embodiment of the invention, cam means for moving a fragmentarily-shown yarn joining assembly and its support arm parallel to the drafting rolls of a textile machine during their movement toward and away from such rolls; and

FIG. 12 is an enlarged fragmentary sectional view taken substantially along line 12—12 of FIG. 11 through one of the cam elements shown in FIG. 11.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The spinning machine 10 fragmentarily shown in FIG. 1 is of a conventional type having a plurality of deliveries at each of which yarn (roving) normally passes downwardly from a creel 12 through sets of drafting rolls 14, a guide member 16, a balloon control ring 18, and a traveler (not shown) movable about a spinning ring 20 carried by a vertically movable ring rail 22. The yarn then normally passes to and is wound upon a bobbin 24 projecting axially through ring 20 and removably seated upon an upright spindle 26 supported by a spindle rail 28 and rotated at its lower end portion by a drive tape 30. Upon breakage of the yarn at a delivery of machine 10, that issuing at such delivery from drafting rolls 14 passes downwardly over the bottom front one of such rolls and into the suction orifice 32 of a waste collection duct 34 provided therebeneath, all in accordance with conventional practice.

The yarn piecing apparatus 36 shown in its entirety in FIG. 1 comprises a mobile carriage 38 connected in any suitable manner, as by a track 40 and overhead rail 42, to spinning machine 10 for movement longitudinally of and closely adjacent at least one side of the machine to any one of its deliveries requiring servicing by reason of a broken-yarn condition thereat. Carriage 38 includes an open center section 44 and four enclosed housing-like sections 46, 48, 50, 52, the sections 46, 48 being disposed on opposite sides of open center section 44 and the sections 50, 52 being above and below the same. Repair of the yarn discontinuity at a delivery of machine 10 requiring servicing is effected by various servicing mechanisms which are mounted within open center section 44 of carriage 38 for movement forwardly therefrom toward machine 10. These include a mechanism 54 for controlling the rotation of the spindle 26 and bobbin 24 at the machine delivery undergoing servicing; a mechanism or assembly 56 for withdrawing and traveler threading a length of yarn from the delivery's bobbin 24, and for thereafter extending such bobbin yarn upwardly to an elevation adjacent that of the spinning machine's drafting rolls 14; and an assembly 58 operable adjacent the elevation of the machine's drafting rolls 14 for joining together the yarn issuing from such rolls and the yarn extended upwardly from bobbin 24. The present invention is directed to yarn joining assembly 58 and its immediately associated components. The remaining components of piecing apparatus 36 may be of any desired construction, and no restriction to those shown and described for purposes of illustration is intended or should be made.

Referring now also to FIGS. 2–4, the means supporting assembly 58 for movement forwardly toward and rearwardly away from drafting rolls 14 of machine 10 includes an elongate support arm 60 and a carriage shaft 62. Shaft 62 extends longitudinally through the upper portion of open center section 44 of carriage 38, parallel to drafting rolls 14 of machine 10, and is mounted for rotation about its axis by suitable bearings 64 upon carriage side sections 46, 48. Arm 60 is clamped or otherwise rigidly secured adjacent one end to shaft 62, and supports assembly 58 at its outer end for pivotal movement therewith about the axis of shaft 62 in response to the shaft's rotation. An end portion of shaft 62 projects into carriage section 46, wherein means are provided for imparting rotation to the shaft. Such means includes a plurality of levers 66, 68, 70, a stud shaft 72, and resilient biasing means in the form of a coil spring 74. Stud shaft 72 extends vertically within carriage section 46 in spaced parallel relationship to a cam shaft 76 projecting upwardly through such carriage section and constituting, in accordance with known practices, a standard part of the overall control system of piecing apparatus 36. Lever 70, which is of the bell-crank type, is carried by and rotatable about the axis of shaft 72. One arm of lever 70 carries a follower 78 engageable with the peripheral edge of a cam 80 carried by and rotatable with cam shaft 76. Lever 68 pivotally interconnects the other arm of bell-crank lever 70 and the remaining lever 66, which is secured to shaft 62. Coil spring 74 is connected at one end to a wall of carriage section 46 and at its opposite end is also connected to lever 66, so as to bias shaft 62 and bell-crank lever 70 in clockwise and counterclockwise directions, respectively. The counterclockwise bias upon lever 70 urges its follower 78 into peripheral engagement with cam 80. When rotation of cam shaft 76 brings a high-dwell segment of cam 80 into engagement with follower 78, it will be apparent that shaft 62 will be rotated by the aforesaid linkage in a counterclockwise direction causing arm 60 to swing forwardly toward machine 10. When a low-dwell segment of cam 80 passes into engagement with follower 78, spring 74 rotates shaft 62 in a clockwise direction, causing arm 60 to swing rearwardly away from machine 10. During the movement of arm 60 toward and away from machine 10, the yarn joining assembly 58 carried by and movable with it passes closely adjacent a pivotal cam element 156 (FIGS. 2 and 4) and associated stop element 158 mounted within open center section 44 of carriage 38 by a support 159 extending from carriage side section 48.

