Aug. 28, 1956 E. H. SHATTUCK 2,760,252

FILAMENT CRIMPING APPARATUS

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Fig. 1

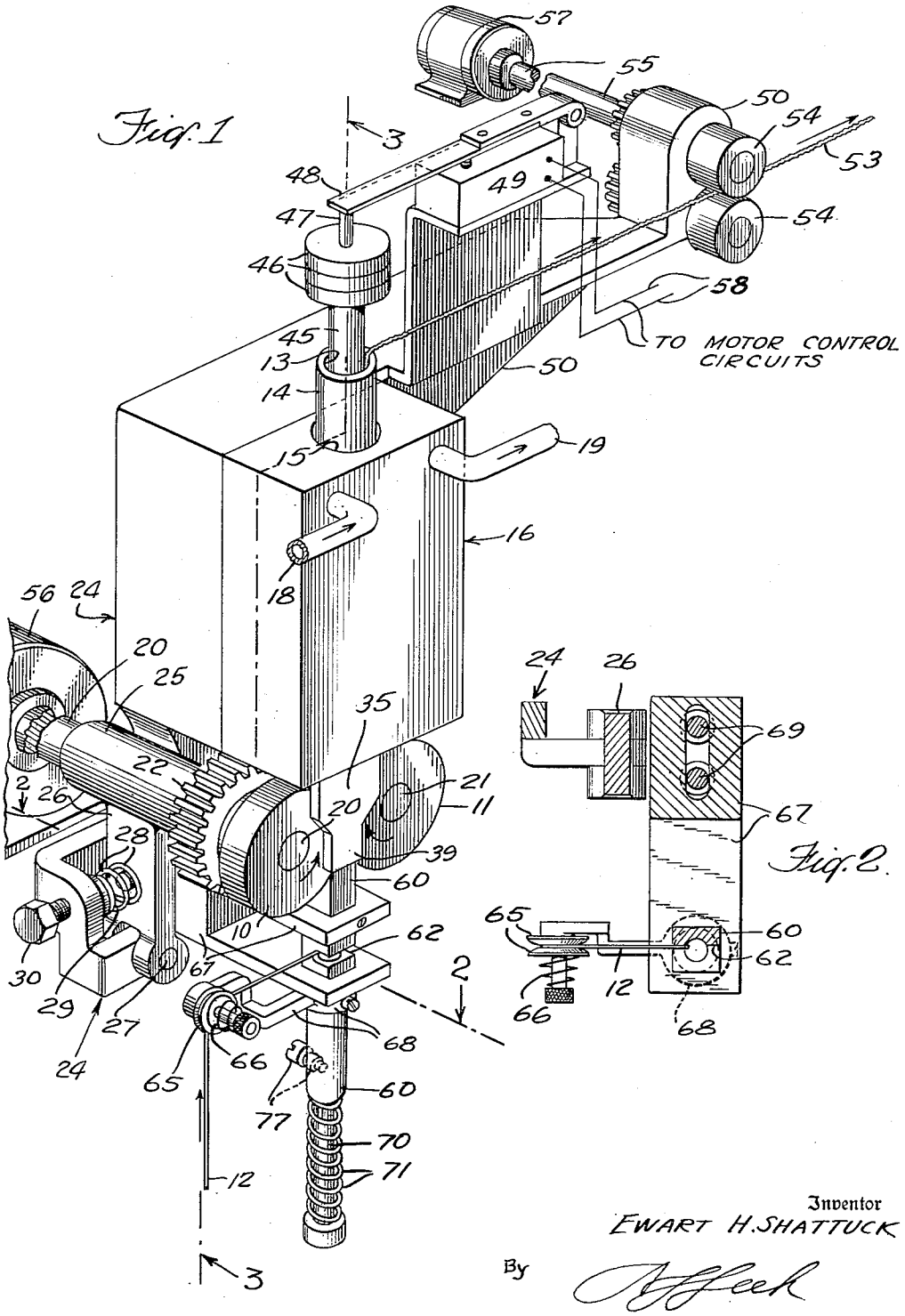

Fig. 2

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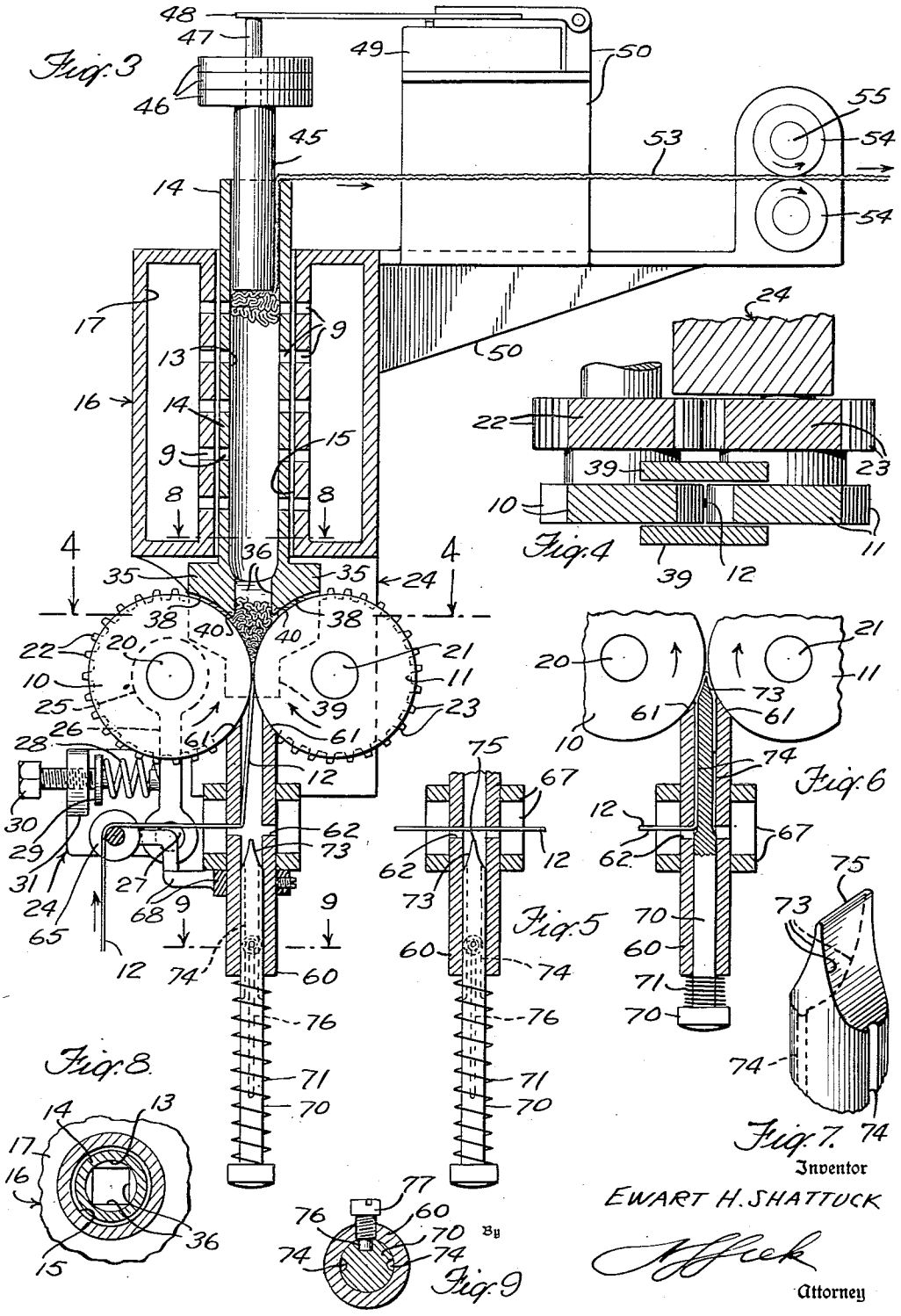

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FILAMENT CRIMPING APPARATUS

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21 Claims. (Cl. 28—1)

This invention relates to an apparatus for crimping continuous filament tow or filament or spun yarn.

