Dec. 16, 1952

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2,621,372

APPARATUS AND METHOD FOR THE TREATMENT OF TEXTILE FIBERS IN STRAND FORM

Filed May 9, 1946

6 Sheets-Sheet 1

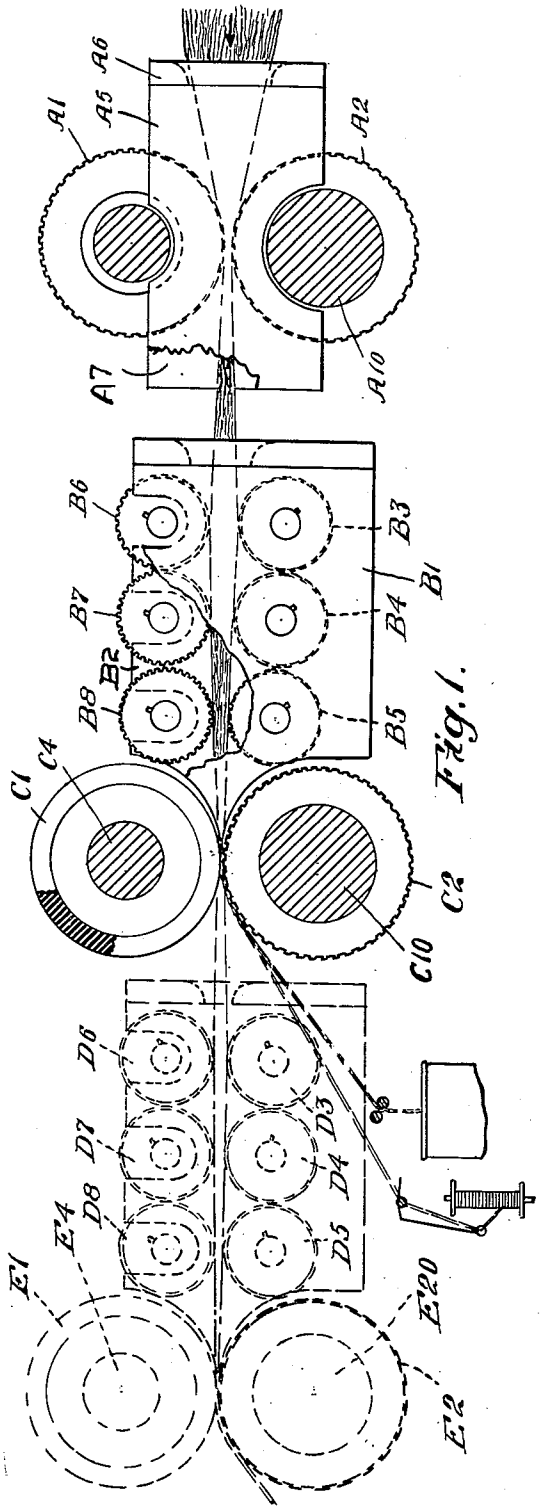


Fig. 1.

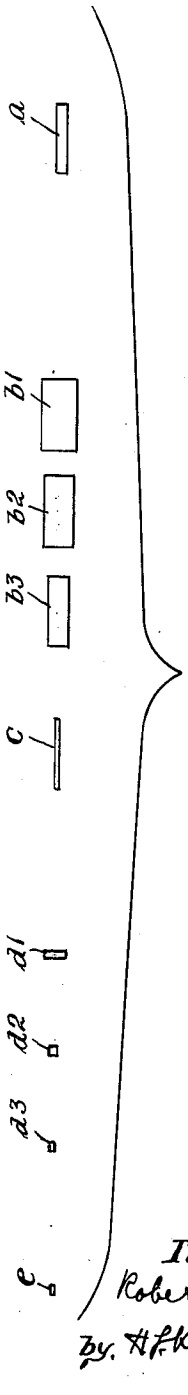


Fig. 2.

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6 Sheets-Sheet 2

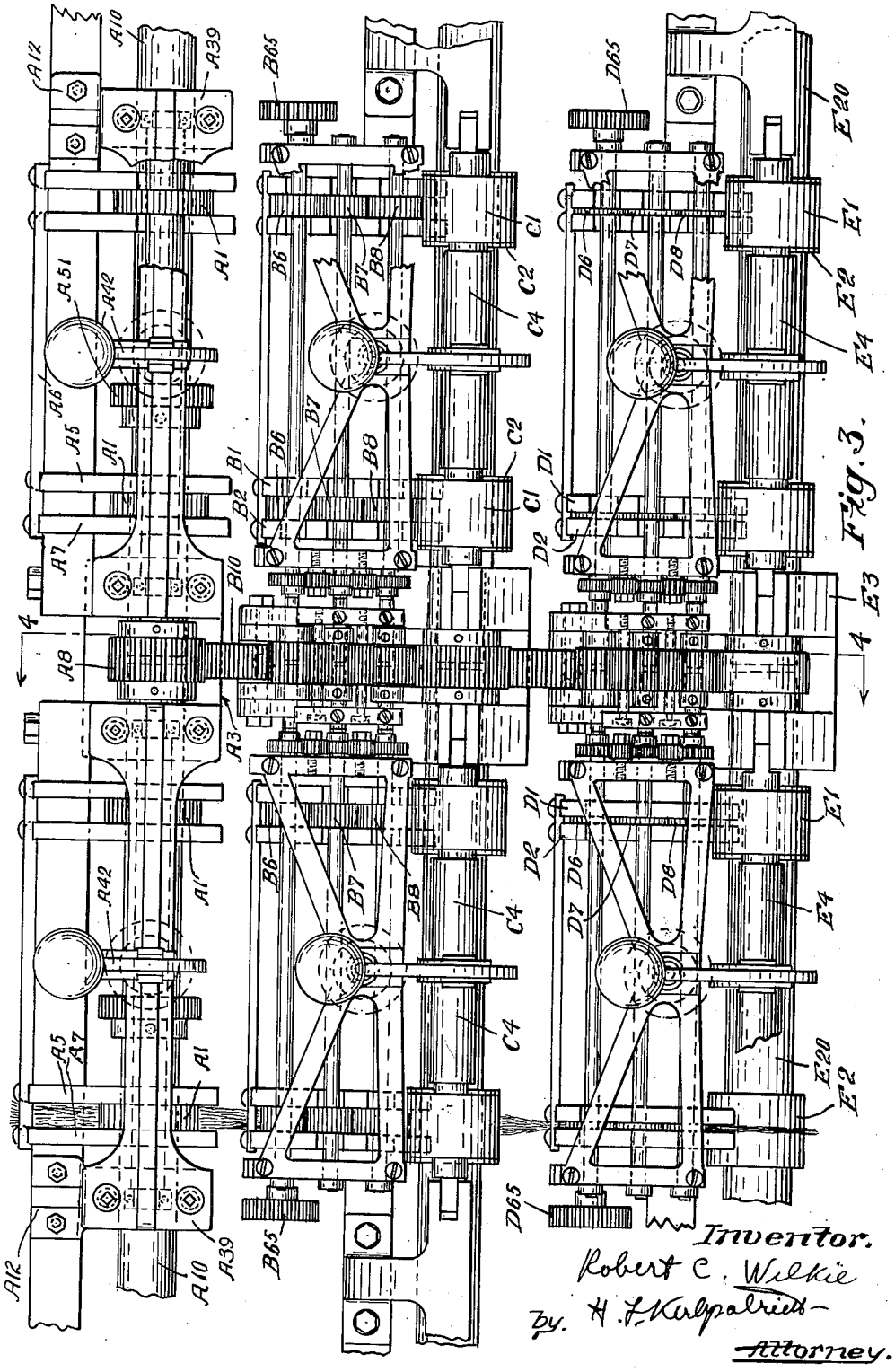


Fig. 3.