Referring now particularly to FIGS. 4–10, yarn joining assembly 58 generally comprises a frame 82 connected to or formed integrally with the free end of support arm 60 and directly or indirectly supporting, for movement therewith toward and away from drafting

rolls 14 of machine 10, a freely rotatable yarn joining roller 84; engageable and disengageable yarn clamping means including respective upper and lower clamping jaws 86, 88; means including a leaf spring element 90 for biasing roller 84 in a forward direction relative to frame 82 and for at desired times releasably maintaining the aforesaid clamping means in engaged condition; means including a vifurcate bracket 92 mounting lower clamping jaw 88 for resilient movement and for convenient positional adjustment; adjustable cutting means including a substantially rigid blade element 94 and resilient mounting clip 96 therefor; tension control means including a generally L-shaped tension control arm 98; and means including a control shaft 100 and cam levers 102, 104 for at desired times imparting coordinated movement to certain of the aforesaid components.

As is best shown in FIGS. 6 and 7, frame 82 is provided with three bores 106, 108 and 110 therein, the first two of which extend generally parallel to carriage shaft 62 and therefore drafting rolls 14 of machine 10, and the third of which extends through frame 82 in a forward-rearward direction. An elongate rod 112 is slidably mounted within the third bore 110 and projects axially therefrom at its opposite ends. Yarn joining roller 84 is supported in any suitable manner at the forward end of rod 112 for forward-rearward movement therewith and for free rotation of roller 84 about its horizontally-extending central axis. In accordance with known practice, a yarn guide plate 114 is also mounted at the forward end of rod 112 in spaced overlying relationship to roller 84.

Adjacent the rearward end of rod 112, spring 90 is adjustably secured to frame 82 by means of a retainer plate 116 and screws 118 (FIGS. 7 and 8). Plate 116 and a generally horizontally-extending section 90' of spring 90 underly the rear end of rod 112 and have vertically aligned guide slots 120 extending therein parallel to the rod's axis. One leg 122' of a generally L-shaped pin 122 projects vertically through and is adjustably secured to the rear end portion of rod 112 as by a set screw 124. The lower end portion of pin leg 122' is received by slots 120, which thus assist in stabilizing the forward-rearward movement of rod 112 and simultaneously prevent rotation of the rod about its axis. The second leg 122'' of pin 122 extends above and rearwardly from rod 112, parallel to the rod's projected axis, toward and into abutment with an upstanding section 90'' of leaf spring 90. Though its aforesaid engagement with pin leg 122'', spring 90 biases rod 112 and yarn joining roller 84 forwardly to the position thereof shown in FIG. 7, wherein pin leg 122' abuts frame 82, while yieldingly permitting controlled rearward movement of rod 112 and roller 84 relative to frame 82.