An object of the invention is to provide crimping apparatus which is particularly adapted for use with small denier tow or yarn.

Another object is to provide a crimping apparatus for the above purpose having novel and improved details of construction and features of operation.

Various other objects and advantages will be apparent as the nature of the invention is more fully described.

The nature of the invention will be better understood by referring to the following description, taken in connection with the accompanying drawings forming a part thereof, in which a specific embodiment has been set forth for purposes of illustration.

In the drawings:

Fig. 1 is a perspective view of a crimping apparatus embodying the present invention;

Fig. 2 is a partial horizontal section taken on the line 2—2 of Fig. 1 showing the guide and tensioning means;

Fig. 3 is a vertical longitudinal section taken on the line 3—3 of Fig. 1;

Fig. 4 is a horizontal section taken on the line 4—4 of Fig. 3;

Fig. 5 is a detail view, partly in section, showing the filament threading mechanism in retracted position;

Fig. 6 is a similar detail view showing the filament threading mechanism in advanced position;

Fig. 7 is an enlarged detail view showing the end of the threading plunger; and

Figs. 8 and 9 are transverse sections taken on the lines 8—8 and 9—9 respectively of Fig. 3.

Referring to the drawings more in detail the invention is shown as comprising a pair of feed rolls 10 and 11 which are adapted to feed continuous filament tow or yarn 12 into a sleeve 14, shown as loosely mounted in a bore 15 in a housing 16. The housing 16 is provided with an internal passage 17 forming a jacket communicating with pipes 18 and 19 for the circulation of heating fluid. The housing 16 and sleeve 14 may have passages 9 for the injection of a heating fluid or setting fluid such as steam into the sleeve. The housing 16 may be electrically heated as by Calrods if desired.

Feed rolls 10 and 11 are shown as mounted on shafts 20 and 21 respectively and driven by meshing gears 22 and 23 respectively. The shaft 21 is mounted in a fixed bearing carried by a frame 24 which also carries the housing 16. The shaft 20 is journaled in a bearing 25 carried by an arm 26 which is pivoted at 27 to the frame 24 and is spring-pressed by spring 28 seated against a disc 29 held on an adjusting screw 30 threaded into a fixed ear 31 attached to the frame 24. The spring 28 is adapted to hold the roll 10 in pressure engagement with the filament passing between the rolls 10 and 11 and the teeth on the gears 22 and 23 are sufficiently deep to remain in mesh when the roll 10 is retracted in response to the passage of the filament. The roll 10 may

be loaded hydraulically or weighted for gravity loading if desired.

The sleeve is formed with a bore 13 which may be circular in cross section or of any other desired cross section and may be tapered, and carries at its lower end a saddle 35 having a bore 36 which may be square in cross section as shown in Fig. 8, the diagonals of which conform in diameter to the circular bore 13 in the sleeve 14 and the sides of which join the circular bore 13 smoothly without sharp bends or corners which might restrict the feed of the yarn from the saddle to the bore 13. The bore 36 of the saddle 35 has been shown as square for ease of construction only. Obviously the bore 36 may be circular or any other desired shape and may form a continuation of the bore 13 if desired.

The saddle 35 is provided with a pair of curved surfaces 38 conforming generally to the peripheries of the feed rolls 10 and 11 and with a pair of side members 39 which extend on opposite sides of the rolls 10 and 11 so as to form a confined crimping chamber. The curved surfaces 38 of the saddle 35 intersect the bore 36 at edges 40 which are rounded so as to avoid corners or sharp edges which might damage the filaments.

The sleeve 14 is so designed that the saddle 35 rests lightly upon the rolls 10 and 11 and is free to be retracted from the rolls a limited distance, such as a few thousandths of an inch, in response to the pressure of the material which is packed into the crimping chamber by the feed rolls. The sleeve 14 also fits within the bore 15 of the housing 16 with a sufficient clearance to permit a limited amount of lateral movement in all directions. Hence the entire sleeve 14 is floating and is free for limited vertical and lateral movement in response to the pressure and distribution of the material therein.