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6 Sheets-Sheet 3

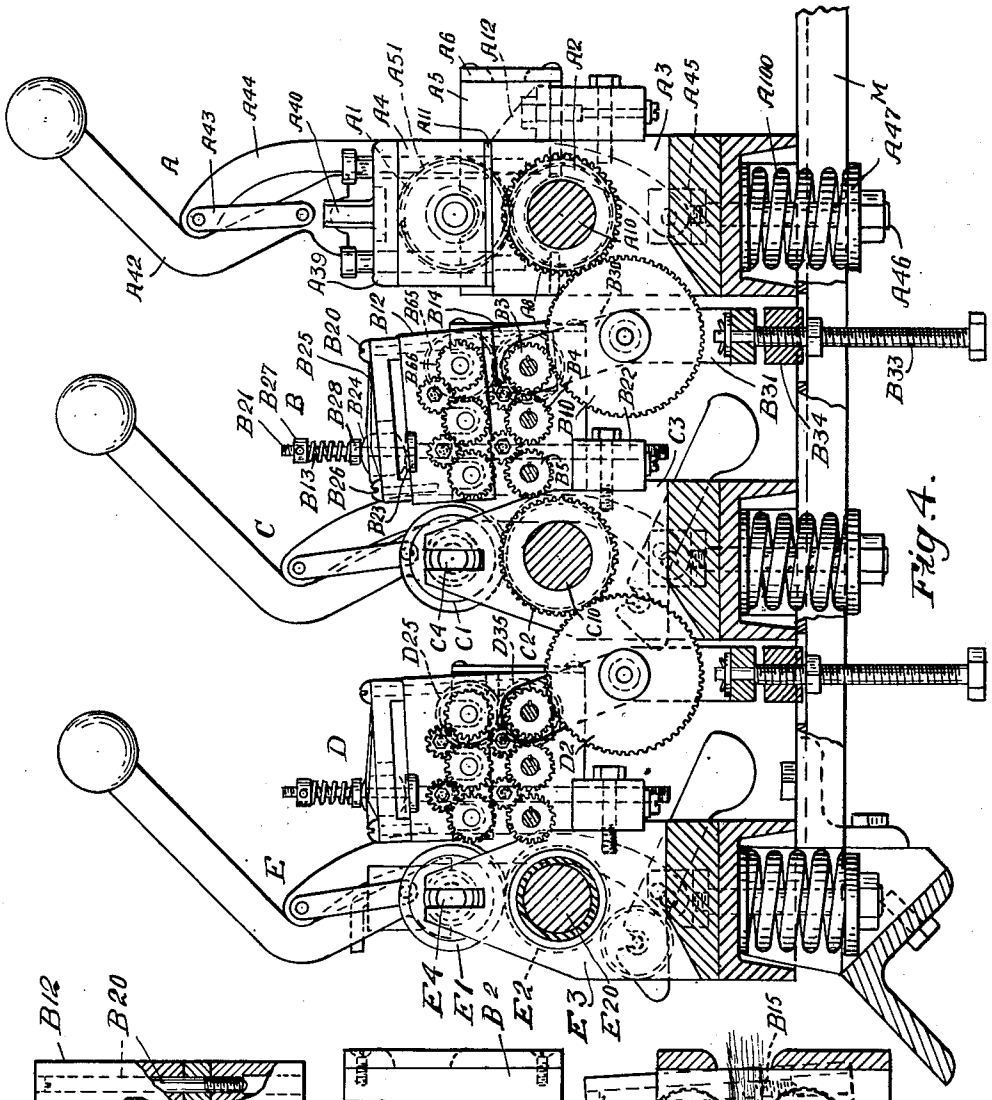


Fig. 4.

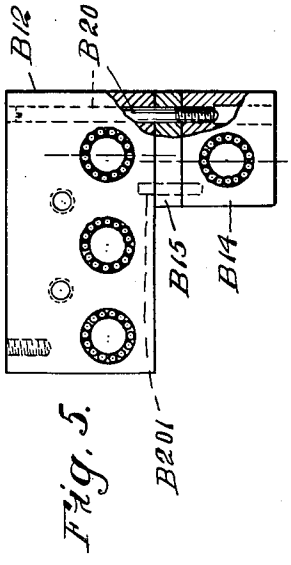


Fig. 5.

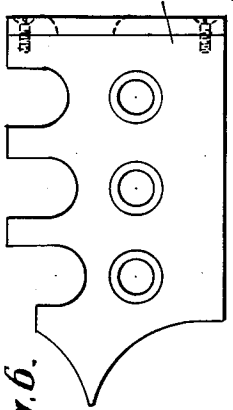


Fig. 6.

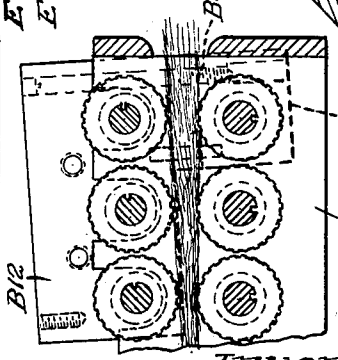


Fig. 7.

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APPARATUS AND METHOD FOR THE TREATMENT OF TEXTILE FIBERS IN STRAND FORM

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Fig. 8.

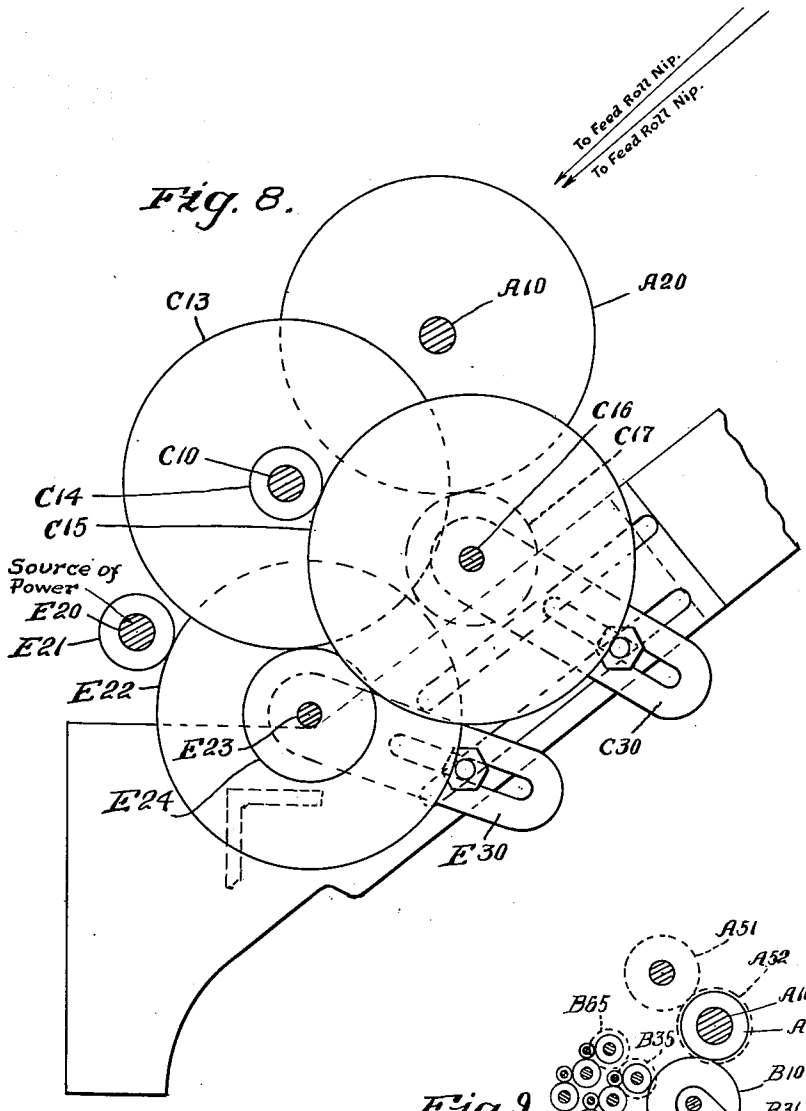
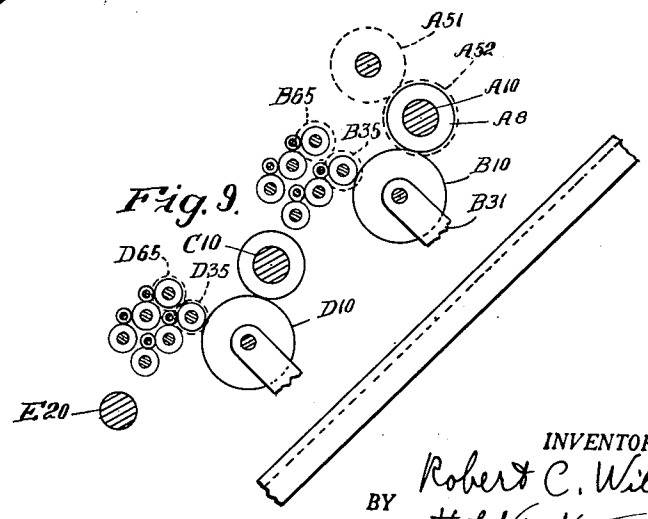


Fig. 9.



