

July 31, 1951

M. L. ENGLER ET AL

2,562,540

MACHINE FOR SPLICING INNER TUBES

Original Filed Aug. 23, 1946

5 Sheets-Sheet 1

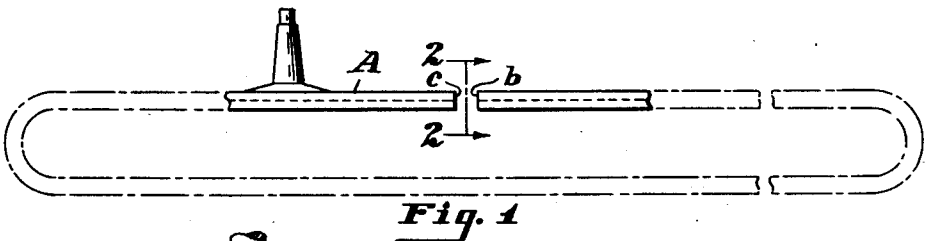


Fig. 1

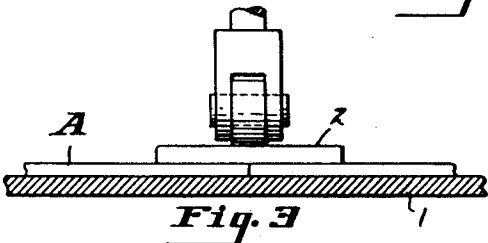


Fig. 3

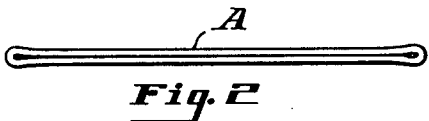


Fig. 2

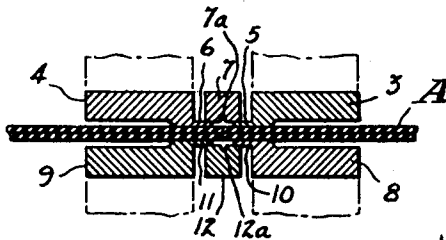


Fig. 5

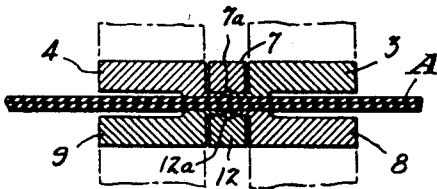


Fig. 6

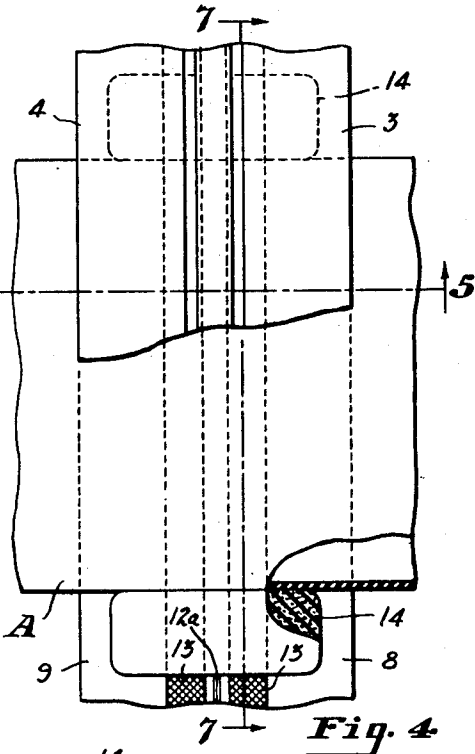


Fig. 4

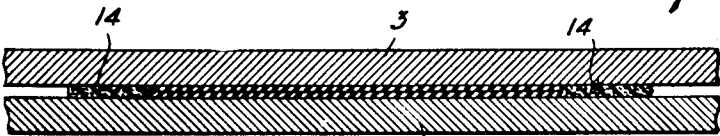


Fig. 7

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5 Sheets-Sheet 2

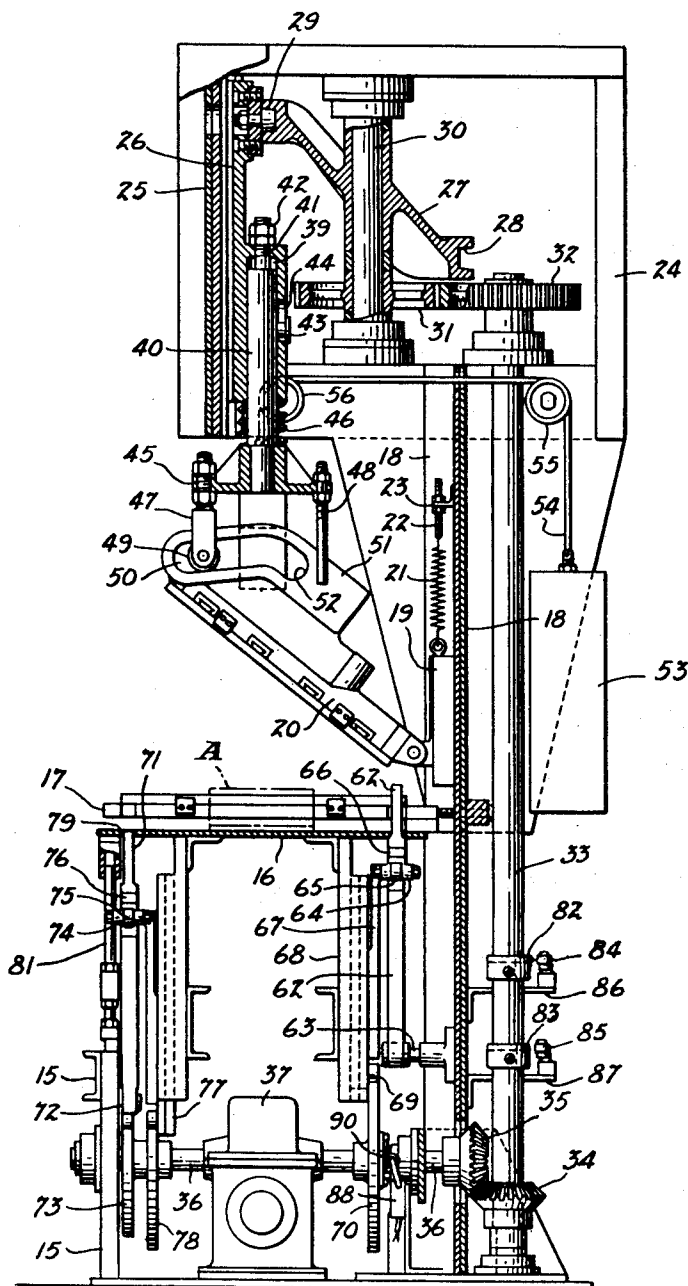