The crimped material within the bore 13 is held compacted by a plunger 45 which fits loosely within the bore 13 and rests upon the packed material therein. The plunger 45 is shown as extending upwardly beyond the sleeve 14 and is provided with removable weights 46 which may be applied as desired in accordance with the pressure which is to be exerted upon the packed material within the bore 13. At its upper end the plunger 45 is provided with a pin 47 which engages an arm 48 which is adapted to actuate a microswitch 49 for the purpose to be described. The microswitch 49 is mounted on a bracket 50 which is secured to the frame 24.

The plunger 45 fits within the sleeve 14 with sufficient clearance to permit the passage of the crimped tow or yarn 53 therebetween, but sufficiently closely to form a friction device for eliminating slubs or snarls. The result may also be obtained by forming the plunger with a central bore of suitable size to pass the crimped tow or yarn. The crimped tow or yarn thus passes over the upper edge of the sleeve 14 to take-up rolls 54 by which it is withdrawn from the bore 13.

The take-up rolls 54 are shown as also mounted on the brackets 50 and are connected to be driven by shaft 55 at a speed which has a predetermined ratio to the speed of the feed rolls 10 and 11. The feed and take-up rolls may be driven by separate motors 56 and 57 respectively or may be coupled together and driven by a single motor. The microswitch 49 is connected by leads 58 in a circuit to control the operation of the driving motor 56 for the feed rolls 10 and 11 or the driving motor 57 for the take-up rolls 54, or may be connected in other ways to control the relative quantity of material withdrawn from the bore 13. The switch may of course be replaced by other proportional means to vary the drive to one set of rolls as a function of the elevation of the plunger 45.

For guiding the yarn 12 to the feed rolls 10 and 11

a guide tube 60 is provided having at its upper end curved surfaces 61 which conform to the surfaces of the feed rolls 10 and 11 and which serve to guide and center the filament 12 with respect to the feed rolls. The guide tube 60 is provided with a transverse slot 62 through which the filament may be inserted. The filament is tensioned by a spring-tension device comprising a pair of discs 65 which are spring-pressed by a spring 66. The tube 60 is mounted on a bracket 67 which is slidably secured in the frame 24 by screws 69. The disc 65 and spring 66 are mounted on an arm 68 which is pivoted on the bracket 67 for adjustment about the axis of the tube 60.

A threading plunger 70 is provided which fits within the bore of the guide tube 60 and is held in its retracted position by a spring 71. The plunger 70 is provided at its upper end with a tapered portion 73 forming an edge 75 and has side grooves 74 for the yarn and a keyway 76 engaged by a key 77 to maintain the edge 75 in proper alignment with respect to the bite of the rolls 10 and 11. The plunger 70 is of a length such that the edge 75 is brought into the bite of the feed rolls 10 and 11 when the plunger 70 is in advanced position as shown in Fig. 6.

The filament 12 is threaded by passing the same between the tension discs 65 and through the transverse slot 62 in the tube 60. The plunger 70 grips the filament which extends through the transverse slot 62 and pushes the filament up into contact with the feed rolls 10 and 11. It is then gripped by the feed rolls and fed into the bore 36 of the saddle 35.

In starting the device it is usually desirable to insert a temporary spacer of some material such as felt or cotton pads between the feed rolls and the curved surfaces of the saddle to elevate the metal saddle and serve as a temporary soft saddle to prevent pinching of or injury to the filament. As the filament is fed into the chamber 36 between the feed rolls 10 and 11 it is folded over and crimped as set forth in Rainard Patent No. 2,575,837 dated November 20, 1951, and is advanced through the chamber 13 in which it is held compacted and crimped. After sufficient filament has been crimped and fed into the chamber 13 to fill the same the temporary felt saddle is removed and the saddle 35 is held in raised position by the packed filament. The plunger 45 is now inserted in the sleeve 14. The feed rolls 10 and 11 now operate to feed the filament continuously into the chamber 36 where it is crimped, and through the chamber 13 where it is held compacted under setting conditions until the crimp has been set. The temperature is controlled by the heat supplied to the housing 16. The heat supply may be electrical or a fluid such as steam. If moisture is required for setting the passages 9 may be used to pass steam into the interior of the sleeve.