Turning now to the yarn clamping means of assembly 56, bifurcate bracket 92 extends forwardly and rearwardly along the upper surface of frame 82, in parallel overlying relationship to shaft 112, and carries lower clamping jaw 88 at its forward end. The rear end of bracket 92 is connected to a tubular portion of frame 82 for pivotal movement of the bracket about a substantially horizontal axis. An intermediate portion of bracket 92 overlies an upstanding boss 126 provided upon frame 82. Boss 126 has a threaded vertical bore therein, and is encircled by a compression spring 128. A screw 130 extends loosely through an opening provided within that portion of bracket 92 overlying boss 126, and is received within the threaded bore of such boss. Spring 128 urges bracket 92 upwardly into engagement with the enlarged head of screw 130, which comprises stop means determinative of the position normally occupied by bracket 92 and the lower clamping jaw 88 carried by it. By rotative adjustment of screw 130, which is readily accessible for such purpose, the position of lower clamping jaw 88 can therefore be varied as desired.

Under clamping jaw 86 is mounted for movement downwardly toward and upwardly away from lower clamping jaw 88 by an arm 132 secured to one end of a rocker shaft 134 projecting through bore 106 of frame 82. A yoke element 142 secured to the opposite end of rocker shaft 134 is engaged by a biasing spring 144, which biases shaft 134 in a clockwise direction tending to pivot arm 132 to its solid-line position of FIG. 7. Clamping jaw 86 extends laterally from the forward end of arm 132 into overlying relationship with lower jaw 88, and has a serrated but otherwise continuous lower surface adapted to engage the lower jaw. The upper surface of jaw 86 slopes downwardly away from arm 132, so as to deflect yarn engaging the same toward lower jaw 88. At the rear end of arm 132 a generally cylindrical detent element 136 projects laterally therefrom closely adjacent the forward surface of upright section 90'' of leaf spring 90. A notch 136' is provided within the rear surface portion of detent element 136. Counterclockwise pivotal movement of arm 132 from its solid-line position of FIG. 7, which movement is achieved by rotation of rocker shaft 134 in a manner discussed hereinafter, simultaneously moves clamping jaw 86 downwardly and detent element 136 upwardly. As detent element 136 moves upwardly, it deflects upright spring section 90'' rearwardly to a slight extent. As upper clamping jaw 86 moves into clamping engagement with lower jaw 88, a notch 136' of detent element 136 reaches the elevation of the free upper edge of spring section 90'', which immediately returns forwardly into underlying engagement with the notch and thereby releasably secures clamping jaw 86 in engagement condition with jaw 88. The clamping means remains in engaged condition, as shown in phantom lines in FIG. 7, until yarn joining roller 86 and rod 112 are moved rearwardly relative to frame 82. When such movement occurs, pin leg 122'' deflects spring section 90'' rearwardly out of engagement with notch 136' of detent element 136, permitting disengagement of the clamping means. The rearward movement of roller 84 and rod 112 relative to frame 88, and against the biasing force of spring 90, is not impeded by detent element 136, which is significant since impedance of such rearward movement could defeat the yarn joining operation performed by assembly 58.

Blade element 94 extends upwardly through bifuracate bracket 92 rearwardly of lower clamping jaw 88, the blade having a central opening therein permitting passage of rod 122 therethrough (see FIG. 9). As upper clamping jaw 86 moves downwardly toward and into clamping engagement with lower jaw 88, its terminal rear edge must pass closely adjacent the sharpened upper edge of blade 94 to sever any yarn extending

over the blade. Some yielding movement of the blade in response to its engagement by upper clamping jaw **86** should also be possible. In the present invention, the precise positioning and yielding movement of blade **94** are achieved by forming the blade itself of relatively rigid and inflexible material, while mounting the same in a readily adjustable manner upon frame **82** by means of resilient mounting clip **96**. Screws **138**, **140** respectively secure blade **94** to clip **96** and clip **96** to frame **82**. By loosening screws **138**, the position of blade **94** can be vertically adjusted, while loosening of screws **140** permits forward-rearward adjustment of the blade in unison with clip **96**.

