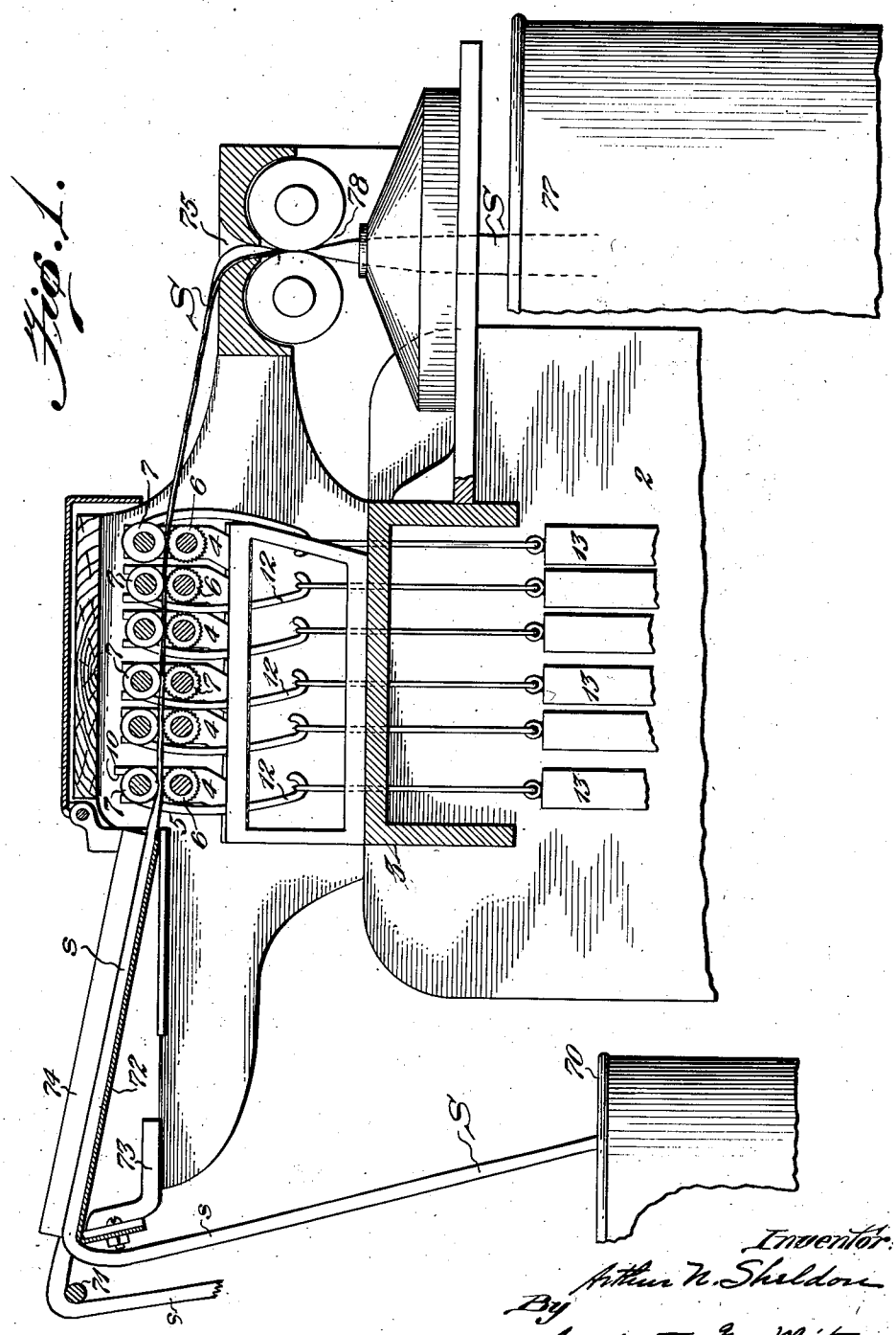
May 4, 1926. 1,583,425

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YARN AND THREAD MANUFACTURE

Filed May 6, 1924 4 Sheets-Sheet 1

Fig. 1.