Fig. 8

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5 Sheets-Sheet 3

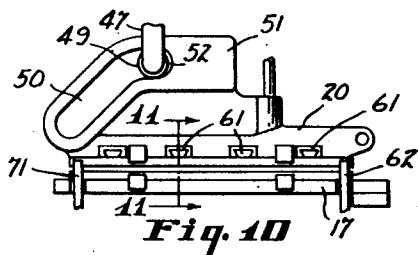


Fig. 10

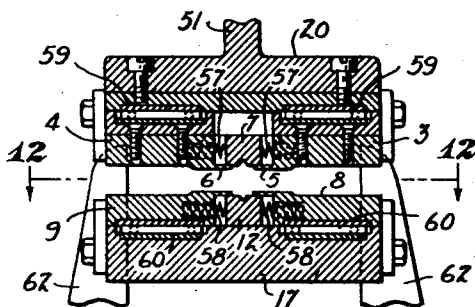


Fig. 11

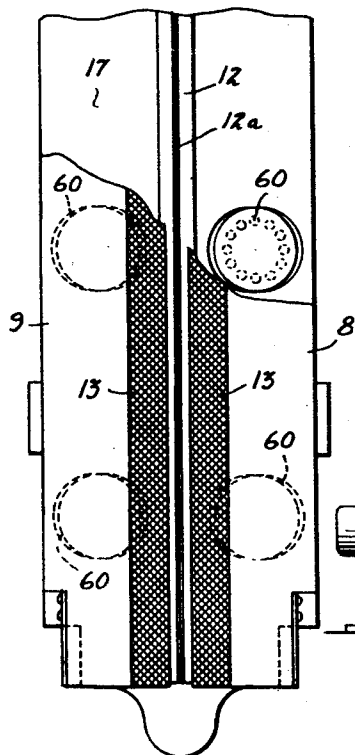


Fig. 12

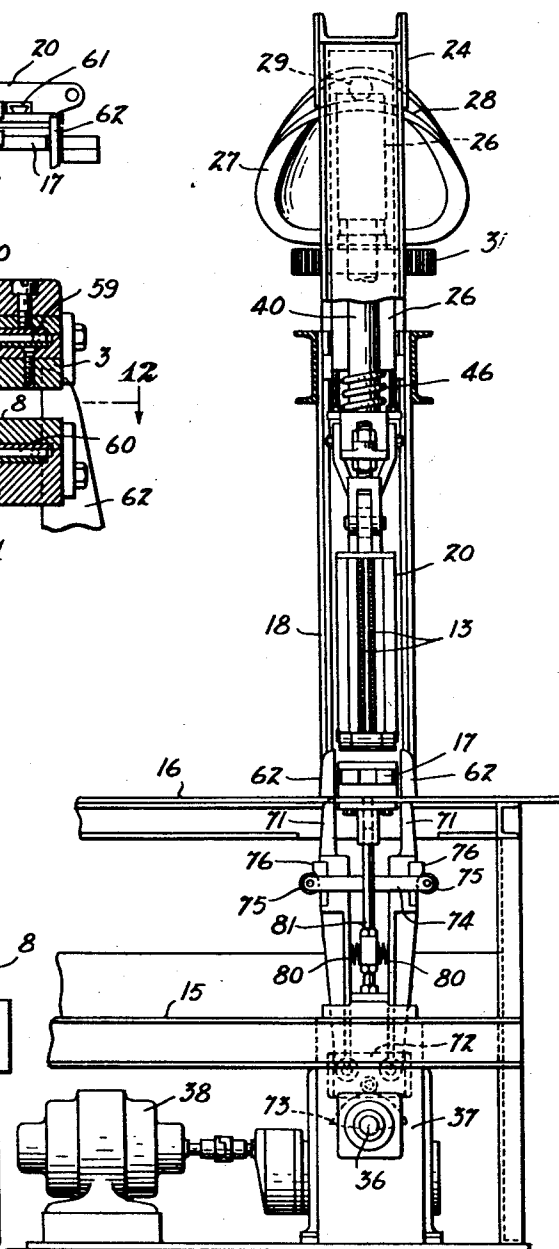


Fig. 9

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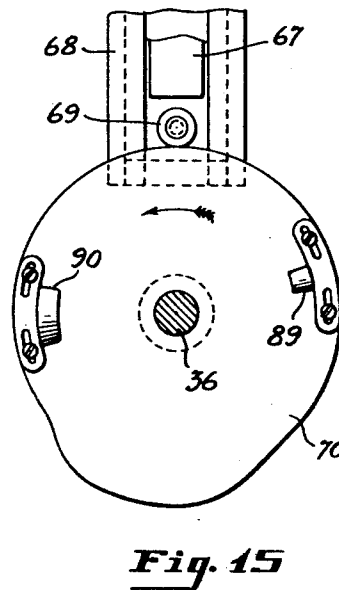
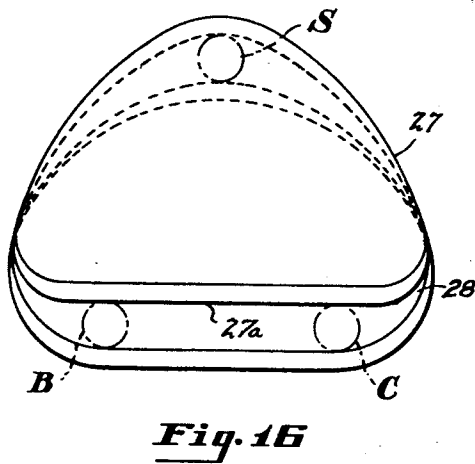
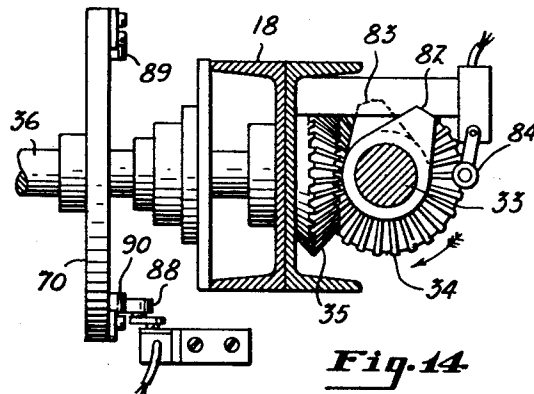
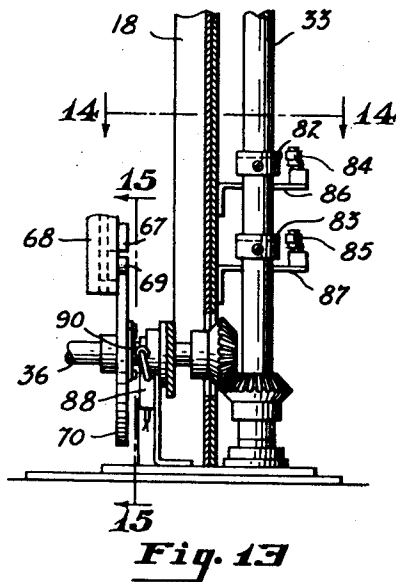
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5 Sheets-Sheet 4