Control shaft **100** of assembly **56** extends through bore **108** (FIG. 6) of frame **82**, and is mounted for rotation about its axis by suitable bearings provided within such bore. Tension control arm **98** is connected to one end of shaft **100** and extends first forwardly therefrom and then laterally into overlying relationship with the forward end portion of rod **112** and the yarn guide plate **114** supported thereby. Arm **98** is movable between raised and lowered positions respectively indicated in phantom lines and solid lines in FIG. **4**.

As is best shown in FIGS. **6** and **10**, cam levers **102**, **104** are mounted in spaced adjacent relationship to each other upon the opposite end portion of control shaft **100** from tension arm **98**. Lever **102** is keyed or otherwise rigidly affixed to shaft **100**, while lever **104** is freely rotatable relative to the shaft about its axis. A coil compression spring **146** encircles shaft **100** between levers **102**, **104**, maintaining the levers in spaced relationship and by its engagement with lever **102** exerting a desired drag force tending to resist rotation of shaft **100**. Cam follower elements **148**, **150** project respectively from levers **102**, **104** in parallel and overlapping relationship to each other. A stud **152** also carried by lever **104** is received by the yoke **142** upon rocker shaft **134**. A pin element **154** carried by lever **102** extends therefrom in the path of rotative movement of lever **104**, and upon engagement by lever **104** will cause lever **102** to rotate in unison therewith about the axis of control shaft **100**.

Upon forward movement of assembly **56** toward drafting rolls **14** of machine **10**, followers **148**, **150** both engage cam element **156** (FIGS. **2** and **4**) which is then maintained stationary by its stop element **158**, causing rotation of the respective cam levers **102**, **104** in a clockwise direction. Due to the interconnecting control shaft **100**, the rotation of lever **102** moves tension control arm **98** from its lowered and to its elevated position (FIG. **4**, phantom lines). The rotation of lever **104** is transmitted by stud **152**, yoke **142** and rocker shaft **134** to arm **132**, which moves upper clamping jaw **86** downwardly into clamping engagement with lower jaw **88**.

Mode of Operation

Prior to the commencement of a yarn joining operation, assembly **56** and its support arm **60** are maintained stationary in their rearward retracted position, shown in solid lines in FIG. **4**, by spring **74** (FIGS. **2** and **3**) and the presence of a low-dwell segment of cam **80** adjacent cam follower **78**. Clamping jaw **86** is biased to its upward disengaged position by spring **144**. Yarn joining roller **84** is biased forwardly by leaf spring **90**. Tension control arm **98** is in its lowered position.

The yarn joining operation commences after assembly **56** of the piecing apparatus has extended a length of yarn upwardly from the bobbin **26** of the spinning-machine delivery being serviced, which bobbin is then maintained stationary by spindle control mechanism **54**. The extended length of yarn (not shown) intersects the path of forward movement of yarn joining assembly **58**, and particularly roller **84** thereof, which movement is produced by rotation of cam shaft **76** bringing a high-dwell segment of cam **80** into engagement with follower **78**, causing rotation of carriage shaft **62** in a direction moving arm **60** and assembly **58** forwardly toward drafting rolls **14** of machine **10**.

The initial forward movement of assembly **58** causes the upwardly extended length of bobbin yarn to be entrained over yarn joining roller **84**, lower clamping jaw **88**, and that section of tension control arm **98** disposed therebetween, the yarn being deflected to such position by guide plate **114** and also, if coming into engagement therewith, by the sloping upper surface of upper clamping jaw **86**.