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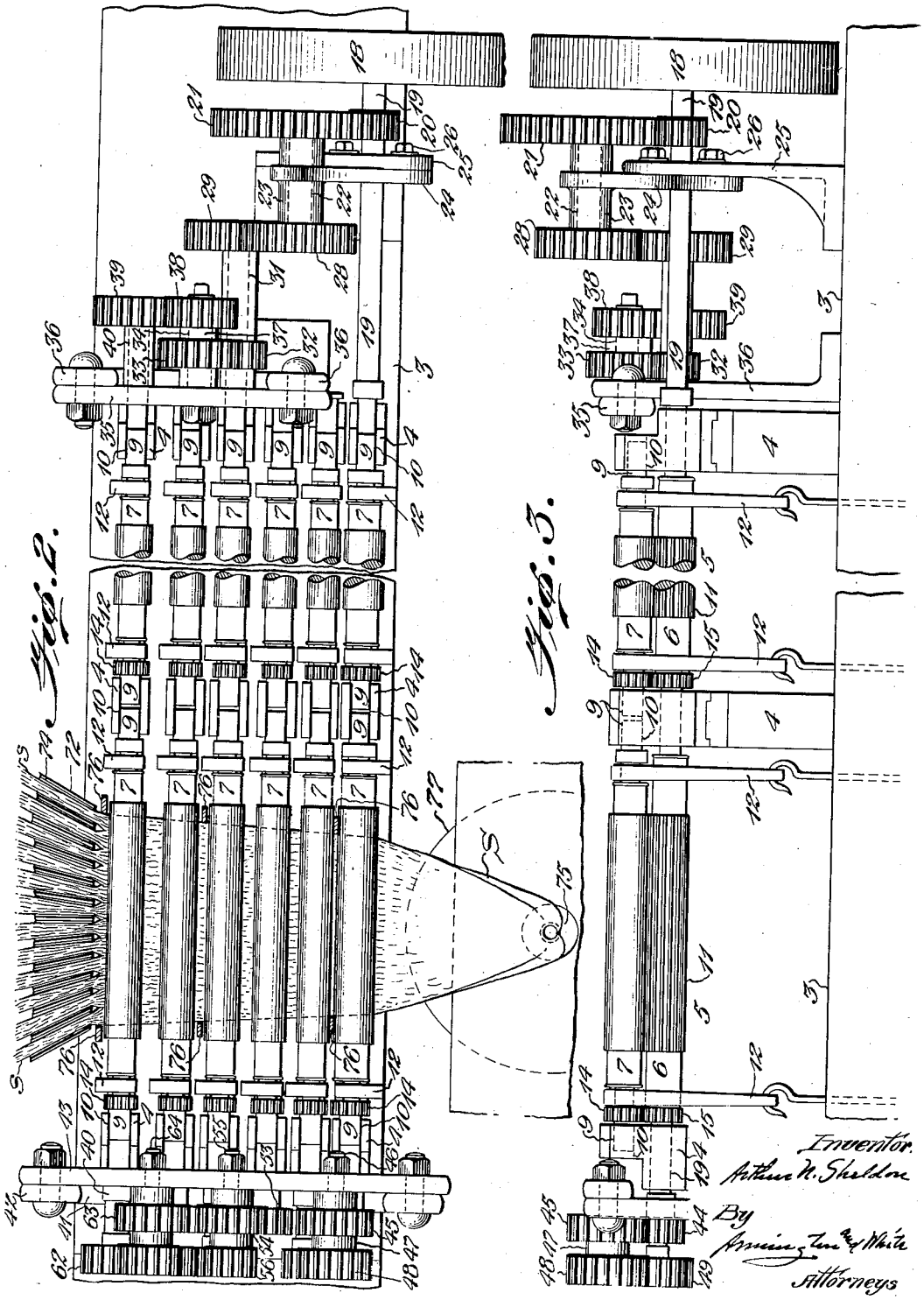


Fig. 2.

Fig. 3.

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YARN AND THREAD MANUFACTURE

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Fig. 4.

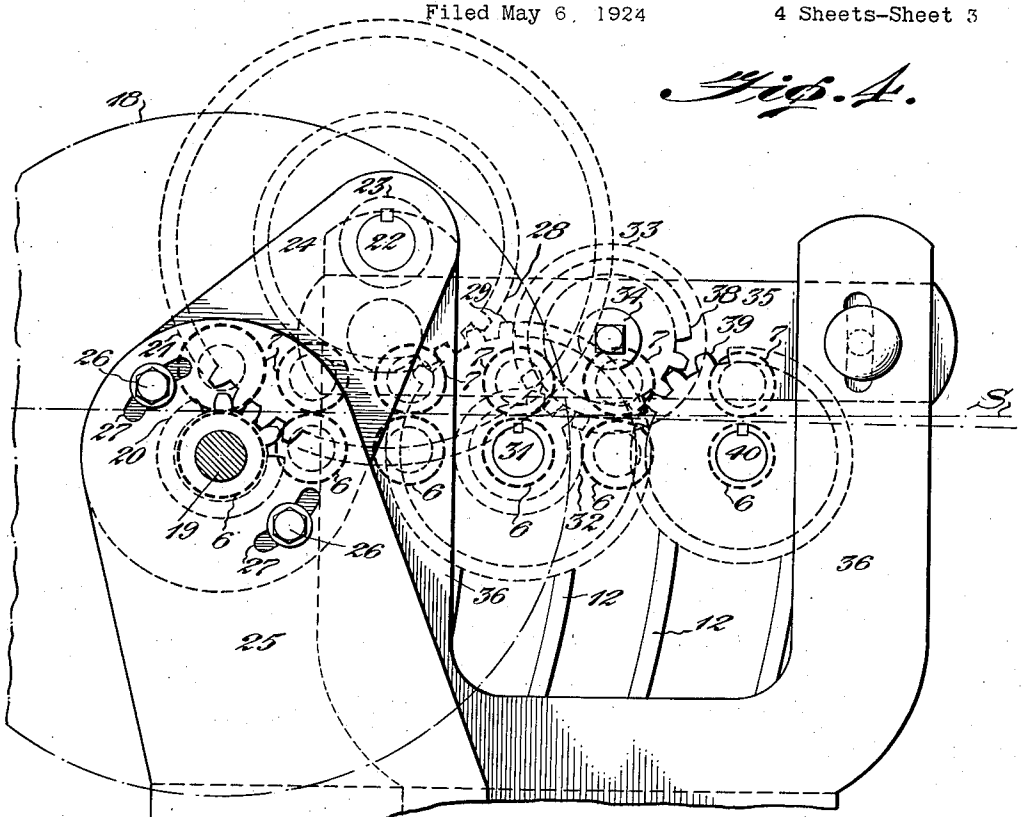
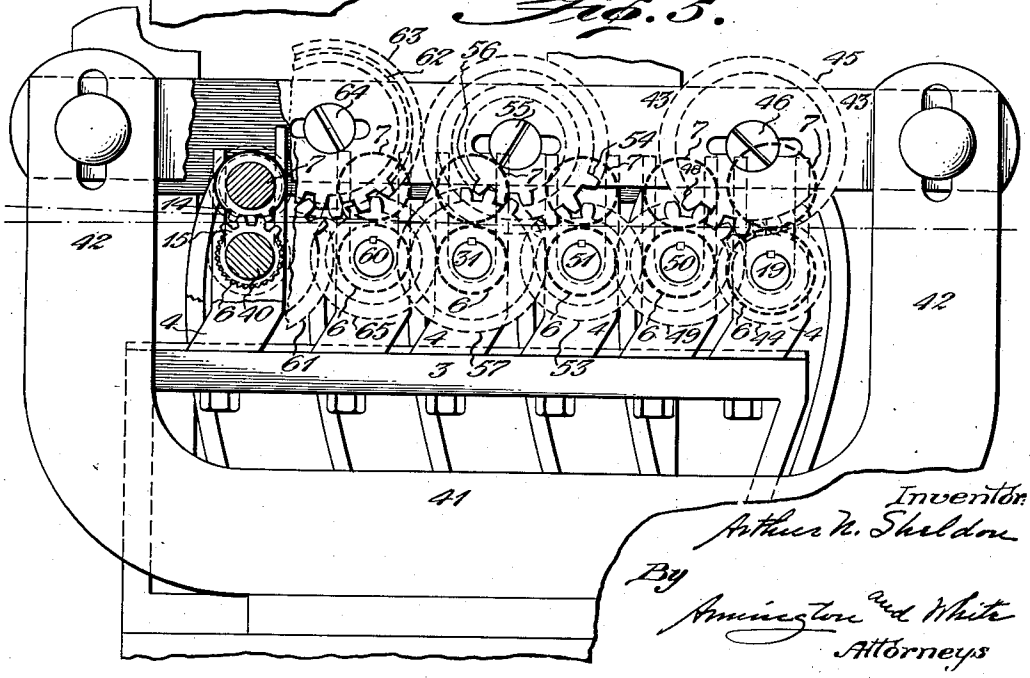