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5 Sheets-Sheet 5

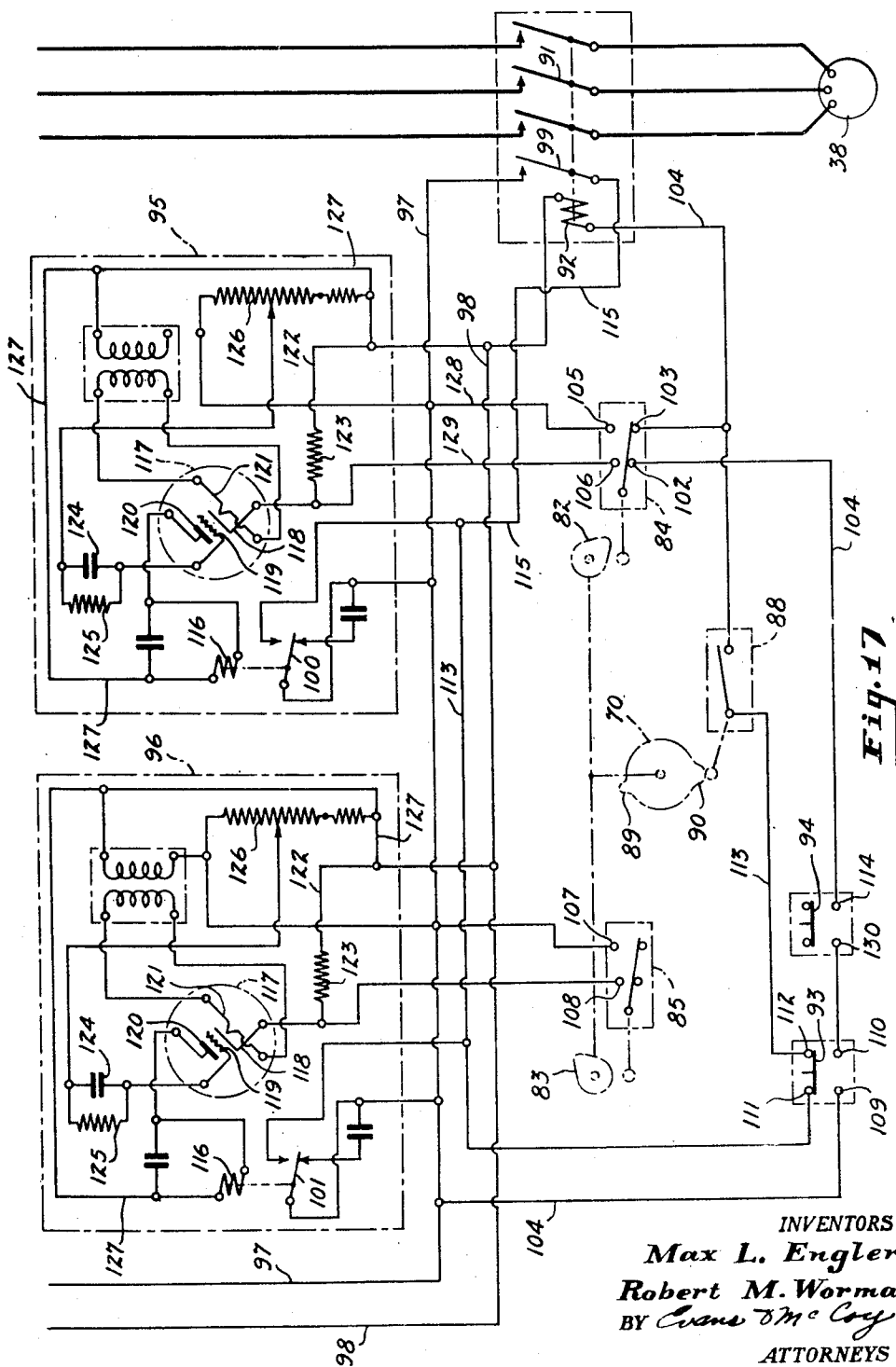


Fig. 17

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UNITED STATES PATENT OFFICE

2,562,540

MACHINE FOR SPLICING INNER TUBES

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Original application August 23, 1946, Serial No. 692,468. Divided and this application March 19, 1949, Serial No. 82,425

23 Claims. (Cl. 154-9)

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This invention relates to a machine for splicing inner tubes of vulcanizable material prior to vulcanization, the machine being particularly useful for splicing tubes made of material such as butyl rubber which is less tacky and more fluent under pressure than natural rubber, the present application being a division of our application Serial No. 692,468, filed August 23, 1946 for Method and Apparatus for Splicing Inner Tubes.

Because of the fact that butyl rubber is softer and less adhesive than natural rubber, great difficulty has been experienced in making satisfactory splices between the ends of an inner tube prior to vulcanization. Tube splicing machines such as those which have been designed for the splicing of tubes made of natural rubber have not been satisfactory for butyl rubber tubes because they distort the tube at the splice due to excessive flow of the rubber under pressure and in addition many splices prove to be defective because of poor adhesion between the tube ends.

The present invention has for an object to provide a machine for splicing tubes by means of which good adhesion may be obtained between the ends of a butyl rubber inner tube without distortion of the tube at the splice.

A further object of the invention is to provide a machine which is of simple construction, which is convenient to operate and which is so designed that a substantial pressure may be applied to the rubber at the splice and maintained for a substantial time interval without distortion or weakening of the walls of the tube adjacent the splice.

Reference should be had to the accompanying drawings forming a part of this specification, in which:

Figure 1 is a side elevation of an inner tube to be spliced;

Fig. 2 is an elevation of one of the tube ends viewed as indicated at 2-2 in Fig. 1;

Fig. 3 is a sectional view showing a press for forcing the ends of the tube into full contact;

Fig. 4 is a fragmentary plan view showing the grippers of a splicing machine designed to apply and maintain sufficient pressure upon the abutting ends of a tube to cause the ends to firmly adhere together;

Fig. 5 is a section taken on the line indicated at 5-5 in Fig. 4, showing the gripper bars in the position which they occupy before pressure is applied;

Fig. 6 is a section like Fig. 5 showing position

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to which the gripper bars are moved to apply endwise pressure to the tube ends at the splice;

Fig. 7 is a section taken on the line indicated at 7-7 in Fig. 4;

Fig. 8 is a side elevation of the splicing machine;

Fig. 9 is a front elevation of the splicing machine;

Fig. 10 is a side elevation of the clamping platens;

Fig. 11 is a section taken on the line indicated at 11-11 in Fig. 10;

Fig. 12 is a fragmentary plan view of the lower platen and the tube gripping bars mounted thereon;

Fig. 13 is a fragmentary vertical section showing the stop and timer control switches that are associated with the actuating mechanism;

Fig. 14 is a horizontal section taken on the line indicated at 14-14 in Fig. 13;

Fig. 15 is a side elevation of the main stop switch on a somewhat enlarged scale;

Fig. 16 is a diagrammatic view illustrating the cycle of operation, and

Fig. 17 is a wiring diagram of the motor control circuit.