The continued forward movement of assembly **58** then brings followers **148**, **150** of cam levers **102**, **104** into engagement with cam **156**, which is maintained stationary by stop element **158**. As is shown in phantom lines in FIG. **4**, the ensuing rotation of cam lever **102** raises tension control arm **98** to its elevated position, while the rotation of cam lever **104** causes upper clamping jaw **86** to be moved downwardly past blade element **94** and into clamping engagement with lower clamping jaw **88** and the yarn extending thereover. This causes the yarn rearwardly of the engaged clamping jaws to be cut, and that forwardly of the jaws to be extended upwardly by arm **98**. The clamping jaws are maintained in engaged condition by detent **136**, the notch **136'** of which automatically receives the upper edge of spring element **90** as upper clamping jaw **86** moves into clamping engagement with lower jaw **88**.

As assembly **58** passes beyond cam **156** (FIG. **4**) and more closely approaches drafting rolls **14** of machine **10** (FIG. **5**), twist is accumulated in the clamped yarn extending from the assembly to bobbin **26**, which bobbin is then allowed by spindle control mechanism **54** to commence its winding rotation. The resulting increase in tension of the yarn moves arm **98** downwardly again to its lowered position, against the cushioning drag force exerted thereon by spring **146** (FIG. **10**) through control shaft **100**. The aforesaid action is indicated by phantom lines in FIG. **5**, wherein for convenience of illustration the spatial separation between the phantom-line position of assembly **58** and its preceding and succeeding positions (respectively shown in phantom lines in FIG. **4** and solid lines in FIG. **5**) is greatly exaggerated.

As is shown in solid lines in FIG. **5**, the continued forward movement of assembly **58** finally brings yarn joining roller **84** and the bobbin yarn entrained thereover into abutment with the lower front one of the drafting rolls **14** and the yarn passing over that roll into suction orifice **32** (FIG. **1**) of waste collection duct **34**. Such abutment moves roller **84** rearwardly relative to frame **82**, causing deflection of the upper edge of spring element **90** out of engagement with detent **136** (FIG. **7**), whereupon clamping jaw **86** is immediately biased upwardly by spring **144** (FIGS. **6** and **10**). The unclamped

bobbin yarn then passes from assembly **58** and twistingly interconnects with that issuing from drafting rolls **14** to complete the yarn joining operation.

Continued rotation of cam shaft **76** (FIGS. **2** and **3**) brings the low-dwell segment of cam **80** back into engagement with follower **78**, whereupon spring **74** rotates carriage shaft **62** in a direction returning arm **60** and assembly **58** back to their solid line position of FIG. **4**. During such return movement, spring element **90** again advances yarn joining roller **84** forwardly. Cam **156** pivots away from stop **158** to allow free passage of assembly **58** thereby.

When assembly **58** again reaches its rearward position shown in solid lines in FIG. **4**, all of its components are in a condition of readiness for another cycle of operation. Cam lever **104** was restored to its original rotative position by yoke **142** and stud **152** upon disengagement of the clamping means and rotation of rocker shaft **134** by spring **144**. Cam lever **102** should have been restored to its original rotative position by downward movement of tension control arm **98**. If, however, the latter result should not have transpired, cam lever **104** would during its aforesaid return movement engage pin **154** of cam lever **102** and thus then cause lever **102** and tension control arm **98** to be restored to their original positions.

Alternative Embodiment

If assembly **58** should not be properly aligned with yarn issuing from drafting rolls **14** of machine **10**, roller **84** may not engage that yarn when it abuts the lower front one of the drafting rolls. The joining operation will then necessarily fail. FIGS. **11** and **12** disclose an alternative embodiment of the invention adapted to obviate the possibility of such a result.