Fig. 5.



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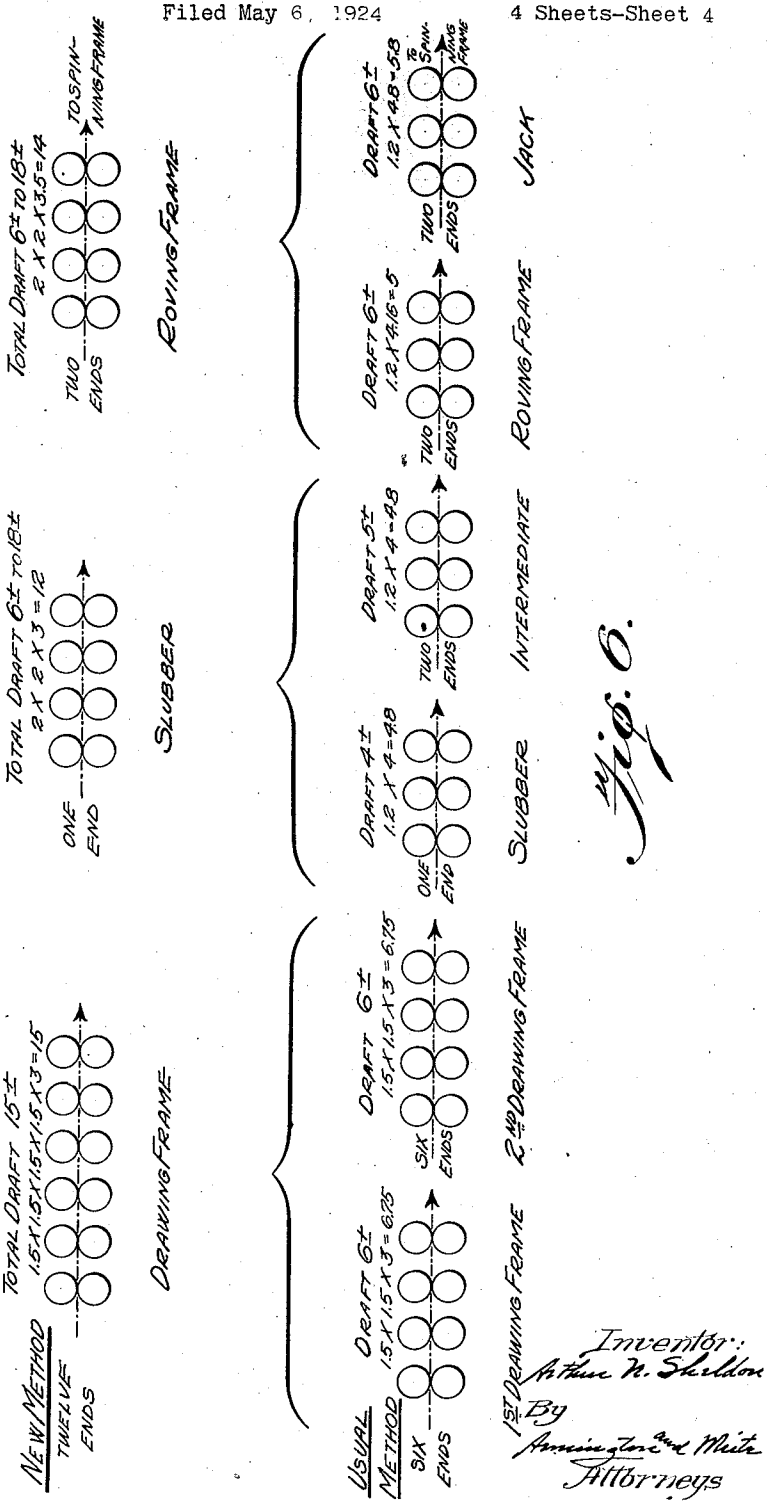


Fig. 6.