Referring to the accompanying drawings, a tube A to be spliced has its ends b and c cut in planes at right angles to the length of the tube to provide square, clean ends for adhesive contact. The tube is flattened transversely as shown in Fig. 2 prior to the cutting of the ends b and c. After the cutting operation the ends b and c are placed in contact and the tube ends are pressed between a bed 1 and a platen 2 so as to completely flatten the ends of the tube and bring the abutting edges into full contact throughout the width of the flattened tube.

After the initial pressing operation illustrated in Fig. 3, the tube ends are engaged by a pair of upper gripping bars 3 and 4 which have thin flanges 5 and 6 projecting from their opposing edges and forming part of the gripping faces of the two bars. The flanges 5 and 6 provide a recess between the bars 3 and 4 in which is mounted a gap closing bar 7 which bridges the gap between the flanges 5 and 6. The under sides of the tube ends are engaged by gripping bars 8 and 9 similar to the bars 3 and 4 which have flanges 10 and 11 corresponding to flanges 5 and 6. A second gap closing bar 12 is mounted in the recess formed by the flanges 10 and 11 and bridges the space between the edges of the flanges 10 and 11. The gap closing bars 7 and 12 preferably are made of brass to reduce frictional re-

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sistance with the steel flanges 5, 6, 10 and 11. The gap closing bars have small V-shaped grooves 7a and 12a extending centrally along the length of each. The tube gripping faces of the flanges 5, 6, 10 and 11 preferably are sharply knurled as shown at 13 in Fig. 4 to provide more effective gripping of the tube and prevent slippage of the tube ends.

With the two flattened tube ends firmly gripped between the bars 3 and 8 and 4 and 9 as shown in Fig. 5 of the drawings, gripping pressure is applied for a time interval sufficient to permit the knurling 13 to sink somewhat into the faces of the tube to improve the grip on the tube ends after which the two pairs of gripping bars are moved, one pair toward the other while the gripping pressure is maintained to apply endwise pressure to the abutting tube ends, as shown in Fig. 6. This movement pushes the gripped portions of the tube toward each other until the tube material at the splice contacts the confining walls. The bars 7 and 12 are held against the flanges 5 and 6 and 10 and 11 during this movement so that the lateral flow of rubber is confined to the very limited space provided between the edges of the thin flanges. In order to prevent lateral flow of rubber from the splice at the opposite side edges of the tubes, blocks of sponge rubber 14 are inserted between the tube gripper bars and against opposite side edges of the tube A. These blocks of rubber which bridge the space between the two pairs of grippers when compressed between the gripper bars press inwardly against the opposite side edges of the tube and prevent spreading of the edge portions of the tube due to lateral flow of rubber. If two or more tubes are spliced in the machine at the same time, their side edges are placed together and the rubber blocks 14 are used only on the outer edges of the outer tubes.

With the tube A confined between the gripper bars and the rubber blocks 14, pressure is maintained on the tube ends for a substantial time interval sufficient to cause the tube ends to firmly adhere so that subsequent vulcanization will cause complete joining of the rubber at the splice.

The operations above described are preferably performed in a tube splicing machine such as illustrated in Figs. 8 to 12 which has a supporting frame 15 and a flat table or bed 16 which provides support for the inner tubes while they are being spliced. A lower elongated platen 17 is supported in fixed horizontal position a short distance above the table 16, the platen 17 being rigidly attached at its inner end to a standard 18 that is a rigid part of the machine frame and that extends above the table 16. A carriage 19 is slidably mounted for vertical movement on the standard 18 above the platen 17 and an upper platen 20 is pivoted at its inner end to the carriage 19 to swing vertically. The carriage 19 is suspended at the lower end of a coil spring 21 which is connected at its upper end to a vertically adjustable screw 22 mounted in a bracket 23 attached to the standard 18. The spring 21 serves to yieldably support the carriage 19 in an elevated position where the platen 20 is supported in a position far enough above the platen 17 to provide convenient clearance for insertion of a tube to be spliced, or removal of a spliced tube.

The standard 18 supports an upper framework 24 that overhangs the upper platen 20 and which has a vertical guideway 25 that is spaced forwardly of the standard 18. A slide 26 is mounted in the guideway 25 and is actuated by means of

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a cam 27 of the wobble plate type which has a peripheral groove 28 that receives a roller 29 attached to the slide 26. The lower portion of the cam groove is flattened to provide an arcuate horizontally disposed portion 27a which serves to continue the application of gripping pressure to the platen 20 while the cam 27 makes a considerable part of a revolution. The cam 27 is attached to a vertical shaft 30 mounted in the framework 24 and the shaft 30 has a gear 31 attached thereto which meshes with a gear 32 on a vertical shaft 33 which extends from the framework 24 to adjacent the base of the machine. The shaft 33 has a bevel gear 34 at its lower end which meshes with a bevel gear 35 on a horizontal shaft 36 mounted in the frame 15, which is driven through reduction gearing in a case 37 from an electric motor 38.

The slide 26 has a vertical socket 39 which slidably receives a plunger 40 which has limited movement therein. The plunger 40 has a threaded stem 41 that projects through the closed upper end of the socket 39 and which carries adjustable stop nuts 42 which limit the downward movement of the plunger 40 with respect to the slide 26. The plunger 40 has a pin 43 that slides in a vertical slot 44 in the wall of the socket 39 to hold the plunger 40 against vertical movements. The plunger 40 has a head 45 at its lower end and a coil spring 46 is interposed between the lower end of the slide 26 and the head 45 to normally hold the plunger 40 in its lowermost position in the socket 39. The head 45 has front and rear vertical arms 47 and 48 attached thereto and the forward arm 47 carries a roller 49 that travels in the slot 50 formed in a vertical flange 51 formed integrally with the platen 20. The slot 50 extends longitudinally of the platen 20, the forward portion of the slot being inclined with respect to the face of the platen 20 and the rear end portion 52 of the slot being substantially parallel to the platen 20. A counterweight 53 is connected through a cable 54 to the head 45 to normally hold the head 45 and platen 20 in an elevated position, the counterweight 53 being mounted at the rear of the standard 18 and the cable 54 extending over guide pulleys 55 and 56.

When the shaft 30 is turned somewhat less than a one-half turn from the position shown in Fig. 8, the roller 29 is brought into engagement with the horizontal portion 27a of the cam 27 and the slide 26 is moved to its lowermost position carrying the head 45 and platen 20 downwardly to a position where the platen 20 is parallel with the lower platen 17 and the gripping bars 3 and 4 carried by the platen 20 are brought into gripping engagement with the ends of a tube overlying the platen 17. As the head 45 approaches its pressure applying position, the roller 49 enters the inner portion 52 of the slot and the arm 48 engages the top of the platen 20 so that pressure is exerted upon the horizontally disposed platen through both the front arms 47 and the rear arms 48. The spring 46 serves to limit the pressure applied to the platen 20, the gripping pressure exerted upon the tube to be spliced being merely the pressure required to compress the spring 46 which provides an elastic connection between the slide 26 and the head 45 that insures uniformity of gripping pressure during the splicing operation and a yieldable connection that accommodates different thicknesses of tubes.