The carriage shaft **62'**, support arm **60'** and yarn joining assembly **58'** shown in FIG. **11** may be of similar construction to the corresponding components **62**, **60** and **58** of the previously described embodiment of the invention. However, shaft **62'** is longitudinally splined and the upper end of arm **60'** is connected thereto by a bearing assembly **160** mating with such splines in a manner permitting arm **60'** to move freely longitudinally of shaft **62'**, and therefore parallel to drafting rolls **14**, while still constraining arm **60'** to move toward and away from the drafting rolls in response to rotation of shaft **62'** about its axis. First cam means including cooperating cam elements **162**, **164** are provided for shifting arm **60'** longitudinally of shaft **62'** during movement of assembly **58'** toward drafting rolls **14**. Cam element **162** comprises a V-shaped block secured to any convenient part of machine **10** adjacent the path of forward movement of assembly **58'**, as upon the roller beam **166** supporting drafting rolls **14**. Cam element **164** is mounted upon any convenient part of the lower end of arm **60'** or, as shown, the frame of assembly **58'**, and comprises a retractable finger element slidably mounted within and biased forwardly from a tubular housing **168** by a coil spring **170** disposed within such housing. The block **162** is so longitudinally positioned upon machine **10** that if no misalignment exists as assembly **58'** moves toward drafting rolls **14**, finger **164** will engage block **162** precisely at the point where the latter's sloping surfaces converge. Such engagement results in rearward retraction of finger **164**, against the biasing force of coil spring **170** and during the continued forward movement of assembly **58'** toward drafting rolls **14**, but does not in such case shift arm **60'** axially of shaft **62'**. In the event of a misalignment, however, finger **164** engages one or the other of the sloping surfaces of block **162** during forward movement of assembly **58'**. Such engagement then not only causes retraction of finger **164**, but also causes the finger to be cammed toward the center of block **162**, thereby shifting arm **60'** axially of shaft **62'** in the direction and to the extend required to properly align assembly **58'** with the yarn issuing from drafting rolls **14**. When assembly **58'** is of the same type as assembly **58** of the first embodiment, it will of course be properly aligned when its yarn joining roller **84'** engages that portion of the bottom front drafting roll directly over suction orifice **32** of duct **34**.

Additional return cam including cooperating cam elements **172**, **174** are preferably provided for returning arm **60'** to its original inoperative position longitudinally of shaft **62'** during movement of arm **60'** and assembly **58'** away from drafting rolls **14** after completion of the yarn joining operation. Element **172** comprises a V-shaped plate mounted upon the undersurface of upper section **50** of carriage **38** adjacent the upper end of arm **60'**. Element **174** comprises a pin affixed to the upper end of arm **60'** and engageable with element **172** upon return pivotal movement of arm **60'** and assembly **58'** away from drafting rolls **14**. Engagement of element **174** with element **172** shifts arm **60'** axially of shaft **62'** if and as required to position element **174** centrally of element **172**. When element **174** is disposed centrally of element **172**, the position of arm **60'** longitudinally of shaft **62'** is that inoperative position normally occupied by it prior to the commencement of a yarn joining operation.

A separate cam element **162**, or one equivalent to it, would of course be provided upon machine **10** for each of its deliveries adapted to be serviced by the piecing apparatus.

While specific embodiments of the invention have been shown and described, it is to be understood that this was for purposes of illustration only, and not for purposes of limitation, since various modifications within the scope of the following claims will be apparent to those skilled in the art.

That which is claimed is:

1. In an automatic yarn piecing apparatus servicing a textile spinning frame or like machine having drafting means at which yarn issued therefrom is adapted to be joined by said apparatus with yarn extending to a bobbin of said machine, an improved yarn joining assembly comprising:

a frame movable forwardly toward and rearwardly away from said drafting means;

engageable and disengageable yarn clamping means carried by said frame;

a yarn joining roller element carried by said frame for forward movement therewith into abutment with said drafting means and for limited forward-rearward movement relative to said frame;

and spring means upon said frame for biasing said roller element forwardly relative to said frame and for at times contacting and releasably securing said clamping means in engaged condition, said spring

means being deflectable by rearward movement of said roller relative to said frame to a position permitting disengagement of said clamping means.