The filament with the set crimp is removed by the take-up rolls 54 which are timed to operate at the speed required to maintain the chamber 13 filled to a constant level. For ease of control the take-up rolls 54 may be operated at a speed slightly in excess of that normally required to maintain the chamber 13 filled to the proper level. Then, as the crimped filament 53 is withdrawn, the plunger 45 moves downwardly thereby actuating the microswitch 49 to break the driving circuit for the take-up rolls 54 and momentarily stop the rolls. The feed rolls 10 and 11 however continue to operate and as the material is fed into the chamber and again elevates the plunger 45, the microswitch is again closed. This operation is repeated at a rate to maintain a substantially constant amount of material within the chamber 13. The control may be reversed and the feed rolls driven intermittently or a proportional control may be used as above mentioned.

Since the saddle 35 is floating with respect to the feed rolls 10 and 11 the filament cannot become wedged between the curved surfaces 38 of the saddle and the periphery of the feed rolls. Hence there is no tendency to wedge and damage the filament or break the same between the feed rolls and the contiguous surfaces of the saddle. In fact the material forms its own saddle in contact with the rolls when the saddle 35 is raised from the rolls during the normal operation of the crimper. The weight of the saddle 35, sleeve 14, plunger 45 and the material packed within the sleeve 14 determines the back pressure against which the material is fed by the rolls 10 and 11 for crimping. The crimp frequency and amplitude is controlled as a function of the back pressure and the mechanical characteristics of the filament (bending movement, crushing resistance and the like). Spring loading may be used to supplement or replace the weights on the plunger 45, if desired.

The free movement of the saddle in all directions eliminates the possibility of damage to the delicate filaments as they are fed from the feed rolls into the crimping chamber. The saddle shifts laterally to compensate for any irregularity in feed such as when the filament tends to loop under one of the rolls and in this way insures a uniform feed into the sleeve without injury to the material. The filament is guided to a center position on the feed rolls by the guide tube 60 and by adjusting the arm 68 around the tube 60 to cause the pull to be effected from the proper direction to maintain the filament centered on the rolls.

Obviously the crimping chamber may be reversed with respect to the feed rolls so that the filament is fed downwardly instead of upwardly to the crimping chamber if desired, in which case spring loading will be used for the floating saddle and closure plunger.

The crimped filament remains in the crimping chamber under setting conditions a sufficient length of time for the internal stresses produced by the crimping to be relieved, so that the tendency of the crimp to open up after the material is removed from the chamber is eliminated. The material immediately cools and becomes permanently set upon withdrawal from the crimping chamber or the crimping chamber may be so designed that the material cools to a temperature below that at which there is any tendency for plastic flow while still packed in the chamber. Since the stresses have been relieved by maintaining the material in heated condition in the crimping chamber the crimp becomes permanently set. Suitable moisture and pH conditions may be established in the crimping chamber, depending upon the type of material being crimped. The provision of a controlled rate of discharge as well as a controlled rate of feed establishes a uniform operation. The nature of the crimp, the temperature, the time within the crimping chamber, and the rate of feed can be regulated with great accuracy.

The take-up rolls 54 may constitute the delivery rolls of a winder which may be of the constant tension type or may deliver the crimped product to any subsequent process step which is usual in the textile industry.

Although a specific embodiment of the invention has been shown for purposes of illustration it is to be understood that the invention may be applied to various uses and that changes and modifications may be made therein as will be apparent to a person skilled in the art.