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Patented May 4, 1926. 1,583,425

UNITED STATES PATENT OFFICE.

ARTHUR N. SHELDON, OF PROVIDENCE, RHODE ISLAND.

YARN AND THREAD MANUFACTURE.

Application filed May 6, 1924. Serial No. 711,412.

To all whom it may concern:

Be it known that I, ARTHUR N. SHELDON, a citizen of the United States, residing at Providence, in the county of Providence, State of Rhode Island, have invented certain new and useful Improvements in Yarn and Thread Manufacture, of which the following is a specification.

This invention relates to improvements in the manufacture of yarn or thread and in the machines employed in certain processes thereof.

The principal object of the invention is to reduce the number of steps or processes heretofore required between the carding machines and spinning-frames, thus dispensing with much of the intermediate machinery usually employed with a resultant economy in cost of equipment, space, and plant-overhead, and a material saving in time and labor, besides improving the product by reducing the amount of handling to which the fibers are subjected and in which they are rendered liable to deterioration or injury.

Other advantages accruing from the elimination of certain processes to which the fibers are subjected result from a lessening of the liability of imperfect work due to improper adjustment of the different units of machinery, and also from reducing the number of piecings in the sliver and roving which are always a source of poor work.

Further advantages of the invention are set forth in the following specification which explains a preferred method of carrying out the new process of manufacture and describes certain improvements in the machinery therefor as illustrated in the accompanying drawings.

In the drawings:

Fig. 1 is a side elevation of the improved drawing-frame employed in the first process of my new method of yarn manufacture, illustrating the general arrangement of the amplified drawing-rolls;

Fig. 2 is a plan view of a portion of the draw-frame showing two groups or series of the drawing-rolls;

Fig. 3 is a front elevation of the same;

Fig. 4 is a more or less diagrammatic view illustrating the gearing at the driving end of the draw-frame;

Fig. 5 is a similar view of the opposite end of the draw-frame showing in detail the differential gearing for the bottom-rolls and the gears connecting the top-rolls to be driven therefrom; and

Fig. 6 is a diagrammatic view illustrating the new drawing processes as compared with the usual processes of present mill practice.

It is to be understood that while the present invention is adapted particularly for use in the manufacture of cotton yarns or threads and is herein described in this connection, certain of its features may be employed to advantage in the processing of fibers of other materials.

In order that a clear understanding may be had of the several novel features of the present improvement, as compared with usual methods of manufacture, a brief description will first be given of the generally accepted mill practice for producing cotton yarns.

In spinning carded yarns the sliver from the carding-machine is usually subjected to two preliminary processes of drawing, a first and second process in different draw-frames, and thence it passes to a third drawing in a "slubber", so-called, then to an intermediate fly-frame, next to a roving frame and finally to the spinning-frame, making five steps or processes of drawing between the card and the spinning-frame where it is eventually converted into the twisted yarn or thread. In the manufacture of fine combed yarns the number of preliminary drawings is sometimes increased from two to three and generally there is one more process on a fly-frame called a "jack", making seven drawing processes in all between the card and spinning-frame.

The sliver is delivered from the carding-machine into cans which are placed in back of the first draw-frame with the sliver fed thereto usually six ends up. The six slivers in each group are then combined and subjected to a draft of approximately six to produce a single sliver of the same weight as the individual card-slivers fed into the back of the draw-frame. The sliver from this first drawing process is then placed in back of the second draw-frame, six ends up, and combined again with a draft of six in the manner as first described, the object of repeating the drawing being to even the sliver through the additional doublings.

In the next process the sliver from the second draw-frame is placed in back of the

slubber in cans, usually one end to each slubber-spindle, and the individual slivers pass through the slubber without doubling while being subjected to a draft of from three to five. In this process the sliver is converted into roving having a slight twist and wound onto bobbins which are placed in a creel at the back of the intermediate fly-frame.

In the next process in the intermediate fly-frame the roving is doubled two ends up, twisted slightly and reduced in size with a draft of from five to seven. This machine also winds the reduced roving onto bobbins and these, in turn, are placed in back of the roving-frame where two ends are again doubled into one and twisted as on the intermediate frame with a corresponding draft of from five to seven. This completes the drawing processes and the bobbins from the roving-frame are placed in the creel of the spinning-frame to be spun or twisted into the finished-yarn, it being understood that the fibers are drawn to some extent in the spinning-frame.

In making combed yarns the procedure is substantially the same with the exception that the slivers from the card are subjected to an additional process in combers before being taken to the first draw-frame and also go through a third draw-frame and an additional fly-frame or jack. The present improved method of manufacture, however, relates more particularly to the processing of the fibers in the draw-frames and fly-frames and hence is not affected by the combing operation so that it is applicable to the manufacture of either combed or uncombed yarns.