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6 Sheets-Sheet 5

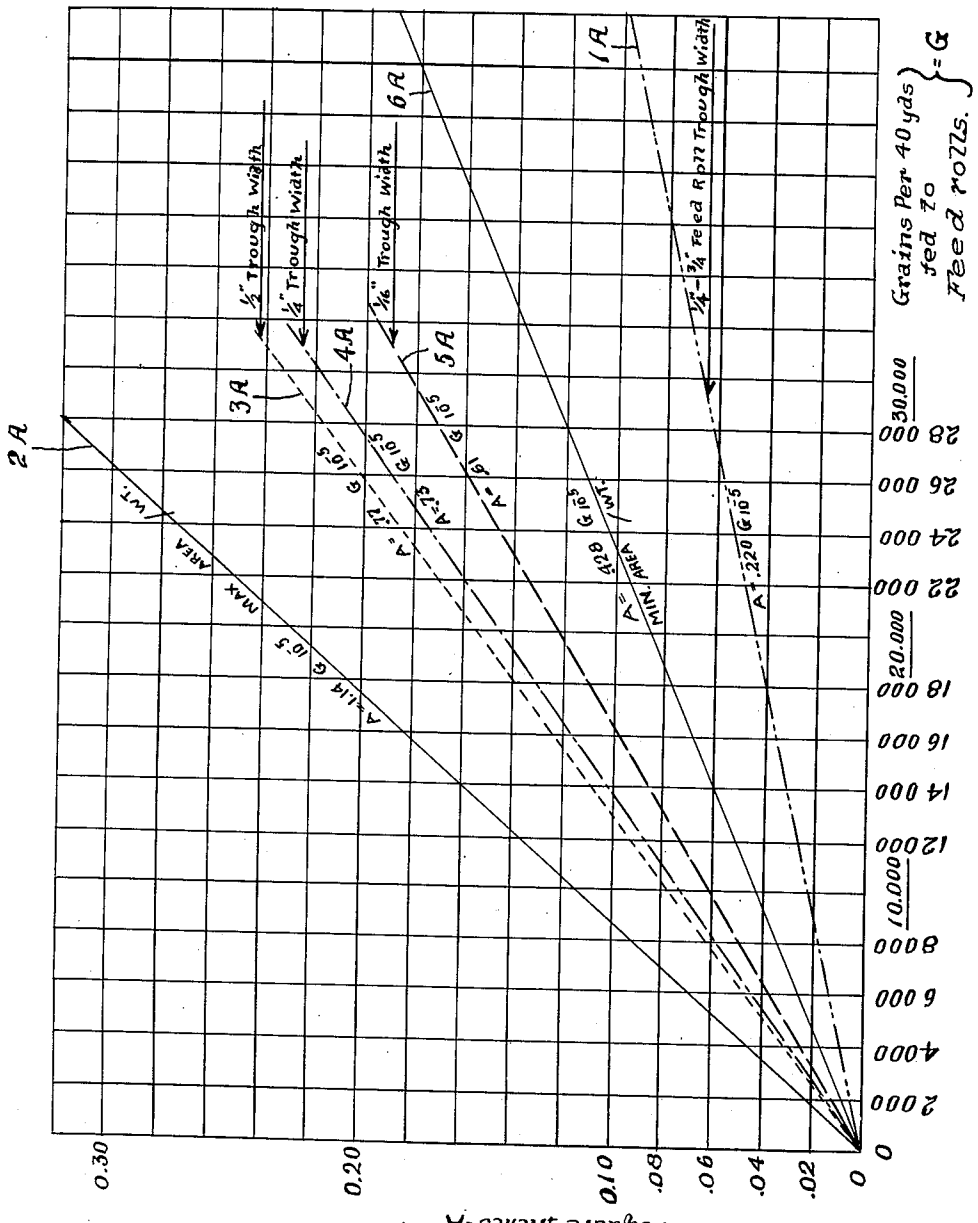


Fig. 10.

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6 Sheets-Sheet 6

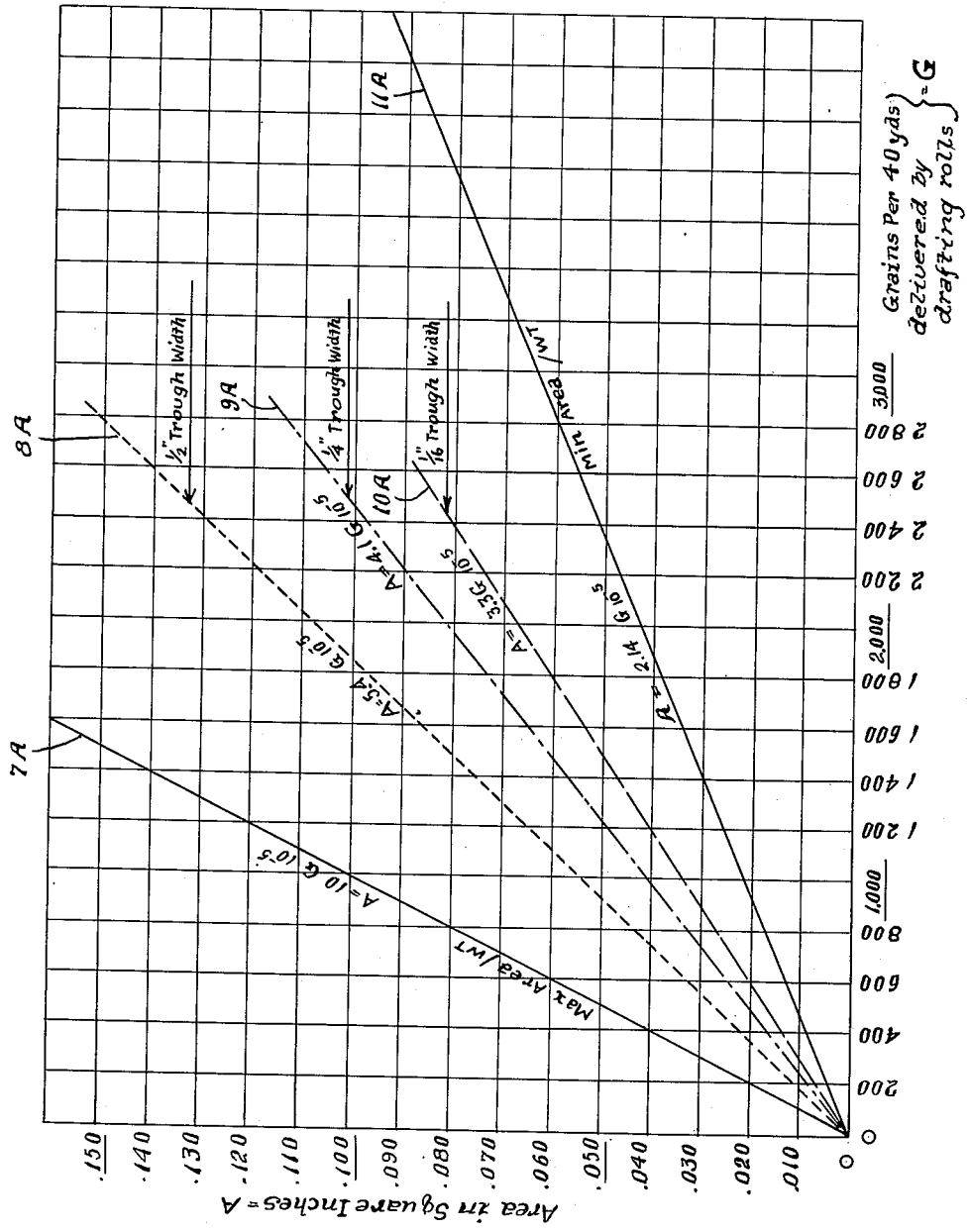


Fig. 11.

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Patented Dec. 16, 1952

2,621,372

UNITED STATES PATENT OFFICE

2,621,372

APPARATUS AND METHOD FOR THE TREATMENT OF TEXTILE FIBERS IN STRAND FORM

Robert C. Wilkie, Andover, Mass., assignor to Pacific Mills, Lawrence, Mass., a corporation of Massachusetts

Application May 9, 1946, Serial No. 668,396

29 Claims. (Cl. 19—130)

1

This invention relates to apparatus and methods for the treatment of textile fibers in strand form and has particularly to do with the drawing and blending of wool fibers, long or short, with or without the addition thereto of other natural fibers, or synthetic fibers (or both), whether or not they differ in length from the usually longer wool fibers, though the invention is also useful for such other kinds or lengths of textile fibers, alone or mixed.

By the employment of this invention, and despite large differences in lengths of fibers that may be handled, wool, cotton, synthetic textile fibers (rayon, nylon, Aralac, etc.) can be handled alone or combined, drawn, and blended to produce, with or without doublings, highly uniform products, including slivers, rovings and yarns.

According to my preferred method a sliver (meaning either sliver or roving) is firmly gripped and compressed between feed rolls to a cross-sectional area predetermined in proportion to the weight of the sliver fed to those rolls and the sliver is fed to means which, while advancing it, compacts it in one or more stages to definite cross-sectional area or areas predetermined in proportion to the weight of the sliver at the point or points of compression as the fibers are drawn from the compacted sliver.

The invention will be described in connection with the drawings showing the preferred embodiment thereof, in which,

Fig. 1 is a side sectional elevation generally illustrating the principal groups of mechanism that may be employed;

Fig. 2 shows a series of rectangles illustrating successive cross-sectional orifices or openings through which the textile fibers, in strand form, pass in the mechanism of Fig. 1, the series of rectangles of Fig. 2 being arranged below the respective openings in the mechanism illustrated in Fig. 1;

Fig. 3 is a top plan view of a suitable machine for drawing four strands, with each strand passing through the groups of mechanism illustrated in Fig. 1;

Fig. 4 is a side elevational view taken on line 4—4 of Fig. 3;

Figs. 5 and 6 illustrate the blocks which may be employed in conjunction with certain of the rolls;

Fig. 7 illustrates the blocks of Figs. 5 and 6 together with rolls associated therewith;

Figs. 8 and 9 illustrate the driving arrangement of the machine of Figs. 1 and 3–7 inclusive; and

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Figs. 10 and 11 are charts setting forth certain relationships between masses of material and the areas of openings through which the material passes.

Referring to the drawings in more detail:

The preferred form of my invention is embodied in the machine shown in the drawings in which the material in strand form, top or sliver, is drafted one or more times in succession, and may be delivered from the machine in the form of a sliver, roving or yarn.

This machine has five groups of mechanism, A, B, C, D and E which are mounted on a bed M, Fig. 4. The group A comprises the feeding rolls A1, A2. The group B comprises what is herein termed a "trough" having sides, which confine the material laterally, and pairs of bottom and top pressure rolls, B3—B8, which constitute the effective bottom and top of the trough in which the material is concentrated, i. e., compressed vertically and restrained from expansion laterally, as it is drafted. The group C comprises a pair of rolls C1, C2 which draw the compressed material from the trough at a speed substantially greater than the speed at which it is delivered to the trough by the rolls A1, A2, thereby drafting the material as desired.

The apparatus of groups A, B and C may be employed to effect a single drafting by which a strand may be drawn to a sliver, roving or yarn. Where two draftings are desired in tandem, as in the machine of the drawings, the rolls C1, C2, constitute the feed rolls for the second drafting which employs the groups D and E.

The group D comprises a trough having side walls set more closely together than the side walls of the trough of group B. The trough of group D is provided with upper and lower pairs of pressure rolls, D3—D8, which extend into the trough and constitute the effective bottom and top of the trough. The group E comprises a pair of delivery rolls E1, E2 which draft the material through the trough of group D and reduce it to the desired sliver, roving or yarn. The rolls E1, E2 are driven at a speed greater than the speed of the rolls C1, C2 and hence draft the material as desired. The total draft in the tandem machine shown is the product of the two drafts and may be varied as desired.