What is claimed is:

1. An apparatus for crimping filament tow or yarn, comprising a member having walls forming a chamber, a pair of feed rolls at one end of said member positioned to feed material into one end of said chamber for crimping, said member having surfaces forming with said rolls a confined entrance to said chamber, said member being mounted with said surfaces adjacent said rolls and being movable with respect to the bite of said rolls in response to the pressure exerted by the material fed by said rolls into said chamber.

2. An apparatus for crimping filament tow or yarn, comprising a member having walls forming a chamber, a pair of feed rolls at one end of said member positioned to feed material into one end of said chamber for crimp-

ing, said member having surfaces forming with said rolls a confined entrance to said chamber, said member being mounted with said surfaces adjacent said rolls and being movable with respect to the bite of said rolls in response to the pressure exerted by the material fed by said rolls into said chamber, a guide disposed to guide said filament to said feed rolls, and tensioning means disposed in advance of said guide adapted to hold said yarn centered with respect to said feed rolls.

3. An apparatus for crimping filament tow or yarn, comprising a member having walls forming a chamber, a pair of feed rolls at one end of said member positioned to feed material into one end of said chamber for crimping, said member having surfaces forming with said rolls a confined entrance to said chamber, said member being mounted with said surfaces adjacent said rolls and being movable with respect to the bite of said rolls in response to the pressure exerted by the material fed by said rolls into said chamber, said surfaces of said member terminating at an inner edge which is smooth and blunt to prevent injury to the material fed thereover.

4. Apparatus for crimping filament tow or yarn, comprising a housing, a sleeve fitting loosely in said housing for limited axial and lateral movement and having walls forming a crimping chamber, a pair of feed rolls at one end of said housing positioned to feed material into one end of said chamber, said sleeve having a saddle with an external surface forming with said rolls a confined entrance to said chamber, means mounting said saddle to rest lightly against said rolls and to be movable both vertically and laterally in response to the pressure exerted by the material fed by said rolls into said chamber.

5. Apparatus as set forth in claim 4 in which said sleeve is disposed above said rolls and rests thereon by gravity.

6. Apparatus as set forth in claim 4 in which the edge of the saddle engaging said feed rolls is blunt to prevent injury to the filament.

7. Apparatus as set forth in claim 4 in which said saddle includes side members extending over but spaced from the ends of said feed rolls to permit limited movement of the saddle with respect to said rolls.

8. Apparatus for crimping filament tow or yarn, comprising a housing, a sleeve fitting loosely in said housing for limited axial and lateral movement and having walls forming a crimping chamber, a pair of feed rolls at one end of said housing positioned to feed material into one end of said chamber, said sleeve having a saddle with an external surface forming with said rolls a confined entrance to said chamber, means mounting said saddle to rest lightly against said rolls and to be movable both vertically and laterally in response to the pressure exerted by the material fed by said rolls into said chamber, a guide disposed to guide said filament to said feed rolls, and tensioning means disposed in advance of said guide adapted to hold said yarn centered with respect to said feed rolls.

9. An apparatus as set forth in claim 8 having means to exert a predetermined pressure upon the crimped filament tow or yarn in said chamber and means for withdrawing the crimped material therefrom.

10. An apparatus for crimping filament tow or yarn, comprising a member having walls forming a crimping chamber, a pair of feed rolls below said member positioned to feed material upwardly into the lower end of said chamber, a plunger loosely mounted in the upper end of said chamber to rest by gravity upon the material therein and to exert pressure upon the material in said chamber, and means for withdrawing the crimped material from said upper end of said chamber.

11. An apparatus for crimping filament tow or yarn, comprising a member having walls forming a crimping chamber, a pair of feed rolls at one end of said member positioned to feed material into one end of said chamber, a plunger loosely mounted in the other end of said chamber to rest upon the material therein and forming a friction device to eliminate slubs and snarls, means causing said plunger to exert pressure upon the material in said chamber, means for withdrawing the crimped material from said other end of said chamber, and means responsive to the movement of said plunger as the quantity of material in said chamber varies to control the relative rate of feed of material to said chamber by said feed rolls and the withdrawal of the crimped filament from said chamber by said withdrawing means so as to maintain said plunger at a predetermined level in said chamber.