The usual draw-frame is generally fitted with sets of four top-rolls cooperating with a like number of bottom-rolls which apply the draft to the slivers as they are doubled six ends up; while the slubber and fly-frames are each fitted with sets of three top- and bottom-rolls. As before stated, the object of passing the sliver through the two draw-frames is to even it and to bring the fibers into parallelism under the drawing action of the rolls. Likewise, the purpose of repeating the drawing process in the slubber and fly-frames is also to even the yarn by multiplicity of the doublings and to parallelize the fibers by means of roll-drafting and further to attenuate the roving to produce a finer thread.

The rolls in the usual draw-frame consist of top and bottom units with the bottom-rolls driven by a train of gears, while the upper rolls rest thereon and are held by weights for intended contact therewith to be driven by friction. The standard width of the rolls is approximately eight or nine inches and with six or more strands of sliver, weighing from fifty to seventy-five grains per yard, passing between the top- and bottom-rolls it is obvious that there cannot be actual contact between the surface of the rolls. That is to say, the multiple strands of sliver spread across substantially the full width of the rolls and hold them apart so that each top-roll is driven from its respective bottom-roll not by direct contact therewith, but through the medium of the sheet or mat of fibers passing between the rolls. The top-rolls are usually cushioned by a covering of felt or leather which is intended to be compressed by the sliver so that the surfaces of the rolls will be in contact at their ends. It can readily be seen, however, that with the slivers spread across practically the whole width of the rolls when six or more ends are being doubled there can be practically no contact between the rolls themselves, and hence the driving action is exerted by the friction of the fibers on the top-rolls. Furthermore, since it is necessary to apply considerable weight to the top-rolls to cause them to frictionally grip the fibers to draw them out, and since the greater the weight applied the greater is the resistance to the turning-movement of the rolls in their bearings, it is apparent that a deleterious action on the fibers takes place which is passed on to the finished yarn. That is to say, the fibers may be and generally are strained and broken which results in weakening the cotton with a consequent impairment of the final product.

The extent of this injury or impairment to the yarn depends to some extent upon the weight of the individual slivers and the number fed between the rolls, or, in other words, it is proportionate to the width of the rolls covered by the slivers and separated from contact. For this reason the capacity of the drawing-frame is held to certain limits beyond which it has been impossible to extend the drawing process without serious defects in the final product. It has long been recognized that if the drafting process could be successfully applied to a greater number of ends a reduction could be made in the number of drawings with a saving in time and labor besides effecting an improvement in the product. In order to make this possible, therefore, one feature of the present invention contemplates the employment of means for positively driving the top-rolls from the bottom-rolls so that no undue friction or strain is imposed on the fibers to turn the top-rolls. In other words, in order to render it practicable to feed a much increased number of slivers between the rolls, and in order to eliminate the deleterious action on and injury to the sliver caused by its use as a driving-medium for turning the top-rolls, and, further, to insure a constant speed of rotation of the associated rolls to prevent slipping and un-

even drawing a majority of the top- and bottom-rolls are geared together in the manner as later more fully explained.

The strength of the ultimate yarn depends largely upon the degree of parallelization of the fibers, and since the completeness of the parallelization of the fibers is dependent upon the number and length of roll-draftings to which the cotton is subjected, it is desirable to increase the number of such draftings as far as practicable in order that the draft between each two sets of rolls may be relatively short to avoid the plucking action which takes place where the drafts are too long. To accomplish this result the improved draw-frame used with the present method of manufacture is preferably equipped with six pairs of drawing-rolls, or two more than the usual number, and usually the slubber and fly-frames are provided with four pairs of rolls instead of three. In this way the length of draft between each two sets or pairs of rolls is very materially reduced as compared with the draft applied in accordance with present practice, while at the same time the total draft applied in each of the steps of the new method is greatly increased over what has heretofore been possible in each of the several machines employed with the old method. The exact manner of obtaining this increased draft will be hereinafter more full explained in connection with the diagrammatic views in Fig. 6.

Referring now to the drawings, it will be sufficient to illustrate in detail only the draw-frame used with the present improved method of manufacture, the other units of machinery being indicated more or less schematically by diagrams in Fig. 6. Fig. 1 illustrates in end view the improved draw-frame equipped with six pairs of drawing-rolls. The machine comprises in general the end-frames or legs 2 connected by a cross-frame 3 forming the table or bed for the roll bearing-brackets 4, see Figs. 2 and 3. The drawing-rolls, indicated generally by the reference-character 5, are arranged in sets or series extending longitudinally of the frame and as each set constitutes a working unit of the machine, the arrangement of all of the sets being the same, only one set will be herein described. As shown more particularly in Fig. 1, there are six bottom-rolls 6 arranged in parallel relation at spaced intervals and six top-rolls 7 adapted to co-operate therewith to press upon the sliver S feeding between the two rolls of each pair. The bottom-rolls 6 of the different sets are continuous along the whole frame and are journaled in fixed bearings in the brackets 4; while the top-rolls 7 of each set are made separate and have end-trunnions 9 adapted to turn in vertical slots 10 in the brackets.