The mechanism of group A is adjustably mounted longitudinally of the bed of the machine so the ratch between the rolls A1, A2 and the rolls C1, C2 may be adjusted according to the length of the fibers being drawn. Likewise the mechanisms of groups B and C are adjust-

able as a unit on the bed so that the ratch between the rolls C1, C2 and the rolls E1, E2 may be varied according to the length of the fibers being drawn.

The supply of material, consisting, for example, of a sliver or multiple slivers, is fed in from the right, Fig. 1. It passes first between the fluted steel rolls A1 and A2. The roll A2 is journaled in a block A3, Fig. 4. The roll A1 is journaled in a block A4, Fig. 4, which is vertically positioned by shims A11, which may be changed, on the blocks A3 and A12 to fix the minimum distance desired between the rolls. The rolls A1 and A2 are driven by gearing to be described.

The rolls A1, A2 extend between the side walls A5, A7 of a trough into which the material is fed through a guide opening in an end plate A6 fastened to the trough walls A5 and A7, Figs. 1 and 3. The material is firmly gripped and compressed at the nip between the rolls A1 and A2 and the side walls A5 and A7 so that it preferably has a fixed cross-section, for example in the form of a rectangle *a*, Fig. 2.

When the material leaves the nip of the rolls A1, A2 it passes through a guide opening in an end plate and then into the trough having the side walls B1, B2, which in the machine shown are ½ of an inch apart, Figs. 1 and 3. In the trough the material passes through the space between the side walls B1, B2, lower pressure rolls B3, B4 and B5 and upper pressure rolls B6, B7 and B8, Fig. 1. The rolls are preferably of steel and fluted.

The lower rolls are mounted on shafts journaled in the side trough walls B1, B2 and are geared together by intermediate gears, Fig. 4, so that they are rotated by the gear B10 to convey the sliver in the same direction, Figs. 3 and 4. Gear B10 is driven by a gear A8 on the shaft A10, Fig. 9.

The upper rolls B6, B7 and B8 are driven by gearing from a gear on the shaft of roll B3 so that all the rolls B3—B8 are driven in the same peripheral direction and at the same peripheral speed which is slightly faster than the surface speed of the rolls A1, A2 to tension the material. If desired, a pair of rolls may be driven slightly faster than the preceding pair by suitably changing the ratio of the gearing.

The upper rolls B6—B8 are journaled in a block B12, Figs. 5 and 7, which is fastened by bolts B20 and pins B201 to a block B14, Fig. 5. The blocks B12 and B14 are maintained a predetermined distance apart by a shim B15. The block B14 is pivoted on the shaft of the roll B3, Fig. 1, and the left-hand end of block B12 is pressed down by a spring B13 to a predetermined stop B23, Fig. 4, as explained later in detail.

The bottom surfaces of the upper rolls B6, B7 and B8 lie substantially in a plane so that when the left-hand end of the pivoted block B12 is pressed down, the spaces at the nips between each of these rolls and the corresponding roll of the lower set are smaller progressively, Fig. 1, as the material is fed from right to left and drawn by the rolls C1, C2. The minimum height between the rolls B3 and B6 is fixed by the thickness of the shim B15 as desired. The minimum heights of the spaces at the nips between the rolls B4 and B7 and between the rolls B5 and B8 are fixed by adjustable means including the stop B23, which limits the extent to which the left end of frame B12 is depressed by the spring B13. Thus the vertical thickness of the material between successive pairs of rolls diminishes, as shown in

Fig. 2 at *b1*, *b2* and *b3*, in which the horizontal dimension in the drawing is the width of the nip opening, i. e., the width of the trough, and the vertical dimensions are the heights of the respective nip openings. The material fills the space between the pairs of pressure rolls and between the side walls and is confined and compressed by the rolls and the walls. The degree to which the cross-sectional areas of the material, shown as rectangles *b1*, *b2* and *b3*, diminish progressively in vertical thickness, depends on the draft, the staple length and the mass of material being drawn. In some cases, particularly with the shorter staple fibers, or with material which includes a major proportion of shorter staple fibers with longer fibers, it appears satisfactory in practice to have the cross-sectional areas substantially the same. Also, if a longer and uniform staple, for example 3 inch staple rayon material be drawn, the cross-sectional areas may be the same or more nearly the same, whereas with mixed staples and wool and for the usual variety of conditions and materials handled the diminishing cross-sectional areas give better results.

In the preferred practice of the invention, the material being drawn is maintained in rectangular form at the nip opening between each pair of rolls and is thus of uniform thickness throughout its width at the nip opening between each pair of rolls. Thus there are obtained a substantially uniform pressure at each nip and a substantially uniform frictional restraint between the fibers which are being drawn through the compressing means, i. e., the side walls and the rolls of the trough.

The side walls B1, B2 of the trough are provided with portions, shown at the left in Figs. 1 and 6, which confine the material laterally close up to the nip of the rolls C1, C2 so that the mass of material is prevented from unduly spreading sidewise at that nip.

The material passes from the trough of group B to the nip of the rolls, C1 and C2, Fig. 1. The lower roll C2 is fluted and of steel and is mounted in a bearing in a block C3, Fig. 4, which is adjustably fastened on the bed of the machine. The upper roll C1 has a resilient covering, such as rubber, and is journaled on an arbor C4 which is vertically movable in slots in the block C3, Figs. 1, 3 and 4, so that the roll may be pressed strongly against the lower roll by means to be described. The lower roll C2 is positively driven by gearing to be described and the upper roll C1 is driven by the frictional contact of its resilient surface with the surface of the lower roll C2.

The ratch between the first pair of rolls A1, A2 and the pair of rolls C1, C2 is generally and preferably greater than the length of the longest fibers of the material. The blocks, in which the rolls A1, A2 are mounted, are adjustably mounted on the machine bed M so that the ratch may be changed according to the fiber length of the material.

The roll C2 is driven at a peripheral speed which is, for example, from five to twenty or more times the peripheral speed of the roll A2. Thus the material may be drawn out as desired between the pair of rolls A1, A2 and the pair of rolls C1, C2. If no more drafting is desired the product may be delivered from the rolls C1, C2 as shown in Fig. 1, and either collected or spun as there indicated.

The machine, in its tandem form, embodies a second set of drafting means which drafts the material between the rolls C1, C2 and a pair of

rolls E1, E2. Roll E2 is preferably fluted and of steel and is mounted in journals in a block E3, Fig. 4. Roll E1 has a resilient covering, such as rubber, and is mounted on an arbor E4, which is vertically movable in slots in the block E3, Figs. 1, 3 and 4. The roll E1 is pressed strongly against the roll E2 by means to be described, and is driven by the latter.

This second set of drafting means comprises a trough bounded by side walls D1, D2, Fig. 3, and upper and lower pressure rolls D3—D8, Fig. 1, which are the same as those of the group B, except that, as the side walls are spaced more closely together, for example about $\frac{1}{16}$ of an inch apart, the rolls D3—D8 are correspondingly narrow. The side walls D1, D2 have portions which extend close to the nip of rolls E1, E2.

The rolls D3—D8 are driven at the same peripheral speed that is slightly greater than the peripheral speed of the rolls C1, C2. Tht roll E2 is driven at a peripheral speed of, for example, from five to twenty or more times the peripheral speed of the rolls C1, C2 to cause the desired draft. The ratch between the rolls C1, C2 and the rolls E1, E2 is generally and preferably greater than the length of the longest fiber of the material. The block C3, Fig. 4, on which the groups B and C are mounted, is adjustable on the bed of the machine to provide the desired length of ratch.

The material in the nips of the rolls D3—D8 and E1, E2 has a width represented by the horizontal dimension of *d1*, *d2*, *d3* and *e*, Fig. 2, for example $\frac{1}{16}$ of an inch, the width of the trough, and has vertical dimensions represented by the vertical dimensions of *d1*, *d2*, *d3* and *e* respectively.

The total draft is the multiple of the two draftings. The product delivered by the rolls E1, E2, Fig. 1, is in condition to be further drawn or twisted into yarn.

The means by which the upper members of the pairs of rolls of the groups A, B, C, D and E are pressed toward one another will now be described.

The feed rolls A1, A2 take a firm grip of the material without slip at their nip opening which is of a predetermined minimum height, depending on the thickness of the shims A11, which may be changed as desired.

The means for pressing the block A4, in which the roll A1 of group A is mounted, into position on the shims is shown in Fig. 4. The projection A40 on a casting A39 which rests on the top of the block A4 is pressed downward by the end of lever A42 to which is pivoted a link A43, the upper end of which is pivoted to a rod A44, the lower end of which is pivoted in a vertically movable block A45. A stud A46 is threaded into this block and the nut on the stud A46 holds a washer A47 on which the spring A100 bears. Thus, with the parts in the positions shown in Fig. 4, the spring A100 is under compression and presses downwardly the bolt A46, the block A45, the rod A44, the link A43, the lever A42, the casting A39 and the block A4. The downward movement of the block A4 is limited by a predetermined stop, namely the shims A11, so that the roll A1 is pressed strongly towards the roll A2, but is separated therefrom a predetermined and adjustable distance by the shims A11, the distance being determined according to the mass being passed through the rolls as will be set forth.

Substantially the same mechanism is embodied in the group C to press the resiliently covered roll

C1 against the steel roll C2, except that in this case there are no shims to separate the roll C1 from the roll C2 so that the rolls are pressed together.

Substantially the same mechanism is shown in the group E, as in the group C, to press the resiliently covered roll E1 against the roll E2.

The means in group B for adjusting the block block B12 with relation to block B14 to determine the minimum heights of the openings at the nips of the pairs of pressure rolls B3—B6 is as follows:

The block B12, Figs. 4 and 5, is separated from the block B14 by the thickness of the shims B15 between the blocks and the blocks are held in relative position by bolts B20 and the pins B201. The thickness of the shims determines the minimum height of the nip opening between the rolls B3, B6.