2. Apparatus as in claim 1, including detent means operatively connected to said clamping means, and wherein said spring means comprises a leaf spring element having an edge portion receivable by said detent means for releasably securing said clamping means in engaged condition.

3. Apparatus as in claim 1, wherein said clamping means includes a pair of clamping jaws, a bifurcate bracket pivotally connected adjacent one end to said frame and supporting one of said clamping jaws adjacent the other end thereof, adjustable stop means extending through a portion of said bracket intermediate its length and projecting into the path of pivotal movement thereof, and biasing means biasing said bracket into engagement with said stop means to resiliently maintain said one clamping jaw in a desired position of adjustment determined by said stop means.

4. Apparatus as in claim 1, including yarn cutting means cooperable with said clamping means, said cutting means including a substantially rigid blade element, and resilient means adjustably mounting said blade element upon said frame closely adjacent said clamping means.

5. Apparatus as in claim 4, wherein said clamping means includes a pair of clamping jaws, and said blade element is cooperable with a terminal edge of one of said clamping jaws.

6. Apparatus as in claim 1, including a control shaft mounted upon said frame for rotation about its axis, a yarn-tension control arm affixed to one end of said shaft for pivotal movement of said arm in unison with rotation of said shaft, a cam lever affixed to the other end of said shaft for at times imparting rotation to it, and a coil spring encircling an intermediate portion of said shaft and exerting a predetermined drag force tending to oppose rotation of said shaft.

7. Apparatus as in claim 6, wherein said clamping means includes a pair of clamping jaws, a rocker shaft carried by said frame for rotation about its axis, an arm secured to one end of said rocker shaft and mounting one of said clamping jaws for movement toward and away from the other of said jaws in response to rotation of said rocker shaft, a second cam lever carried by said control shaft for free rotation about its axis, and motion-transmitting linkage means interconnecting said second cam lever and the other end of said rocker shaft.

8. Apparatus as in claim 7, wherein said linkage means includes a yoke element secured to said other end of said rocker shaft, and a stud element carried by said second cam lever and received by said yoke element.

9. Apparatus as in claim 7, including spring means biasing said rocker shaft in a rotative direction tending to move said one clamping jaw away from said other jaw.

10. Apparatus as in claim 7, including cam follower elements carried respectively by each of said cam levers and extending therefrom toward the other of said levers in generally parallel and overlapping relationship to one another, and further including a pin element carried by one of said cam levers for at times engaging the other of said levers and thereby causing rotation of said levers in unison with one another about the axis of said control shaft.

11. In an automatic yarn piecing apparatus servicing a textile spinning frame or like machine having drafting means at which yarn issued therefrom is adapted to be joined by said apparatus with yarn extending to a bobbin of said machine, said apparatus including a mobile carriage disposed forwardly of said machine, an improved yarn joining assembly for said apparatus comprising:

a frame;

means on said carriage mounting said frame for movement relative to said carriage forwardly toward and rearwardly away from said drafting means;

engageable and disengageable yarn clamping means carried by said frame for movement with and relative to it;

yarn-tension control means carried by said frame for movement with and relative to it;

and means for moving said clamping means and said tension control means relative to said frame, including

a control shaft upon said frame,

a pair of cam levers mounted in adjacent relationship to one another upon said control shaft for rotation about its axis,

a pair of cam follower elements carried respectively by each of said cam levers and extending therefrom toward the other of said levers in generally parallel and overlapping relationship to each other,

and a cam element mounted upon said carriage for engagement with both of said cam follower elements during movement of said frame forwardly toward said drafting means.

12. Apparatus as in claim 11, wherein said yarn-tension control means includes a tension control arm, said arm and one of said cam levers being affixed to said shaft for movement in unison about the axis thereof, the other of said cam levers being carried by said shaft for rotation relative to it and said first cam lever, and a pin element carried by said one cam lever for engagement at times by said other cam lever to thereby rotate said one cam lever in unison with said other cam lever.