The bottom drawing-rolls 6 are constructed with slightly enlarged central bosses 11 having their surfaces longitudinally ribbed or fluted as shown in Fig. 3; while the top-rolls 7 are generally provided with leather coverings which act as a cushioning medium for the sliver. Suitable straps or stirrups 12 are hooked over the trunnions 9 at the ends of the top-rolls 7 to adapt them to carry suspended weights 13, see Fig. 1, which apply the pressure for holding the top-rolls bearing on the sliver drawing across the bottom-rolls. At one end of each top-roll 7 is a toothed gear or pinion 14, preferably constructed integral therewith, arranged with its teeth in mesh with a gear 15 on its associated bottom-roll 6 as shown in Fig. 3, see also Fig. 5 in which the gears of the two back rolls are illustrated in fragmentary view. Where the top-rolls and bottom-rolls are of the same diameter the gears or pinions 14 and 15 are equal, but in some cases where associated rolls of different sizes are employed the gears are proportioned to connect the rolls to be driven at the same peripheral speed.

The bottom-rolls 6 are rotated from the drive-mechanism of the machine through a system of differential gearing as next described. Referring to Figs. 2 and 3, the drive-end of the machine is shown at the right in these views. A driving-pulley 18 rotated from a belt connected with the source of power is mounted fast on the shaft 19 which forms an extension of the front bottom-rolls 6 of the several sets disposed longitudinally of the machine; it being before noted that the bottom-rolls are continuous on a common shaft while the top-rolls 7 of each set are constructed as separate units so that they may be individually lifted out of their bearings to provide for placing the different groups of slivers between the rolls. At the end of the shaft 19 of the front bottom-roll adjacent the pulley 18 is a pinion 20 meshing with a larger crown-gear 21 keyed to a stud-shaft 22, see Figs. 2, 3 and 4. The stud-shaft 22 is journaled in a bearing 23 at the end of an arm 24 which is swiveled on the shaft 19 and fastened to a bracket 25 by means of bolts 26 extending through slots 27. At the opposite end of the stud-shaft 22 is a gear 28 meshing with a gear 29 fast on the bottom-roll shaft 31 fourth removed from the front of the machine, the several rolls of the sets being indicated by the heavy dotted lines in Figs. 4 and 5. The fourth bottom-roll shaft 31 also carries a pinion 32, fast on the extended hub of the gear 29, which meshes with an idler 33 journaled on a stud 34 which is supported by a cross-bar 35 bolted to the upright forks of a bracket 36. The idler 33 has a hub 37 carrying a gear 38 which meshes with a gear 39 on the sixth or rearward bottom-roll shaft 40, and through this train of gearing just described

the front roll-shaft 19 drives the fourth bottom-roll shaft 31 and sixth or back bottom-roll shaft 40 at the prescribed speeds in accordance with the ratio of the gearing. It will be understood that the several rolls of each set are rotated at different speeds to provide the draft between the succesive pairs of rolls and the speed-ratio between the rolls is not arbitrarily determined, but may be varied in accordance with any preferred practice. That is to say, the gears 28, 29, constitute change-gears for altering the speed-ratio and consequently the draft between the back-roll and front-roll and, likewise, the draft between the other rolls may be varied if desired by changing the ratio of the intermediate gearing. When gears of different diameter are employed in place of the change-gears 28 and 29 the arm 24 may be shifted in position to adjust the relation of their axes.

Referring now to Fig. 5, this is a view of the left-hand end of the machine looking in the opposite direction from that of Fig. 4 and illustrating the system of gearing for driving the intermediate rolls from the front and back bottom-roll shafts. At this end of the machine is a forked bracket 41 having opposite uprights 42 to which is bolted a cross-arm 43 providing a support for the journal-studs of a series of idler-gears. On the end of the front bottom-roll shaft 19 is a gear 44 meshing with a larger idler-gear 45 which is journaled on a stud 46 bolted through a slot in the cross-arm 43. As shown in Figs. 2 and 3 the idler 45 has a hub 47 carrying an equal gear 48 which meshes with a smaller gear 49 fast at the end of the second bottom-roll shaft 50, see also Fig. 5.

The third bottom-roll shaft 51 is driven through the means of a gear 53 thereon which meshes with an idler gear 54 journaled on a stud 55. The gear 54 is compounded with a smaller gear 56 on its hub, see Fig. 2, the latter meshing with a gear 57 on the fourth bottom-roll shaft 31.

The fifth bottom-roll shaft 60 is driven from a gear 61 on the sixth or back-roll shaft 40 through the intermediary of compound idler-gears 62 and 63 connected by a hub journaled on a stud 64, the gear 62 meshing with the gear 61 and the gear 63 with a gear 65 on shaft 60. Through the above-described arrangement of differential gearing all of the several bottom-roll shafts are driven from the main driving-pulley 18 to rotate the successive rolls of each set at varying speeds in accordance with the required ratio to effect the prescribed draft on the fibers. At the same time, the top-rolls 7 are positively driven from their respective bottom-rolls 6 through the means of the gears 14 and 15 previously referred to, the peripheral speed or surface speed of the top- and bottom-rolls of each pair being the same whether the rolls are equal in diameter or of different size. In the present drawings the rolls of each pair are shown as being of uniform size, but with the top and bottom front-rolls slightly larger than the other rolls. This arrangement is shown by way of example only, however, the relative proportions of the rolls being variable as desired. It is also to be understood that the ratio of the gearing may be varied to meet requirements in accordance with any preferred system of applying different degrees of draft to the sliver; and further, the arrangement and disposition of the gearing may be altered if desired, the present showing being by way of example only.