To determine the heights of the nip openings between the rolls B4, B7 and between the rolls B5, B8, the block B14 is journaled on the shaft of the roll B3, Fig. 1, and the left end of block B12 is pressed down by the spring B13, Fig. 4, but its downward position is limited as follows. Rod B21 is threaded into cross piece B22 mounted on bearing block C3 mounted on the bed of the machine. The rod is provided with a collar B23 fast thereon which supports a part B24 of frame B25 which is secured to the block B12 by bolts B20 and B26. By adjusting the vertical position of the rod B21 by turning it in the cross piece B22 the extent permitted of the downward position of the left end of the block B12 is limited by the vertical position of the collar B23 which constitutes a predetermined stop. The spring B13 surrounding rod B21 is compressed between an upper collar B27 fast on the rod and a lower collar B28 loose on the rod and bearing against the top of the part B24. By these means the spring B13 presses down the left end of the block B12 as far as it is permitted by the adjustment of the rod B21 and its collar B23 so that the minimum height of the nip openings between the rolls B4 and B7 and between the rolls B5 and B8 are determined.

Substantially the same means is embodied in the group D to determine the minimum nip openings between the pairs of rolls, D3—D8.

The mass of the strand of fibers in the trough of either group B or group D is of such cross-section and so confined and compressed between the sire walls of the trough and the upper pressure rolls and the lower rolls that there is a substantially even pressure throughout the mass of fibers at any given cross-section. The effect is that the fibers in the nip of rolls C1, C2, or E1, E2, are drawn evenly and uniformly by the draft of the rolls and the fibers not caught in the nip are retained by the pressure rolls by which they are accurately and uniformly advanced while confined laterally by the side walls. In the preferred construction, the side walls are shown as fixed but, with wider rolls, they may be made adjustable widthwise to control the cross-section of the strand of fibers.

As the fibers are drawn from a trough the area of the cross-section of the mass of fibers decreases as shown in Fig. 2, but it is important that the minimum cross-sectional area between the rolls of a pair should be limited to a predetermined range of area within which there is an optimum.

I adjust the height of the nip openings between rolls A1, A2, between the entrance rolls of

a trough, such as B3, B6 and D3, D6 and between the exit rolls of a trough, such as B5, B8 and D5, D8, in accordance with the volume or weight of a given length of the material passing between these rolls as will be explained.

The mechanism for driving the several rolls of the machine is shown diagrammatically in Figs. 8 and 9 in which the circles represent the pitch lines of the gears. Shaft E20, Fig. 8, is the driving shaft on which roll E2, Fig. 1, is fast. A gear E21 fast on shaft E20, Fig. 8, meshes with and drives a gear E22 journaled on a stud E23. On the same stud and fastened to gear E22 is gear E24 which drives gear C13 fast on shaft C10 to which is secured roll C2, Fig. 4.

Also fast on shaft C10 is a gear C14, Fig. 8, which drives a gear C15 mounted on stud C16. Gear C17, also mounted on stud C16 and secured to gear C15, drives gear A20 fast on shaft A10 on which roll A2 is fastened, Fig. 4. Thereby shafts C10 and A10 are driven from shaft E20. By changing the sizes of gears E21, E24, C17 and C14 the drafts may be altered.

The stud E23 is on the end of slotted arm E30 which is adjustably secured to the frame of the machine, which has a slot, by a bolt passing through the slots, Fig. 8. Thereby, when the group C is adjusted on the bed of the machine to vary the ratch between rolls C1, C2 and the rolls E1, E2, the gear E22 may be repositioned to mesh with the gear E21 and the gear E24 may be repositioned to mesh with the gear C13. Likewise stud C16 on the end of slotted arm C30 may be adjusted to maintain the meshing of gears C14 and C15 with gears C17 and A20 when group A is moved on the bed of the machine to change the ratch between rolls A1, A2 and rolls C1, C2.

To drive the rolls B3—B8, a gear A8 fast on shaft A10 drives a gear B10 journaled in a yoke B31, Figs. 4 and 9. Gear B10 drives a gear on the shaft of roll B3, which through intermediate gears drives rolls B4 and B5. A gear B35 on shaft of roll B3, Fig. 9, drives a gear B65 on the shaft of roll B6. Another gear on the shaft of roll B6 drives, through intermediate gears, gears on shafts of rolls B7 and B8. When the distance between B3 and B6 is changed by the use of shims B15 of different thicknesses, Fig. 5, the gears B35 and B65 are changed correspondingly.

Gear B10, Fig. 4, is journaled in a yoke B31 which is vertically and horizontally adjustable with relation to the bed of the machine by the bolt B33 which is threaded into a block B34 which is adjustably secured to the bed of the machine. Thus, when the group C mechanism is adjusted horizontally on the bed of the machine to change the ratch between rolls C1, C2 and rolls A1, A2, the gear B10 may be so adjusted to mesh with gear A8. The gear B10 is also positioned by arms B30 which are pivotally mounted on the shaft of roll B3 so that the gear B10 is always in mesh with the gear on the shaft of roll B3.

The rolls D3—D8 of group D are driven from the shaft C10 in the same manner and by similar means as are the rolls of group B driven from the shaft A10.

A gear A52 fast on shaft A10 drives a gear A51, Fig. 9, fast on the shaft of roll A1, Figs. 3, 4 and 9. The teeth of gears A51 and A52 are of sufficiently coarse pitch so that, whatever the relative usable adjustment of roll A1 to roll A2 may be, the teeth remain in mesh.

An important feature in the preferred forms and use of the apparatus herein described, for best results, involves certain relationships between the mass of the material being handled and the size (area) of the respective nip openings through which the material is conducted in the course of being drawn, blended, etc. When the area of such openings is thus properly related, the pressure upon and hence the frictional restraint of the fibers inter se are rendered more uniform, so that, as a consequence, the drawing operation is rendered precise and uniform drawn products are attained, especially, when the material is subjected to relatively high drafts, for example, to successive drafts up to twenty or more.

In Figs. 10 and 11 of the drawings, the relationships of areas of typical nip openings to masses of fiber, suitable for textiles, which are drawn therethrough, are graphically indicated to illustrate a feature of my invention which is of great practical value and which I believe to be novel.

In Fig. 10 the line 1A represents the relationship of the mass of material to the area (in square inches) of the optimum opening at the nip of the feed rolls A1, A2 between the sides A5, A7 of the trough, the width between the sides being from ¼ to ¾ of an inch. The area varies in proportion to the weight of the material, taken as grains per 40 yards, which I call G. I have determined that this relationship, indicated by the line 1A, is at an optimum when the area A equals .220 times G 10^{-5}. If the pressure applied to the roll A1 is such as to reduce the area much below this optimum the pressure on the fibers may become so great as to injure them. On the other hand, the pressure should not be reduced to a value such that the material slips, that is, the area preferably should not be greater than .253 G 10^{-5}.

The five lines 2A to 6A represent the relationships of the masses of material to the areas at the nip of the first pair of rolls B6, B3, or D6, D3 at the entrance of a trough between the side walls of the trough.

The lines 2A and 6A represent respectively the relationships of the mass of material to the approximate maximum area between the rolls and to the approximate maximum area between the rolls. These areas are respectively equal to 1.14 G 10^{-5} and .428 G 10^{-5}. Between these lines 2A and 6A there is a range of areas with which good results may be obtained with optimum drafts, but as departure is made from the optimum the results are less satisfactory.

The lines 3A, 4A and 5A represent, respectively, the optimum relationships in the typical case of the apparatus shown in the drawings in which the sizes of the rolls and the distances by which they are separated are substantially as shown in Fig. 1.

The line 3A represents the optimum relationship of the mass of material to the area between the nip of the rolls B3 and B6 with a trough width of ½ in. This area I have found to be .77 G 10^{-5}.

The line 4A represents the optimum relationship of the mass of material to the area between the rolls B3 and B6 with a trough width of ¼ in. This area is equal to .73 G 10^{-5}.

The line 5A represents the optimum relationship of the mass of material to the area between the rolls with a trough width of $\frac{1}{16}$ of an inch. This area is equal to .61 G 10^{-5}.

In Fig. 11 the lines 7A to 11A represent the relationships of the masses of material to the areas at the nip of the pair of rolls at the exit

of a trough on the assumption that these masses are taken as being in direct ratio to the masses of material in the nip of the drafting rolls C1, C2, or E1, E2, as the case may be.

The lines 7A and 11A represent respectively the relationship of the masses of material, on this assumption, to the approximate maximum area between the rolls and the approximate minimum area between the rolls. These areas I have found to be respectively 10 G 10^{-5} and 2.14 G 10^{-5}, where G is equal to the grains per 40 yards of the sliver at the nip of the drafting rolls, it being impracticable to measure the weight of the material at the nip of the exit rolls of the trough. Between these lines 7A and 11A there is a range of areas with which good results may be obtained with optimum draft, but as departure is made from the optimum the results are less satisfactory.

The lines 8A, 9A and 10A represent respectively the optimum relationships on the same assumption in the typical case of the apparatus represented in the drawings in which the sizes of the rolls and the distances by which they are separated are substantially as shown in Fig. 1.

The line 8A represents the optimum relationship of the mass of material to the area at the nip of the pair of rolls with a trough width of ½ in. This area I have found to be 5.4 G 10^{-5}, where G is equal to the grains per 40 yards of the material at the nip of the drafting rolls.

The line 9A represents the optimum relationship of the mass of material to the area at the nip of the pair of rolls with a trough width of ¼ in. This area I have found to be 4.1 G 10^{-5}, where G is equal to the grains per 40 yards of the material at the nip of the drafting rolls.