13. Apparatus as in claim 12, wherein said yarn clamping means includes a pair of clamping jaws, a rocker shaft carried by said frame for rotation about its axis, an arm secured to said rocker shaft and mounting one of said clamping jaws for movement toward and away from the other of said clamping jaws in response to rotation of said rocker shaft, a yoke element secured to said rocker shaft, and a stud element carried by said other cam lever and received by said yoke element for transmitting movement between said rocker shaft and said other cam lever.

14. Apparatus as in claim 11, wherein said means mounting said frame movement toward and away from said drafting means includes a shaft extending generally parallel to said drafting means and mounted upon said carriage for rotation about its axis, a support arm connected at one end to said carriage shaft and supporting said frame at its other end for pivotal movement with said support arm in response to rotation of said carriage

shaft, biasing means upon said carriage connected to said carriage shaft and biasing the same in a direction for moving said support arm and said frame away from said drafting means, and linkage means upon said carriage for rotating said carriage shaft in a direction moving said support arm and said frame toward said drafting rolls.

15. In an automatic yarn piecing apparatus servicing a textile spinning frame or like machine having yarn drafting rolls, said apparatus including a carriage disposed forwardly of said drafting rolls, and a yarn joining assembly adapted during a piecing operation to join together yarn issuing from said drafting rolls and yarn extending to a bobbin of said machine, the improvement comprising:

an elongate support member supporting said assembly adjacent one end thereof;

means mounting said support member adjacent its other end upon said carriage for multidirectional movement of said member and said assembly relative to said carriage forwardly toward, rearwardly away from, and generally parallel to said drafting rolls;

and cam means for moving said support member generally parallel to said drafting rolls, during movement of said support member toward said drafting rolls, as required to align said assembly with yarn issuing from said drafting rolls.

16. Apparatus as in claim **15**, wherein said cam means comprises cooperating cam elements, one of said elements being carried by said spinning machine adjacent said drafting rolls and the other of said elements being carried by said support member adjacent said other end thereof for engagement with said one element during movement of said support member toward said drafting rolls.

17. Apparatus as in claim **16**, including means mounting at least one of said elements for forward-rearward movement between extended and retracted positions, and biasing means normally urging said movable element to said extended position thereof and permitting its yielding movement to its said retracted position under the impetus of engagement between said elements.

18. Apparatus as in claim **15**, wherein said support member mounting means includes a shaft mounted upon said carriage for rotation about its axis and extending generally parallel to said drafting rolls, said support member being connected to said shaft for pivotal movement in response to rotation thereof and for linear movement longitudinally of said shaft.

19. Apparatus as in claim **15**, including return means for during movement of said support member away from said drafting rolls returning said support member generally parallel of said drafting rolls to a normal inoperative position.

20. In an automatic yarn piecing apparatus servicing a textile spinning frame or like machine having yarn drafting rolls, said apparatus including a carriage disposed forwardly of said drafting rolls, and a yarn joining assembly adapted during a piecing operation to join together yarn issuing from said drafting rolls and yarn extending to a bobbin of said machine, the improvement comprising:

a shaft mounted upon said carriage in generally parallel relationship to said drafting rolls for rotation about its axis;

an elongate support arm connected adjacent one end to said shaft for movement longitudinally thereof and for pivotal movement about the axis of said shaft in response to rotation thereof;

said yarn joining assembly being supported by said arm adjacent its other end for pivotal movement therewith toward and away from said drafting rolls;

first cam means for moving said support arm longitudinally of said shaft as required to align said assembly with yarn issuing from said drafting rolls, said cam means including cooperating elements respectively carried by said spinning machine and said support arm for engagement with one another during pivotal movement of said support arm and said assembly toward said drafting rolls;

and second cam means for moving said arm longitudinally of said shaft as required to return said assembly to a normal inoperative position, said second cam means including cooperating elements respectively carried by said carriage and said support arm for engagement with one another during pivotal movement of said support arm and said assembly away from said drafting rolls.

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