It has been explained that the sliver S is fed to the drawing-rolls from cans placed at the back of the machine, and preferably a separating-device is employed for guiding the several strands *s* to the rolls. Fig. 1 illustrates the slivers *s* leading up from the cans 70 with certain of them drawing across suitable guide-rods 71 before passing through the separator-guide 72. This latter device consists of a shallow pan supported from brackets 73 and constructed of substantially fan-shape in plan-view as shown in Fig. 2. The pan 72 is partitioned into a series of twelve narrow troughs or chutes 74, one for each of the strands *s* of sliver passing therethrough so that the several strands are kept from merging until they pass between the top and bottom back-rolls 6 and 7. Through this arrangement the slivers are prevented from chafing one against another or from bunching with the fibers becoming commingled. As the slivers pass between the rolls they are combined in a mat or sheet and usually a series of condensers 76, indicated in section in Fig. 2, are employed between certain of the pairs of rolls for preventing the slivers from spreading, the sheet being somewhat contracted in width from back to front of the frame. From the front-rolls the sliver feeds to a trumpet 75, see Fig. 1, which condenses it still further, and thence passing through a pair of calendering-rollers 78 it delivers to a can 77 to be coiled therein in condition to be taken to the next drawing process in the slubber.

The slubber may be of any usual construction as well known in the present art, except that it is provided with four pairs of drawing-rolls instead of three as has heretofore been the practice. The roving-frame, used for the next drawing process after the slubber, is also of standard type with an added pair of rolls and therefore these machines are not herein illustrated in detail, but are indicated diagrammatically in Fig. 6. This view illustrates the three drawing

processes of the present improved method of manufacture as compared with the six processes, employing three more machines, as now generally practiced in mills producing combed yarns. In the manufacture of coarser carded yarns the last fly-frame of jack is sometimes dispensed with, but again, in other instances an additional draw-frame is employed for producing fine combed yarns so that the present comparison is based on the average reduction showing the number of processes reduced from six to three or fifty per cent.

It has been explained that by employing the improved draw-frame as herein shown and described I am enabled to combine or double twelve ends of sliver from the card while passing it through six pairs of rolls to subject it to a maximum draft equal to or greater than the draft heretofore provided by two draw-frames. In other words, where heretofore it has not been found practicable to double more than six ends in a single drafting process, with my present improved machine I make it possible to double twice the number of ends of sliver while subjecting them to an increased draft without any slippage or plucking of the fibers as the cotton passes between the rolls. This is accomplished first by gearing the top-rolls to the bottom-rolls so that their peripheries rotate at the same speed without slippage between the two rolls of each pair and without dependence on the cotton fibers as a medium for driving the top-rolls. Furthermore, less weight is required to hold the top-rolls in proper contact with the sliver and hence less strain is imposed on the fibers, and therefore the material is not weakened to any extent or subjected to other deleterious action as with the usual multiplied drawing processes.

Fig. 6 illustrates graphically at the top and left the first drafting process doubling twelve ends up on the improved drawing-frame employing six pairs of rolls as compared with the two preliminary drawing processes with six ends up on draw-frames having four pairs of rolls as indicated in the bracket below. The next process of drafting with my improved method of manufacture is shown with the single end from the draw-frame feeding through the slubber and subjected to a draft between four pairs of rolls; this process taking the place of the two draftings illustrated in the bracket below as employing a slubber with three pairs of rolls and an intermediate fly-frame also having three pairs of rolls. With the usual practice the single end from the second drawing-frame passes through the slubber without doubling, but in the intermediate fly-frame the roving from the slubber is doubled two ends up. Finally, the third step in my improved method of manufacture consists in a single drafting process with two ends up doubled in the roving-frame using four pairs of rolls as compared with the old method of doubling and drafting with three pairs of rolls in the roving-frame and then doubling and drawing again on the jack with three pairs of rolls.

It will thus be seen that with my improved method of manufacture three machines take the place of the six machines heretofore used in general mill practice for producing combed yarns and, furthermore, where with the old method the six machines required twenty pairs or sets of rolls, with the present improved method only fourteen pairs are employed in the three machines. This means the elimination of twelve rolls and results in a material lessening of the friction action of the rolls on the material during its continuous processing from the card to the spinning-frame. Moreover, where heretofore there were twenty pairs of rolls to adjust and maintain in proper order and repair, with my improved method of manufacture only fourteen pairs of rolls are employed, so that the factors of improper adjustment, insufficient contact of the rolls, or other deficiencies in the operative action thereof due to worn surfaces and other defects, are much less liable to impair the quality of the final product. Stated briefly, there will be less chance of injuring or weakening the fibers and therefore less liability of faults or defects in the ultimate product.

As another advantage of the present improvement the number of piecings between the several drawing processes is reduced very materially over what is usually required with previous methods. Where heretofore it required piecing up six times for the six different drawing processes, with the present method there are only three piecings from the card to the roving-frame. Also, where in the new method the sliver is twisted only twice, once in the slubber and once in the roving-frame, with the old method a twist is put in during four processes or, in other words, in the slubber, the intermediate fly-frame, the roving-frame and the jack. After the sliver has once been twisted into roving the twist must be taken out in the next process to apply the draft and this reverse action follows again in the roving-frame and the jack. These several manipulations of twisting and untwisting the fibers tend to weaken the material and cause unevenness in the finished yarn. With my present improved method of manufacture it has been demonstrated that with the three drawing processes employed in place of five or more a more level, uniform yarn is produced in the final spinning process.