The bars 7 and 12 are confined between the 75 flanges of the gripper bars and the platens upon

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which the gripper bars are mounted, and the gripper bars are normally held in their outermost positions by means of coil springs 57 and 58 which are interposed between the bars 7 and 12 and the gripper bars of the upper and lower platens.

Anti-friction bearings 59 and 60 are interposed between the gripper bars 3 and 4 of the upper platen and the gripper bars 8 and 9 of the lower platen, the bars 3 and 4 being supported on the under face of the upper platen 20 by means of ribs 61 on the bars that fit in undercut grooves formed in the platen 20.

After the upper platen 20 has been moved into tube gripping position, the tube gripping bars are moved toward the center bars 7 and 12 to apply endwise pressure to the abutting faces of the tube ends by means of an actuating mechanism mounted in the frame 15. A pair of rear actuating arms 62 are mounted at their lower ends on fixed horizontal pivots 63 attached to the standard 18. The arms 62 are supported in substantially upright position on opposite sides of the platen 17 and extend through the table 16. The arms 62 are actuated by means of a vertically movable actuating collar 64 that surrounds the arms 62 and has a pair of rollers 65 which engage cams 66 secured to the outer sides of the arms 62 so that when the collar 64 is moved vertically the arms 62 are moved inwardly to exert pressure on the outer edges of the gripping bars. The collar 64 is carried by a vertically movable slide 67 mounted in a guide 68 in the frame 15. The slide 67 has a roller 69 adjacent its lower end which engages a cam 70 on the shaft 36.

A pair of front actuating arms 71 similar to the arms 62 are pivoted at their lower ends to a vertically movable slide 72 that is operated by means of a cam 73 on the shaft 36. The actuating arms 71 are actuated by means of an actuating collar 74 having rollers 75 engaging cams 76 on the outer sides of the arms 71. The actuating collar 74 is carried by a slide 77 that is actuated by a cam 78 on the shaft 36. Suitable springs 80 may be provided between the arms 71 to normally hold the arms in their spread position so that they will clear the platen when they are lifted to operating position. The actuating arms 71 are movable from a position entirely below the surface of the table 16, upwardly through slots or openings 79 in the table 16, to a position straddling the outer end of the platens 17 and 20 for engagement with the gripper bars carried by the platens. The cams 73 and 78 are so disposed that when the shaft 36 is rotated the arms 71 are first elevated to operative position with respect to the gripper bars, and then actuated simultaneously with the actuation of the arms 62 to apply pressure to the gripper bars of both platens.

The platen 17 is preferably of a length sufficient to accommodate a plurality of tubes to be spliced positioned side by side and it is therefore desirable that suitable means be provided to support the outer end of the platen during application of downward pressure. This supporting means as herein shown, is a vertically movable standard 81 suitably guided in the frame 15 and carried by the slide 72 so that it is moved into supporting engagement with the under side of the platen 17 by the cam 73 during downward movement of the platen 20 to support the free end of the platen 17 during the splicing operation. The arms 71 and standard 81 are held in

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retracted position beneath the table 16 while the platen 20 is being held in its elevated position so that tubes to be spliced can be readily positioned on the table 16 with the ends to be spliced resting upon the top of the platen 17.

The platens and the platen actuating arms normally occupy the positions shown in Fig. 8 of the drawings, in which position the outer end of the platen 17 is free to receive a tube to be spliced with the splice resting upon the top face of the platen and with the body of the tube supported upon the table 16. When the tube is properly positioned on the platen 17, with the splice overlying the groove 12a of the gap closing bar 12, the motor 38 is started into operation. Upon a partial revolution of the shaft 33 the platen 20 is moved down to gripping position and the horizontal portion 27a of the cam engages the roller 28 to hold the platen in gripping position for a substantial portion of the cycle, which is completed during a single revolution of the shafts 30, 33 and 36 which turn at the same speed.

In order to obtain satisfactory adhesion between the ends of the tubes it is desirable that the pressure be maintained upon abutting ends of the tube during a substantial time interval. Such time interval could be provided by very slow rotation of the cam 27, but since it is often desirable to maintain pressure on the splice for from one to several minutes, much time would be wasted during the raising and lowering of the platen 20. It would be possible to cut down the speed of rotation during a portion of the cycle but, to provide the desired speed of operation during the end portions of the cycle and the necessary intermediate dwell presents difficulties because of the great difference in the two speeds required. It is therefore preferred to provide means for stopping and starting the motor at intervals during the cycle which are timed to provide the desired interval for sinking and gripping bars into the rubber of the tubes and for applying endwise pressure to the tube ends at the splice.

As shown in Figs. 13 and 14, the shaft 33 carries a pair of cams 82 and 83 that operate switches 84 and 85 that are carried by brackets 86 and 87 on the standard 18. As shown in Fig. 13 a switch 88 is mounted on the frame alongside the cam 70 in the path of two actuating cams 89 and 90 that are attached to a side face of the cam 70. The switches 84 and 88 serve to stop the motor at successive predetermined positions of the actuating mechanism and the switches 84 and 85 serve to initiate the operation of timers which function to restart the motor upon the lapse of a predetermined time interval after it has been stopped. The switch actuating cams are so disposed that the motor 38 is stopped automatically when the actuating shafts reach each of three predetermined positions. Fig. 16 indicates the three positions by showing the positions with respect to the cam 27 occupied by the rollers 28 when the machine is stopped. The position indicated at S is the starting position shown in Fig. 8 where the machine is stopped by engagement of the cam 90 with the switch 88. The position indicated at B is the position of the roller 28 when the machine is stopped immediately after the platen 20 has been moved into engagement with the tubes, and the position indicated at C is the position of the roller when the machine is stopped after actuation of the arms 62 and 71 to maintain pressure upon the contacting tube ends. The cams 89 and 90 are prefer-

ably mounted for circumferential adjustment on the cam 70 so that the operation of the switch 88 may be properly correlated with the operation of switches 84 and 85.

The motor 38 is first started with the platen 23 in elevated position as shown in Fig. 8 and operates until the slide 26 is in its lowermost position and the roller 29 brought to the position B, at which point the motor is stopped by the operation of the switch 84 that initiates the operation of a timer that again starts the motor after a predetermined time interval. During the interval in which the cam 27 moves to cause the roller 29 to traverse the space between positions B and C, the cams 70 and 78 operate to apply lateral pressure to the gripping bars 3, 4, 8 and 9 and at the point C the cams 90 and 82 stop the motor and initiate the operation of a second timer that restarts the motor after a predetermined time interval. At the completion of the cycle the cam 90 operates the switch 88 to stop the motor.

A suitable control circuit for effecting the cycle of operations above described is shown in Fig. 17.