12. Apparatus as set forth in claim 11 in which said withdrawing means includes a pair of driven take-up rolls and the plunger is connected to control the drive of one of said take-up rolls.

13. Apparatus as set forth in claim 12 in which said plunger is connected to control the drive of said feed rolls.

14. An apparatus for crimping filament tow or yarn, comprising a member having walls therein forming a crimping chamber, a pair of feed rolls positioned to feed said filament continuously into one end of said chamber, means withdrawing crimped filament from the opposite end of said chamber, a closure member engaging the material in said chamber at said last end and adapted to advance and retract according to the quantity of material in said chamber, and means responsive to the movement of said member for controlling the operation of said withdrawing means relative to said feed rolls so as to maintain a predetermined quantity of material in said chamber.

15. Apparatus for crimping continuous filament tow or yarn, comprising a member having walls forming a crimping chamber, a pair of feed rolls disposed at one end of said chamber to feed said filament therebetween into said chamber, a guide disposed to guide said filament to said feed rolls, and tensioning means disposed in advance of said guide adapted to hold said yarn centered with respect to said feed rolls, and means mounting said tensioning means for adjustment about the axis of said guide for varying the direction of feed of said filament to said guide so as to center the filament with respect to said feed rolls.

16. Apparatus for crimping continuous filament tow or yarn, comprising a member having walls forming a crimping chamber, a pair of feed rolls disposed at one end of said chamber to feed said filament therebetween into said chamber, a guide tube disposed to guide said filament to said feed rolls, and a yarn threading device comprising a plunger positioned to be inserted in said tube and having an edge at one end to advance a filament into position to be gripped by said feed rolls.

17. An apparatus as set forth in claim 16 in which the end of said plunger conforms to the bite of said feed rolls.

18. An apparatus for crimping continuous filament tow or yarn, comprising a member having walls forming a crimping chamber, a pair of feed rolls disposed at one end of said chamber to feed said filament thereto for crimping, closure means at the other end of said chamber, said closure means being movable in response to the pressure of the material therein, means including rolls to withdraw the crimped filament from the chamber, driving means for said rolls, switch means connected to be actuated in response to the raising and lowering of said closure means due to changes in the quantity of material of said chamber, said switch means being connected to control the operation of said drive means whereby the relative operation of said rolls is varied so as to maintain a substantially constant quantity of material in said chamber.

19. Apparatus for crimping continuous filament tow or yarn, comprising a housing having walls, heating means carried by said housing for heating said walls, a sleeve disposed in said housing and movable both axially and

laterally thereof, said sleeve having walls forming a crimping chamber, a pair of feed rolls disposed at one end of said housing, a saddle formed on said sleeve and having a surface adjacent said feed rolls, said saddle being freely movable with respect to said rolls in response to the pressure exerted by the filament which is fed into said chamber by said feed rolls.

20. Apparatus for crimping continuous filament tow or yarn, comprising a housing having walls, heating means carried by said housing for heating said walls, a sleeve disposed in said housing and movable both axially and laterally thereof, said sleeve having walls forming a crimping chamber, a pair of feed rolls disposed at one end of said housing, a saddle formed on said sleeve and having a surface adjacent said feed rolls, said saddle being freely movable with respect to said rolls in response to the pressure exerted by the filament which is fed into said chamber by said feed rolls, movable closure means for said chamber adapted to maintain a predetermined back pressure on the material therein, means withdrawing crimped material from said chamber at a controlled rate, and means responsive to movement of said closure means to control said rate.

21. An apparatus for crimping yarn, comprising a member having a crimping chamber, a pair of feed rolls below said member positioned to feed yarn upwardly into the lower end of said chamber, a plunger loosely mounted in the upper end of said chamber to rest by gravity upon the yarn therein and to exert pressure upon the yarn in said chamber and means for withdrawing the crimped yarn from said upper end of said chamber.

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