The line 10A represents the optimum relationship of the mass of material to the area at the nip of the pair of rolls with a trough width of $\frac{1}{16}$ of an inch. This I have found to be 3.3 G 10^{-5}, where G is equal to the grains per 40 yards of the material at the nip of the drafting rolls.

In the graphs shown in Figs. 10 and 11 the areas of the openings expressed include cases of troughs which are, respectively, ½, ¼, and $\frac{1}{16}$ of an inch in width. The graphs also show preferred maximum and minimum areas of openings comprising ranges which are applicable to troughs of any usable width.

The following examples represent the processing of material, according to my invention, of wool, viscose, blends of wool and rayon and cotton.

1. Three ends of 40s grade wool, 12 in. maximum staple length, of uncombed worsted sliver making 19,005 grains per 40 yards were fed to the machine. The total draft was 107 and a 2.8 hank roving, worsted count, was produced weighing 178 grains per 40 yards. The roving was then spun into 18s worsted count yarns.

The following were the width, depth and area in inches of the openings between pairs of rolls:

	Width	Depth	Area
Rolls A1, A2	.50	.0937	.0468
Rolls B3, B6	.50	.3125	.1562
Rolls B5, B8	.50	.1718	.0859
Rolls D3, D6	.0625	.1562	.0098
Rolls D5, D8	.0625	.0781	.0049

2. Two ends of 100% 64s wool top, making 21,000 grains per 40 yards, were fed to the machine. The total draft was 173 and a 4 hank roving, worsted count, was produced weighing 123 grains per 40 yards.

The following were the width, depth and area in inches of the openings between pairs of rolls:

	Width	Depth	Area
Rolls A1, A2	.50	.0937	.0468
Rolls B3, B6	.50	.2818	.1409
Rolls B5, B8	.50	.1718	.0859
Rolls D3, D6	.0625	.1562	.0098
Rolls D5, D8	.0625	.0625	.0039

3. Two ends of 100% 64s wool top, making 14,000 grains per 40 yards, were fed to the machine. The total draft was 56 and a 2 hank roving, worsted count, was produced weighing 250 grains per 40 yards.

The following were the width, depth and area in inches of the openings between pairs of rolls:

	Width	Depth	Area
Rolls A1, A2	.50	.0625	.0312
Rolls B3, B6	.50	.2187	.1093
Rolls B5, B8	.50	.2031	.1015
Rolls D3, D6	.0625	.1875	.0117
Rolls D5, D8	.0625	.1250	.0078

4. Six ends of 100% 1 denier bright viscose, $1\frac{9}{16}$ in. staple length, making 12,002 grains per 40 yards, were fed to the machine. The total draft was 193.8 and a 7.6 hank roving, worsted count, was produced weighing 65 grains per 40 yards.

The following were the width, depth and area in inches of the openings between pairs of rolls:

	Width	Depth	Area
Rolls A1, A2	.50	.0937	.0468
Rolls B3, B6	.50	.2187	.1093
Rolls B5, B8	.50	.1875	.0937
Rolls D3, D6	.0625	.0937	.0058
Rolls D5, D8	.0625	.0468	.0029

5. One end of 100% R–99 5.5 denier bright viscose, 3½ to 6 in. staple length, making 13,721 grains per 40 yards, was fed to the machine. The total draft was 423 and 1/15.5s (single 15½s) yarn, worsted count, was produced weighing 32.5 grains per 40 yards.

The following were the width, depth and area in inches of the openings between pairs of rolls:

	Width	Depth	Area
Rolls A1, A2	.50	.0625	.0312
Rolls B3, B6	.50	.1875	.0937
Rolls B5, B8	.50	.0780	.0390
Rolls D3, D6	.0625	.0625	.0039
Rolls D5, D8	.0625	.0310	.0019

6. Two ends of a blend of 20% of 62s wool top and of 80% of 1 denier, $1\frac{9}{16}$ in. staple, bright viscose, making 10,920 grains per 40 yards, were fed to the machine. The total draft was 173 and a 7.8 hank roving, worsted count, was produced weighing 63.5 grains per 40 yards.

The following were the width, depth and area in inches of the openings between pairs of rolls:

	Width	Depth	Area
Rolls A1, A2	.50	.0937	.0468
Rolls B3, B6	.50	.2187	.1093
Rolls B5, B8	.50	.1875	.0937
Rolls D3, D6	.0625	.0937	.0058
Rolls D5, D8	.0625	.0468	.0029

7. Two ends of a blend of 80% of 62*s* wool top and of 20% of 1 denier, $1\frac{9}{16}$ in. staple, bright viscose, making 21,000 grains per 40 yards, were fed to the machine. The total draft was 173 and a 5 hank roving, worsted count, was produced weighing 100 grains per 40 yards.

The following were the width, depth and area in inches of the openings between pairs of rolls:

	Width	Depth	Area
Rolls A1, A2	.50	.0937	.0468
Rolls B3, B6	.50	.2812	.1406
Rolls B5, B8	.50	.1718	.0859
Rolls D3, D6	.0625	.1562	.0098
Rolls D5, D8	.0625	.0729	.0045

8. Five ends of 100% cotton, $\frac{15}{16}$ in. staple single drawn card sliver, making 12,460 grains per 40 yards, were fed to the machine. The total draft was 114 and a 4.5 hank roving, worsted count, was produced weighing 111 grains per 40 yards.

The following were the width, depth and area in inches of the openings between pairs of rolls:

	Width	Depth	Area
Rolls A1, A2	.50	.0937	.0467
Rolls B3, B6	.50	.2187	.1093
Rolls B5, B8	.50	.1090	.0545
Rolls D3, D6	.0625	.0937	.0058
Rolls D5, D8	.0625	.0416	.0026

9. The process was carried out in two stages, first with a machine consisting of groups A, B and C, in which the walls, which confine the material, were ½ an inch apart, and second with a machine consisting of groups A, B, D, C and E in which the material confining walls of groups A and B were ¼ of an inch apart and the walls of group D were $\frac{1}{16}$ of an inch apart.

Two ends of a blend of 100% 62*s* wool top, 70% olive drab and 30% white, making 21,000 grains per 40 yards, were fed to the first machine. The draft was 11.2 and a sliver was produced weighing 1875 grains per 40 yards.

The following were the width, depth and area in inches of the openings between pairs of rolls:

	Width	Depth	Area
Rolls A1, A2	.50	.0937	.0468
Rolls B3, B6	.50	.2812	.1406
Rolls B5, B8	.50	.1875	.0937

Four ends of this sliver, making 7,500 grains per 40 yards, were fed to the second machine. Therein the total draft was 90.2 and a 6 hank roving, worsted count, was produced weighing 83 grains per 40 yards.

The following were the width, depth and area in inches of the openings between pairs of rolls:

	Width	Depth	Area
Rolls A1, A2	.25	.0755	.0188
Rolls B3, B6	.25	.2187	.0546
Rolls B5, B8	.25	.1250	.0312
Rolls D3, D6	.0625	.0937	.0058
Rolls D5, D8	.0625	.0468	.0029

Although the number of doublings was only 240, (including 30 doublings in previous gillings and the 8 doublings in the machine of the invention) the finished fabric made from the roving as above produced, was identical in all respects, such as yarn structure, hand, fiber to

fiber blend etc., with a fabric made from roving in the conventional manner and having 38,400 doublings (including 5 doublings in gillings and 7,680 doublings in the conventional drawing operations).

10. The process was carried out in two stages, first with a machine consisting of groups A, B and C, in which the walls, which confine the material, were ½ an inch apart, and second, with a machine consisting of groups A, B, C, D and E in which the material confining walls of groups A and B were ½" apart and the walls of group D were $\frac{1}{16}$ of an inch apart.

Two ends of 100% wool top, i. e., one end 62*s* and one end 64*s* white, making 21,000 grains for 40 yards were fed to the first machine. The draft used was 12 and the sliver produced weighed 1750 grains per 40 yards.

The following were the width, depth and area in inches of the openings between pairs of rolls:

	Width	Depth	Area
Rolls A1, A2	.50	.0937	.0468
Rolls B3, B6	.50	.2812	.1406
Rolls B5, B8	.50	.1875	.0937

Eight ends of this sliver, making 14,000 grains per 40 yards, were fed to the second machine. Therein the total draft was 173, and a 6.0 hank roving. worsted count, was produced weighing 81 grains per 40 yards.

The following were the width, depth and area of the openings between pairs of rolls:

	Width	Depth	Area
Rolls A1, A2	.5	.0625	.0312
Rolls B3, B6	.5	.1875	.0937
Rolls B5, B8	.5	.1093	.0547
Rolls D3, D6	.0625	.0625	.0039
Rolls D5, D8	.0625	.0468	.0029

In acordance with the apparatus and methods of this invention fibers may be handled despite differences, even large differences, in lengths, character and color, and can be combined, drawn and blended to produce highly uniform slivers, rovings and yarns. Moreover, fibers, including fibers of elastic characteristics, such as wool or nylon, or blends of the same, may be subjected to high drafts, such as are usually considered impractical on existing machinery because of irregularities in the resultant products, particularly with elastic fibers. By this invention however, because of the precise control of the fibers prior to and within the drafting zone, as fully described above, drafts even in excess of the current so-called "high draft" methods are attained, doublings are minimized and much more uniform products are obtained, with resultant savings because of the fewer operations required.