As shown in Fig. 17, current is supplied to the motor 38 through a normally open gang switch 91 that is operated by means of a solenoid 92 that is initially energized by two push button starting switches 93 and 94 and subsequently controlled by the switches 84, 85 and 88 and two electronic timers indicated generally by the numerals 95 and 96. The control circuit for the solenoid 92 is connected to positive and negative lines 97 and 98 and includes a holding switch 99 actuated by the solenoid 92 and switches 100 and 101 actuated by the timers 95 and 96.

The switch 84 is normally held in a position bridging contacts 102 and 103 in a line 104 connecting the power line 97 to the solenoid 92 and is moved by the cam 82 to a position bridging contacts 105 and 106 to initiate operation of the timer 95. The switch 85 is normally open and is moved by the cam 83 to a position bridging contacts 107 and 108 to initiate operation of the timer 96.

The push button switch 93 is normally held out of engagement with a pair of spaced contacts 109 and 110 in the line 104 and in engagement with a pair of contacts 111 and 112 in a line 113 that connects the line 97 to the solenoid 92 through the switch 88 and either of the two timer operated switches 100 and 101.

The switch 94 is normally held out of engagement with contacts 130 and 114 in the line 104. The terminal of the solenoid 92 opposite that connected to line 104 is connected directly to line 98.

The machine is started into operation by simultaneously pressing the push button switches 93 and 94 into engagement with the contacts 109, 110, 130 and 114 to cause current to flow through switches 93, 94 and 84 in line 104 and through the solenoid 92 to close the switch 91 and start the motor 38. The holding switch 99, which connects the line 97 to the line 113 through a line 115, is ineffective during the initial portion of the cycle because the line 113 is then broken by the switches 88 and 93. It is necessary therefore for the operator to hold the two switches 93 and 94 down to keep the motor 38 operating and these two switches are held closed by the operator until the motor is stopped by the actuation of the switch 84 by the cam 82. Two starting switches are employed in order to make it necessary for the operator to have both hands

engaged with the switches until the pressure applying platen is engaged with the tubes to be spliced. This makes it impossible for the operator to have either hand in position to be caught between the platens.

The movement of the switch 84 from its position bridging contacts 102 and 103 to a position bridging contacts 105 and 106 stops the motor 38 and initiates the operation of the timer 95 which actuates the switch 100 after a predetermined time interval to restart the motor 38. The switch 100 connects the positive line 97 to the line 113. The switch 93, having been released by the operator, bridges contacts 111 and 112 and the switch 88, having been freed from the cam 89 just prior to the stopping of the motor, is closed so that the closing of the switch 100 will energize the solenoid 92 and close the motor switch 91 and the holding switch 99.

The two timers 95 and 96 are electronic timers of conventional design adapted to be adjusted to vary the time interval between their energization and the operation of a control switch. As herein shown the two timers are identical and corresponding parts of the two timers are indicated by the same reference numerals. Each timer has a switch operating solenoid 116 that is energized at the end of a predetermined time interval following the actuation of the timer initiating switch 84. Energization of the solenoid 116 is effected by current passing through an electronic tube 117. The tube 117 has a cathode 118, a grid 119, a plate 120 and a heating filament 121. The cathode 118 is connected to the negative line 98 through a line 122 in which is placed a resistance 123. The grid 119 is connected through a capacitor 124 and a bleeder resistor 125 to an adjustable potentiometer 126 that is connected directly across the positive and negative lines 97 and 98. The solenoid 116 has one terminal connected to the plate 120 and its other terminal connected to the negative line 98 through a line 127. The initiating switch 84 serves to connect the cathode to the positive line 97 through lines 128 and 129. When the initiating switch 84 is open the capacitor is charged by grid rectification. The resistor 125 tends to drain the charge from the capacitor, but as long as the initiating switch is open sufficient current passes from the cathode to the grid to replace the losses. When the initiating switch is closed charging of the capacitor 124 ceases and its charge begins to drain off through the resistor 125. When the charge on the capacitor has been reduced to a predetermined value the tube 117 will pass sufficient current to energize the solenoid 116. The time interval between the closing of the initiating switch 84 and the energization of the solenoid 116 may be varied as desired and is determined by the setting of the potentiometer 126 which may be adjusted to provide the desired time interval.

Upon closing of the switch 100 current passes from the positive line 97 through switch 100, the line 113 which includes the switches 93 and 88, and the solenoid 92, to again start the motor, causing the cam 82 to move past the switch 84 and allow the same to break the connection between contacts 105 and 106, which will cause the solenoid 116 to be deenergized. The motor will continue to operate, however, since the circuit through the solenoid 92 will be maintained by the holding switch 99. The motor continues to operate until the arms 62 and 71 have been brought to their innermost positions, whereupon

the cam 83 closes the initiating switch 85 of the second timer and the cam 89 opens the switch 88 to stop the motor. The cam 89 is so positioned that it engages the switch 88 only momentarily and coasts past the switch to permit the same to close immediately after deenergization of the solenoid 92.

While the machine is stopped the second time full pressure is maintained upon the abutting tube ends at the splice for a sufficient time interval to cause the ends to firmly adhere. Upon the closing of the switch 101 the solenoid 92 is again energized to start the motor 88 and the holding switch maintains the current through the solenoid 92 after the switch 85 is opened. When the revolution of the shaft 36 is completed the cycle of operation is completed, the machine has returned to its starting position, and is stopped by the opening of the switch 88 by the cam 89, at which time the switches and their operating cams are in the positions shown in Fig. 17.

It is to be understood that variations and modifications of the specific devices herein shown and described for purposes of illustration, may be made without departing from the spirit of the invention.

What we claim is:

1. A tube splicing machine comprising upper and lower elongated platens mounted for movement one toward and away from the other, pairs of tube gripping bars mounted on opposed faces of said platens, the bars of each pair extending longitudinally of their platen and movable transversely thereof, the opposed edges of the bars of each pair having aligned thin flanges having tube engaging faces, a gap covering bar mounted between the flanges of each pair of bars and the platen on which the bars are mounted, springs interposed between said gap covering bars and gripping bars, and means for moving said bars in opposition to said springs.

2. A tube splicing machine comprising upper and lower elongated platens mounted for movement one toward and away from the other, pairs of tube gripping bars mounted on opposed faces of said platens, the bars of each pair extending longitudinally of their platens and movable transversely thereof, the opposed edges of the bars of each pair having aligned thin flanges having tube engaging faces, a gap covering bar mounted between the flanges of each pair of bars and the platen on which the bars are mounted, springs interposed between said gap covering bars and gripping bars, means for limiting the spreading movements of said bars, means for actuating a platen to grip the tube, and means for simultaneously moving the gripping bars in opposition to said springs to press the ends of a tube together.

3. A tube splicing machine comprising upper and lower elongated platens mounted for movement one toward and away from the other, pairs of tube gripping bars mounted on opposed faces of said platens, the bars of each pair extending longitudinally of their platen and movable transversely thereof, the opposed edges of the bars of each pair having aligned thin flanges having tube engaging faces, a gap covering bar mounted between the flanges of each pair of bars and the platen on which the bars are mounted, springs interposed between said gap covering bars and gripping bars, means for limiting the spreading movements of said bars, means for actuating a platen to grip the tube, pivoted actuating arms engageable with gripping bars at

opposite edges of the platens, and means for simultaneously actuating said arms to move the gripping bars toward said gap closing bar.

4. A tube splicing machine comprising upper and lower elongated platens mounted for movement one toward and away from the other, pairs of tube gripping bars mounted on opposed faces of said platens, the bars of each pair extending longitudinally of their platen and movable transversely thereof, the opposed edges of the bars of each pair having aligned thin flanges having tube engaging faces, a gap covering bar mounted between the flanges of each pair of bars and the platen on which the bars are mounted, springs interposed between said gap covering bars and gripping bars, means for limiting the spreading movements of said bars, means for actuating a platen to grip the tube, pivoted actuating arms engageable with gripping bars at opposite edges of the platens, said arms being movable to a position below the lower platen to permit insertion of a tube, and means for simultaneously actuating said arms to move the gripping bars toward said gap closing bar.

5. A tube splicing machine comprising a tube supporting bed, a stationary elongated platen supported at one end and spaced above the bed to receive a portion of the tube to be spliced between the platen and bed, a second elongated vertically movable platen above the first, pairs of tube gripper bars on the opposed faces of the platens, the bars of each pair extending longitudinally of their platen and movable transversely thereof, means applying downward pressure to the upper platen to clamp the tube ends, pairs of gripper shifting arms extending through the bed and straddling opposite ends of the platens adjacent opposite ends thereof and engageable with said bars, means for actuating said gripper shifting arms to apply endwise pressure to the tube ends gripped between the bars, and means for moving the gripper shifting arms at the free end of the lower platen to a position below the bed to permit insertion of a tube to be spliced or removal of a spliced tube.

6. A tube splicing machine comprising a tube supporting bed, a stationary elongated platen supported at one end and spaced above the bed to receive a portion of the tube to be spliced between the platen and bed, a second elongated vertically movable platen above the first, pairs of tube gripper bars on the opposed faces of the platens, the bars of each pair extending longitudinally of their platen and movable transversely thereof, means applying downward pressure to the upper platen to clamp the tube ends, a pair of gripper shifting arms mounted on fixed pivots below the lower platen and straddling said lower platen adjacent its attached end, a vertically movable support below the free end of the lower platen, a pair of gripper shifting arms pivoted to said movable support, means for moving said support vertically from a position in which the arms pivoted thereto are below the lower platen to a position in which the arms straddle the platen, and means for simultaneously actuating all of said arms to shift said gripper bars and apply endwise pressure to the tube ends.

7. A tube splicing machine comprising a stationary lower platen, a vertically movable slide above said platen, a member slidable vertically in said slide, means for limiting the downward movement of said member, a head carried by said member at its lower end, a spring interposed be-

tween said member and slide for resisting upward movement of said member in the slide, a platen attached to said head, pairs of transversely movable tube gripper bars on the opposed faces of said platens, means for actuating said slide to apply pressure through said spring to the upper platen to grip the tube ends between said bars, and means for actuating said bars to press the tube ends together.

8. A tube splicing machine comprising a stationary lower platen, a vertically movable slide above said platen, a member slidable vertically in said slide, means for limiting the downward movement of said member, a head carried by said member at its lower end, a spring interposed between said member and slide for resisting upward movement of said member in the slide, a platen attached to said head, pairs of transversely movable tube gripper bars on the opposed faces of said platens, a cam for actuating said slide to apply pressure through said spring to the upper platen to grip the tube ends between said bars, cams for actuating said gripper bars to press the tube ends together, and means for actuating said cams.

9. A tube splicing machine comprising a stationary lower platen, a vertically movable slide above said platen, a spring for normally holding said slide in an elevated position, an upper platen pivoted to said slide, pairs of transversely movable tube grippers on the opposed faces of said platens, means for applying pressure to said upper platen to grip the ends of a tube to be spliced between opposed grippers, and means for actuating said grippers to apply endwise pressure to the tube ends.

10. A tube splicing machine comprising a standard, a lower elongated platen attached at one end to said standard, a vertically movable slide on said standard above the lower platen, a spring normally holding said slide in an elevated position, an upper elongated vertically swinging platen pivoted to said slide, a vertically movable head above the upper platen, a supporting connection between said head and upper platen including a member on the head slidable longitudinally of the platen, pairs of transversely movable grippers on the opposed faces of the platens, means for actuating said head to press the upper platen downwardly to grip the ends of a tube to be spliced, and means for actuating the grippers to apply endwise pressure to the abutting tube ends.

11. A tube splicing machine comprising a standard, a lower elongated platen attached at one end to said standard, a vertically movable slide on said standard above the lower platen, a spring normally holding said slide in an elevated position, an upper elongated vertically swinging platen pivoted to said slide, a vertically movable head above the upper platen, a connecting member carried by said head and slidably connected to said upper platen, a thrust applying member carried by the head and spaced inwardly of said connecting member for engagement with said upper platen when it is parallel with the lower platen, transversely movable grippers on the opposed faces of the platen, means for actuating said head to press the upper platen to grip the ends of a tube to be spliced, and means for actuating the grippers to apply endwise pressure to the abutting tube ends.

12. A tube splicing machine comprising a standard, a lower elongated platen attached at one end to said standard, a vertically movable slide

on said standard above the lower platen, a spring normally holding said slide in an elevated position, an upper elongated vertically swinging platen pivoted to said slide, counterbalancing means for normally holding said platen in an elevated position, cam operated means for applying downward pressure to said upper platen, pairs of transversely movable grippers on opposed faces of said platens, and means for moving said grippers laterally to press the tube ends together at the splice.

13. A tube splicing machine comprising upper and lower platens mounted for movement, one toward and away from the other, pairs of tube gripping bars mounted on the opposed faces of said platens, the bars of each pair extending longitudinally of their platen and movable transversely thereof, means including a rotatable cam for moving one of the platens toward and away from tube gripping position, said cam having a dwell portion for holding the platens in tube gripping position, means for actuating said bars to apply endwise pressure to the tube ends, means for driving said cam, means for controlling said driving means to stop said cam while the platens are being held in gripping position by the dwell portion of said cam, and means for restarting said cam after a predetermined time interval.

14. A tube splicing machine comprising a tube supporting bed, a stationary elongated platen supported at its inner end and spaced above the bed at its outer end to receive a portion of tube to be spliced between the platen and the bed, a second elongated vertically movable platen above the first, pairs of tube gripper bars on the opposed faces of said platens, the bars of each pair extending longitudinally of their platen and being movable transversely thereof, means for applying downward pressure to the upper platen to clamp the tube ends, a platen supporting member movable from a position beneath the bed to a position in supporting engagement with the outer end of the stationary platen, means for actuating said supporting member, and means for actuating said tube gripper bars to apply endwise pressure to the tube ends gripped between said gripper bars.