I claim:

1. A drafting unit comprising upper and lower feed rolls, means to drive said feed rolls at the same surface speed, means to press said rolls yieldingly towards each other, means to normally hold the surfaces of said rolls at a predetermined minimum distance apart, means extending on each side of the nip of said rolls to confine the sliver laterally, drafting rolls, means to drive one of said drafting rolls at a surface speed substantially greater than the surface speed of said feeding rolls, the other of said drafting rolls having a surface of resilient material, means to press said rolls yieldingly together, means be-

tween said feed rolls and said drafting rolls to compress the sliver into a compact mass, said means comprising side walls forming a space of a predetermined width extending from near the feed rolls to a point between the curved surfaces of said drafting rolls and immediately adjacent to the nip of said rolls and three pairs of rolls forming a set of three lower rolls and a set of three upper rolls, all of said rolls having surfaces between said side walls, means to drive said rolls at the same surface speed slightly faster than the surface speed of the feed rolls, means to press at least one of the upper rolls toward the lower set of said rolls, means to normally hold the surfaces of the rolls of the first pair a predetermined minimum distance apart and means to normally hold the surfaces of the rolls of the third pair a predetermined distance apart, whereby the feed rolls and the adjacent side walls are adapted to grip firmly a sliver delivered thereto and compress it into a compact substantially vertical rectangular form of predetermined depth and said pairs of rolls, between the feed rolls and the drafting rolls, and the adjacent side walls are adapted to bear upon the sliver delivered from the feed rolls, to feed the same and to compress the sliver into a compact substantially vertical rectangular form of predetermined area at the nip of the first pair of said rolls and to compress the sliver into a compact rectangular form of a smaller predetermined area at the nip of the third pair of rolls and to deliver the sliver substantially in said form to the drafting rolls.

2. A drafting unit comprising upper and lower feed rolls, means to drive said feed rolls at the same surface speed, means to press said rolls yieldingly towards each other, means to normally hold the surfaces of said rolls at a predetermined minimum distance apart, means to confine the sliver laterally in advance of the nip of said rolls, drafting rolls, means to drive one of said drafting rolls at a surface speed substantially greater than the surface speed of said feed rolls, the other of said drafting rolls having a surface of resilient material, means to press said rolls yieldingly together, means between said feed rolls and said drafting rolls to compress the sliver into a compact mass, said means comprising side walls forming a space of a predetermined width extending from near the feed rolls to a point between the curved surfaces of said drafting rolls and immediately adjacent to the nip of said rolls and at least two pairs of rolls forming a set of lower rolls and a set of upper rolls, all of said rolls having surfaces between said side walls, means to drive said rolls at the same surface speed slightly faster than the surface speed of the feed rolls, means to press at least one of the upper rolls toward the lower set of said rolls, means to normally hold the surfaces of the rolls of the first pair a predetermined minimum distance apart and means to normally hold the surfaces of the rolls of the last pair a predetermined minimum distance apart, whereby the feed rolls are adapted to grip firmly a sliver delivered thereto and compress it into a compact substantially vertical rectangular form of predetermined depth and said pairs of rolls, between the feed rolls and the drafting rolls, and the adjacent side walls are adapted to bear upon the sliver delivered from the feed rolls, to feed the same and to compact the sliver into a compact substantially vertical rectangular form of predetermined area at the nip of the first pair of said rolls and to compact the sliver into a compact substantially vertical rectangular form of a smaller predetermined area at the nip of the last pair of rolls and to deliver the sliver substantially in said form to the drafting rolls.

3. A drafting unit comprising upper and lower feed rolls, means to drive said feed rolls at the same surface speed, means to press said rolls yieldingly towards each other, means to normally hold the surfaces of said rolls at a predetermined minimum distance apart, drafting rolls, means to drive at least one of said drafting rolls at a surface speed substantially greater than the surface speed of said feed rolls, means to press said rolls yieldingly together, devices between said feed rolls and said drafting rolls to compress the sliver into a compact mass, said devices comprising means forming a space of a predetermined width and at least two pairs of rolls forming a set of lower rolls and a set of upper rolls, all of said rolls having surfaces between said space-forming means, resilient pressure devices to press at least one of the upper rolls toward the lower set of said rolls, means to normally hold the surfaces of the rolls of the first pair a predetermined minimum distance apart and means to normally hold the surfaces of the rolls of the last pair a predetermined distance apart, whereby the feed rolls are adapted to grip firmly a sliver delivered thereto and compress it into a compact form of predetermined depth and said devices, between the feed rolls and the drafting rolls, are adapted to compact the sliver delivered from the feed rolls into a compact substantially vertical rectangular form of predetermined area at the nip of the first pair of said rolls and to compact the sliver into a compact substantially vertical rectangular form of a smaller predetermined area at the nip of the last pair of rolls and to deliver the sliver substantially in said form to the drafting rolls.

4. A drafting unit comprising upper and lower feed rolls, means to drive said feed rolls at the same surface speed, means to press said rolls yieldingly towards each other, means to normally hold the surfaces of said rolls at a predetermined minimum distance apart, drafting rolls, means to drive at least one of said drafting rolls at a surface speed substantially greater than the surface speed of said feed rolls, means to press said drafting rolls yieldingly together, devices between said feed rolls and said drafting rolls to compress the sliver into a compact mass of substantially vertical rectangular cross-sections, said devices comprising means to confine said mass laterally to a point closely adjacent to the nip of the drafting rolls and means to confine said mass vertically, said last-named means comprising at least two pairs of rolls, resilient pressure devices to press at least one of the upper rolls toward the lower of said rolls, means to normally hold the surfaces of the rolls of the first pair a predetermined minimum distance apart and means to normally hold the surfaces of the rolls of the last pair a predetermined distance apart.

5. A drafting unit comprising upper and lower feed rolls, means to drive said feed rolls at the same surface speed, means to confine the sliver laterally at the nip of said rolls, adjustable means providing a predetermined minimum area of opening of the nip of said rolls, drafting rolls, one of which has a surface of resilient material, means to drive one of said drafting rolls at a surface speed substantially greater than the surface speed of said feed rolls, means to press said drafting rolls together, devices between said feed-

ing rolls and said drafting rolls to compress the sliver into a uniform mass of substantially vertical rectangular decreasing cross-sections, said devices comprising width limiting means, extending to a point between the curved surfaces of said drafting rolls and immediately adjacent to the nip of said rolls and providing a space of a predetermined width, and at least two pairs of rolls forming a set of lower rolls and a set of upper rolls, all of said rolls having surfaces between said width limiting means, means to drive said rolls at a surface speed slightly faster than the surface speed of the feed rolls, and means to adjust one of the rolls of the first pair to provide a predetermined minimum distance between their surfaces, means to adjust one of the rolls of a succeeding pair to provide a smaller predetermined minimum distance between their surfaces, whereby the feed rolls are adapted to grip firmly a sliver delivered thereto and compress it into a compact substantially vertical rectangular form of predetermined depth and said devices between the feed rolls and the drafting rolls are adapted to compact the sliver delivered from the feed rolls into rectangular forms of predetermined decreasing areas and to deliver the sliver in substantially rectangular form to the drafting rolls.

6. A drafting unit having feed rolls and drafting rolls and devices between said feeding rolls and said drafting rolls to compress the sliver into a mass of substantially vertical rectangular decreasing cross-sections, said devices including side walls extending to a point between the curved surfaces of said drafting rolls and adjacent to the nip of said rolls and providing a space of a predetermined width, sliver confining means having surfaces between said side walls, means to drive said sliver confining means at a surface speed slightly faster than the surface speed of the feed rolls, and means to adjust said sliver confining means to provide a space between the surfaces of said sliver confining means of predetermined decreasing minimum depths, whereby said devices between the feed rolls and the drafting rolls are adapted to compact the sliver into substantially vertical rectangular forms of predetermined decreasing areas and to deliver the sliver in substantially rectangular form to the drafting rolls.

7. A drafting unit having feed rolls and drafting rolls and devices between said feeding rolls and said drafting rolls to compress the sliver into a mass of rectangular decreasing cross-sections, said devices including side walls extending to a point between the curved surfaces of said drafting rolls and adjacent to the nip of said rolls and providing a space of a predetermined width, sliver confining means having surfaces between said side walls, means to drive said sliver confining means at a surface speed slightly faster than the surface speed of the feed rolls, and means to adjust said sliver confining means to provide spaces between the surfaces of said sliver confining means and said side walls of substantially vertical predetermined decreasing minimum areas.

8. A drafting unit having feed rolls and drafting rolls and devices between said feed rolls and said drafting rolls to compress the sliver into a mass of decreasing rectangular cross-sections, said devices including parallel side walls extending to a point between the curved surfaces of said drafting rolls and adjacent to the nip of said rolls and providing a space of a predetermined width, pairs of rollers between said side walls, each roller extending from one side wall to the other, the lower roller of each pair being adapted to support and feed the sliver delivered thereto, means to fix the minimum depth of the nip opening between the rollers of the first pair and means to press the rollers of a succeeding pair towards each other and to limit the minimum depth of the nip opening between said rollers.

9. A drafting unit having feed rolls and drafting rolls and devices between said feed rolls and said drafting rolls to compress the sliver into a mass of predetermined rectangular cross-section, said devices including parallel side walls providing a space of a predetermined width and a pair of rollers between said side walls, each roller extending from one side wall to the other, the lower roller of said pair being adapted to support the sliver delivered thereto and means to limit the minimum depth of the nip opening between said rollers.

10. A drafting unit having feed rolls and drafting rolls and devices between said feed rolls and said drafting rolls to compress the sliver into a mass of predetermined rectangular cross-section, said devices including parallel side walls providing a space of a predetermined width and a pair of rollers between said side walls, each roller extending from one side wall to the other, the lower roller of said pair being adapted to support the sliver delivered thereto, means to limit the minimum depth of the nip opening between said rollers and means to drive said rollers to feed said sliver.