15. A tube splicing machine comprising a tube supporting bed, a stationary elongated platen supported at one end and spaced above the bed to receive a portion of the tube to be spliced between the platen and bed, a second elongated vertically movable platen above the first, pairs of tube gripper bars on the opposed faces of the platens, the bars of each pair extending longitudinally of their platen and movable transversely thereof, means applying downward pressure to the upper platen to clamp the tube ends, pairs of gripper shifting arms extending through the bed and straddling opposite ends of the platens adjacent opposite ends thereof and engageable with said bars, means for actuating said gripper shifting arms to apply endwise pressure to the tube ends gripped between the bars, a support engageable with the lower platen adjacent its free end, and means for moving said support and the pair of gripper shifting arms adjacent the free end of the platen to a position below the bed to permit insertion of a tube to be spliced or removal of a spliced tube.

16. A tube splicing machine comprising a tube supporting bed, a stationary elongated platen supported at one end and spaced above the bed to receive a portion of the tube to be spliced between the platen and bed, a second elongated vertically movable platen above the first, pairs of

tube gripper bars on the opposed faces of the platens, the bars of each pair extending longitudinally of their platen and movable transversely thereof, means applying downward pressure to the upper platen to clamp the tube ends, a pair of gripper shifting arms mounted on fixed pivots below the lower platen and straddling said lower platen adjacent its attached end, a vertically movable support below the free end of the lower platen, a pair of gripper shifting arms pivoted to said movable support, means for moving said support vertically from a position in which the arms pivoted thereto are below the lower platen to a position in which the arms straddle the platen, a standard movable with said support and engageable with the lower platen adjacent its outer end to support the same during application of pressure thereto, and means for simultaneously actuating all of said arms to shift said gripper bars and apply endwise pressure to the tube end

17. A tube splicing machine comprising upper and lower platens mounted for movement, one toward and away from the other, pairs of tube gripping bars mounted on the opposed faces of said platens, the bars of each pair extending longitudinally of their platen and movable transversely thereof, a power driven actuating mechanism including a member having a predetermined cycle of movement, means controlled by said member during its cycle of movement for moving one platen toward the other to grip a tube, for holding the platens in tube gripping position during a portion of the cycle and then separating the platens, means controlled by said member while the platens are in tube gripping position for applying lateral pressure to said gripping bars to press the tube ends together, means for stopping said actuating mechanism while the platens are held in gripping position, and timing means for restarting said mechanism.

18. A tube splicing machine comprising upper and lower platens mounted for movement, one toward and away from the other, pairs of tube gripping bars mounted on the opposed faces of said platens, the bars of each pair extending longitudinally of their platen and movable transversely thereof, the opposed tube engaging faces of said bars being knurled, a power driven actuating mechanism including a member having a predetermined cycle of movement, means operated by said member during its cycle of movement for moving one platen toward the other to grip a tube, for holding the platens in tube gripping position during a portion of the cycle and then separating the platens, means operated by said member while the platens are in gripping position for applying lateral pressure to said gripping bars to press the tube ends together, means for stopping said mechanism after the platens are brought to gripping position and before actuation of said lateral pressure applying means, means for restarting said mechanism after a predetermined time interval, means for stopping said mechanism while lateral pressure is being applied, and means for again restarting the mechanism after a predetermined time interval.

19. A tube splicing machine comprising upper and lower platens mounted for movement, one toward and away from the other, pairs of tube gripping bars mounted on the opposed faces of said platens, the bars of each pair extending longitudinally of their platen and movable transversely thereof, means including a rotatable cam for moving one of the platens toward and away from tube gripping position, said cam having a

dwelling portion for holding the platens in tube gripping position, means for actuating said bars while the platens are in gripping position to apply endwise pressure to the tube ends, means for driving said cam and actuating means, means for controlling said driving means to stop the same while the platens are in gripping position before operation of the bar actuating means and during operation of said bar actuating means, and timing means for restarting said driving means after each stop.

20. A tube splicing machine comprising upper and lower platens mounted for movement, one toward and away from the other, pairs of tube gripping bars mounted on the opposed faces of said platens, the bars of each pair extending longitudinally of their platen and movable transversely thereof, means including a rotatable cam for moving one of the platens toward and away from tube gripping position, said cam having a dwelling portion for holding the platens in tube gripping position, a motor for driving said cam, means operated by said motor for moving said bars laterally to apply pressure to the abutting tube ends while the platens are in gripping position, means for automatically stopping the motor with the platens in gripping position and before actuation of said bars, means for automatically stopping the motor while lateral pressure is being applied to said bars, and timing means for restarting the motor after each of said stops.

21. A tube splicing machine comprising upper and lower platens mounted for movement, one toward and away from the other, pairs of tube gripping bars mounted on the opposed faces of said platens, the bars of each pair extending longitudinally of their platen and movable transversely thereof, means including a rotatable cam for moving one of the platens toward and away from tube gripping position, said cam having a dwelling portion for holding the platens in tube gripping position, a motor for driving said cam, means operated by said motor for moving said bars laterally to apply pressure to the abutting tube ends while the platens are in gripping position, means for automatically stopping the motor with the platens in gripping position and before actuation of said bars, means for automatically stopping the motor while lateral pressure is being applied to said bars, a timer operable to restart the motor after the first stop, a second timer operable to restart the motor after the second stop, and means for independently adjusting said timers to vary the time intervals during which the motor is stopped.

22. A tube splicing machine comprising a stationary platen, a platen movable vertically toward and away from said stationary platen, laterally spaced tube grippers between said platens and movable transversely of the platens, a vertically movable actuating member, a pressure applying member attached to the movable platen and slidably engaging said actuating member, a spring interposed between said actuating member and said pressure applying member, means for moving said actuating member toward the movable platen to apply pressure through said spring to said movable platen and for simultaneously applying transverse pressure to said gripper bars to press the tube ends together, and means limiting the movement of said actuating member toward the movable platen.

23. A tube splicing machine comprising a tube supporting bed, a stationary lower platen supported at one end and spaced above the bed, an

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upper platen movable vertically toward and away from the lower platen, laterally spaced and laterally movable tube gripper bars between said platens, means applying downward pressure to the upper platen to clamp the tube ends, pairs of gripper shifting arms extending through the bed and straddling opposite end portions of the platens and engaging said gripper bars, means for actuating said arms to apply pressure to tube ends gripped by said bars, and means for moving the gripper shifting arms at the free end of the lower platen to a position below the bed to permit removal of a spliced tube and insertion of a tube to be spliced.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,027,854	Breth et al.	Jan. 14, 1936
2,254,586	Breth et al.	Sept. 2, 1941
2,272,881	Stevens	Feb. 10, 1942
2,273,464	Campbell et al.	Feb. 17, 1942

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