11. A drafting unit comprising a pair of feed rolls, a pair of drafting rolls, and fiber feeding and compressing means therebetween, said means including three pairs of rollers driven at a surface speed slightly in excess of the surface speed of said feed rolls and parallel side walls spaced apart the approximate normally effective fiber-contacting width of the rollers of said pairs and extending from the third of said pair of rollers to a point between said drafting rolls to confine and control the maximum width of a strand of fibers presented to and drawn by said drafting rolls.

12. A drafting unit comprising a pair of feed rolls, means to limit the minimum depth of the nip opening between said rolls, drafting rolls, and fiber feeding and compressing means between the feed rolls and the drafting rolls, said means including parallel side walls and three pairs of rollers extending across the space between said side walls and stop means to limit the minimum nip opening between the rollers of each pair to progressively decreasing depths.

13. A drafting unit comprising a pair of feed rolls, means to limit the minimum depth of the nip opening between said rolls, drafting rolls, and fiber feeding and compressing means between the feed rolls and the drafting rolls, said means including parallel side walls and three pairs of rollers extending across the space between said side walls, stop means to limit the minimum nip opening between the rollers of each pair to progressively decreasing depths and means to drive said rollers.

14. A drafting unit comprising a pair of feed rolls, drafting rolls, and fiber feeding and compressing means between the feed rolls and the drafting rolls, said means including parallel side walls and at least two pairs of rollers extending across the space between said side walls and stop means to limit the minimum nip opening between

the rollers of each pair to predetermined progressively decreasing depths.

15. A drafting unit comprising a pair of feed rolls, a pair of drafting rolls, and fiber feeding and compressing means therebetween, said means including parallel side walls, three pairs of rollers, each roller extending from one side wall to the other, devices including a shim to fix the depth of the nip opening of the first pair of rollers and devices to press one member of each of the second and third pairs of rollers toward the other member of said pair and stop means to limit the minimum depth of the nip opening of the second pair of rollers to less than the depth of the nip opening of the first pair of rollers and to limit the minimum depth of the nip opening of the third pair of rollers to less than the minimum depth of the nip opening of the second pair of rollers.

16. A drafting unit comprising a pair of feed rolls, a pair of drafting rolls, and fiber feeding and compressing means therebetween, said means including parallel side walls, at least two pairs of rollers, each roller extending from one side wall to the other, devices including a shim to fix the depth of the nip opening of the first pair of rollers and devices to press one member of the other pair of rollers toward the other member of said pair and a stop to limit the minimum depth of the nip opening of said other pair of rollers to less than the depth of the nip opening of the first pair of rollers.

17. In a drafting unit upper and lower feed rolls, means to drive said feed rolls at the same surface speed, means to compress the sliver at the nip opening between said rolls to a substantially vertical cross-sectional area of approximately .220 G 10^{-5} square inches, said means including side walls extending on each side of the nip of said rolls to confine the sliver laterally, a vertically adjustable block in which one of said feed rolls is journaled, and adjustable shim means to limit the minimum depth of the nip opening between said feed rolls, where G equals the weight in grains of forty yards of the sliver at said nip opening.

18. In a drafting unit upper and lower feed rolls, means to drive said feed rolls at the same surface speed, side walls extending on each side of the nip of said rolls to confine the sliver laterally, a vertically movable block in which one of said feed rolls is journaled, a spring, connections between said spring and said block adapted to act upon said block and to cause said spring to press the feed roll journaled in said block towards the other feed roll and shim means to limit the cross-sectional area of the nip opening between said feed rolls to less than .253 G 10^{-5} square inches, where G equals the weight in grains of forty yards of the sliver at said nip opening.

19. A drafting unit comprising a pair of feed rolls, a pair of drafting rolls, and sliver feeding and compressing means between said pairs of rolls, said means comprising parallel side walls to confine the sliver laterally, at least two pairs of sliver feeding and compressing rollers, each of said rollers extending across the space between said side walls, shim means to limit the minimum cross-sectional area of the nip opening between the rollers of the first pair to between 1.14 G 10^{-5} and .428 G 10^{-5} square inches where G equals the weight in grains of forty yards of the sliver at said nip opening, and adjustable stop means to limit the minimum cross-sectional area of the nip opening between the rollers of the last pair to between 10 G 10^{-5} and 2.14 G 10^{-5} square inches, where G equals the weight in grains of forty yards of the sliver at the nip of the drafting rolls.

20. A drafting unit comprising a pair of feed rolls, a pair of drafting rolls, and sliver feeding and compressing means between said pairs of rolls, said means comprising parallel side walls to confine the sliver laterally, at least two pairs of sliver feeding and compressing rollers, each of said rollers extending across the space between said side walls, shim means to limit the minimum cross-sectional area of the nip opening between the rollers of the first pair to between 1.14 G 10^{-5} and .428 G 10^{-5} square inches, where G equals the weight in grains of forty yards of the sliver at the point of compression.

21. A drafting unit comprising a pair of feed rolls, a pair of drafting rolls, and sliver feeding and compressing means between said pairs of rolls, said means comprising parallel side walls to confine the sliver laterally, at least two pairs of sliver feeding and compressing rollers, each of said rollers extending across the space between said side walls, and adjustable stop means to limit the minimum cross-sectional area of the nip opening between the rollers of the last pair to between 10 G 10^{-5} and 2.14 G 10^{-5} square inches, where G equals the weight in grains of forty yards of the sliver at the nip of the drafting rolls.

22. In a method of drafting a sliver the steps which comprise first simultaneously gripping the sliver firmly, positively advancing it and compressing it to a substantially vertical predetermined cross-sectional area positively limited in width and depth and not over .253 G 10^{-5} square inches, G being the weight in grains per forty yards of the sliver at the point of compression and thereafter drafting said sliver.

23. The method of drafting a sliver which comprises simultaneously gripping the sliver firmly, feeding it and compressing it to a predetermined substantially vertical cross-sectional area and compacting said sliver in stages, in the first of which stages the sliver is compressed to a cross-sectional area positively limited in width and depth and in the range between 1.14 G 10^{-5} and .428 G 10^{-5} square inches, G being the weight in grains of forty yards of the sliver at the point of compacting in said first stage, and in the last of which stages it is compressed to a substantically vertical cross-sectional area positively limited in width and depth and between 10 G 10^{-5} and 2.14 G 10^{-5} square inches and drafted, G being the weight in grains of forty yards of the sliver at the point at which the sliver is gripped and drawn forward to draft it.

24. The method of feeding and drafting a sliver which comprises simultaneously gripping the sliver firmly, feeding it and compressing it to an an initial predetermined substantially vertical rectangular cross-sectional area, then drafting said sliver and while it is being drafted advancing, and compacting it in at least two stages, in the first of which stages the sliver is simultaneously advanced and positively compressed, as it is being drafted to a predetermined substantially vertical rectangular cross-sectional area greater than the initial cross-sectional area and in the last of which stages it is advanced and positively compressed, as it is being drafted, to a predetermined substantially vertical rectangular

cross-sectional area which is less than the preceding cross-sectional area.

25. Drafting means having upper and lower feed rolls and delivery rolls and a draft control unit therebetween comprising upper and lower draft control rollers, side walls extending on each side of the nip of said feed rolls to confine the sliver laterally, means to hold said feed rolls at a minimum predetermined distance apart comprising lower blocks in which the shaft of the lower feed roll is journaled, upper blocks mounted on said lower blocks and in which the upper feed roll is journaled, a spring pressing the said upper blocks toward said lower blocks and adjustable means to limit the position of said upper blocks from said lower blocks to limit the minimum depth of the nip opening between the feed rolls.

26. The method of drafting a sliver which comprises feeding the sliver and in said feeding compressing the sliver to a predetermined substantially vertical cross-sectional area not over .253 G 10^{-5} square inches, G being the weight in grains of forty yards of the sliver at the point of compression, then drafting said sliver and while drafting it compacting it in successive steps, in the first step compressing the sliver, as it is being drafted, to a substantially vertical predetermined cross-sectional area in the range between 1.14 G 10^{-5} and .428 G 10^{-5} square inches, G being the weight in grains of forty yards of the sliver at the point of compressing it in said first step, and in the last step compressing the sliver, as it is being drafted, to a substantially vertical predetermined cross-sectional area between 10 G 10^{-5} and 2.14 G 10^{-5} square inches, G being the weight in grains of forty yards of the sliver at the point at which the sliver is gripped and drawn forward to draft it.

27. The method of drafting a sliver which comprises feeding the sliver, drafting the sliver in a drafting zone, repeatedly compacting the sliver under rolling pressure in said drafting zone at points at which it is being drafted to progressively decreasing rectangular predetermined cross-sectional areas positively limited by a fixed width and by minimum depths to sizes predetermined in proportion to the weights of the sliver at the points of compacting.

28. The method of drafting a sliver which comprises feeding the sliver, thereafter drafting said sliver and, as it is being drafted, firmly gripping it and simultaneously compressing it under rolling pressure to a substantially vertical predetermined cross-sectional area positively limited by a fixed width and by a minimum depth to a size predetermined in proportion to the weight of the sliver at the point of compression.

29. The method of drafting a sliver which comprises firmly gripping said sliver and advancing and compressing it under rolling pressure to a substantially vertical cross-sectional area positively limited in both width and depth to a size predetermined in proportion to the weight of the sliver at the point of compression, thereafter advancing and drafting the sliver and, while so advancing and drafting it, repeatedly compacting it to progressively decreasing substantially vertical predetermined cross-sectional areas positively limited by a fixed width and by minimum depths to predetermined sizes in proportions to the weights of the sliver at the points of compacting.

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