As a further advantage of my improved method of manufacture it is to be noted that while the total draft applied to the sliver and roving in three processes is equal to

that applied in the six processes of the old method, at the same time the draft between the different pairs of rolls is maintained at the minimum. This is shown graphically in Fig. 6 in which it will be seen that as a practical working hypothesis the total draft of fifteen, more or less, in the drawing frame is obtained with a draft of one and one-half between the five pairs of rolls, beginning at the back-roll, and a draft of three between the next pair and the front-rolls. This process in the single draw-frame supersedes the present day practice using two draw-frames; but with my improved method I may employ a draft of two between the three rearward pairs of rolls on the slubber and a draft of three between the next pair and the front-rolls to obtain the required total draft of twelve, whereas with the old method the draft in the slubber is usually approximately one and two-tenths between the back-rolls and the intermediate-rolls and four or more between the intermediate-rolls and the front-rolls. The same is true as regards the intermediate fly-frame and also in the roving-frame and jack where to obtain the required total draft the draft between the intermediate-rolls and the front-rolls must be four or more as compared to a draft of not more than three and five-tenths on the roving-frame with the present improved method. It will be understood that the drafts between the rolls as indicated in the diagram in Fig. 6 are figured mathematically to give the proper aggregate draft for a certain weight of sliver for a certain count of yarn and while these figures may be varied to some extent it will none the less hold true that the individual drafts between successive pairs or sets of rolls with the new method of manufacture are less in the average than with the usual practice with present day methods of manufacture. In other words, a shorter draft between rolls is applied to the sliver or roving in the processes of the present method than that usually employed in standard mill practice. For this reason there is less tendency to strain or weaken the cotton, and furthermore the fibers will be drawn more uniformly to produce a more even and level yarn in the ultimate process of spinning. From the diagrams it will be obvious that with my improvement the total draft in each machine is increased over what is customary in the individual machines used with present day methods, while the draft between rolls is reduced to a minimum to secure the advantages above pointed out.

To sum up, with the present improved construction and arrangement of the draw-frame and fly-frames I eliminate one preliminary process of drawing in carded work and two in combed work, while one process is eliminated in the fly-frames on carded work and two processes on fine work, so that with either system a material reduction is made in machine equipment, labor, floor-space and power, as well as in the contingent expenses for upkeep, depreciation, taxes, insurance, and other incidentals. In addition to these savings in capital and labor costs the possibility of bad work is reduced to a minimum, since it is a well known fact that in every process to which the cotton is subjected an opportunity is presented for injuring the material if the machines are not properly adjusted and operated. Moreover, the more cotton fiber is worked the weaker it becomes so that by eliminating certain of the processes between the card and the spinning-frame I conserve the strength of the fibers while also reducing the number of piecings required which are always a source of poor work.

By providing the improved draw-frame herein described and illustrated I am enabled to pass as many ends as desired through the drawing process while producing an even sliver at this point and removing the necessity of further doublings at later stages. By increasing the number of rolls on the draw-frame and providing for a positive drive between the cooperating top- and bottom-rolls of the pairs I am enabled to draw the relatively heavy sliver in easy stages between the rolls while accomplishing a relatively long over-all draft, thus producing a better parallelization of the fibers than is accomplished with two or more draftings in the ordinary draw-frame. By employing four pairs of rolls on the slubber and fly-frame I also accomplish a relatively long over-all draft with much shorter drafts between the pairs of rolls than is the common practice and thus further improve the quality of the finished yarn.

While I have herein described my improved method of manufacture as applied to use with certain types of machine or equipment it is to be understood that I am not limited to the exact arrangement of machinery as shown. Furthermore, while for the sake of convenience I have applied the usual terminology to the different machines and processes as generally employed in the present art it is to be understood that the principles involved are not entirely dependent upon the type of machine or equipment employed or the exact arrangement thereof as herein specified, and therefore the present invention is not limited in this respect.

What I claim is:

1. An improved method of manufacturing yarn or thread with a reduced number of processes consisting in drawing the card-sliver through a series of rolls, with a majority of the top-rolls of the series positively driven, while doubling approximately

twelve ends up with a draft substantially in proportion to the number of ends, drawing the resultant sliver and converting it into roving, and next drawing the roving while doubling two ends up to produce a final roving for direct application to the spinning process.

2. An improved method of manufacturing yarn or thread with a reduced number of processes consisting in doubling and drawing the card-sliver approximately twelve ends up between at least five pairs of drawing-rolls, with a draft corresponding approximately in ratio to the number of ends and with a majority of the top-rolls positively driven, next drawing the resultant sliver between at least four pairs of drawing-rolls in a slubber, next doubling the resultant roving and drawing it between at least four pairs of drawing-rolls in a roving-frame, and finally spinning the last roving.

3. An improved method of manufacturing yarn or thread with a minimum number of drawing processes between the carding-machine and spinning-frame consisting in first doubling the card-sliver with eight or more ends up and drawing it through at least five pairs of drawing-rolls with a draft having a ratio corresponding approximately to the increased number of ends and with a majority of the top-rolls positively driven, next drawing and twisting the resultant sliver in a machine having at least four pairs of drawing-rolls, next drawing the resultant roving in a machine having at least four pairs of drawing-rolls, and finally spinning the last roving produced.

4. An improved method of manufacturing yarn and thread consisting in doubling the card-sliver with eight or more ends up while drawing it between at least five pairs of top- and bottom-rolls with the top-rolls of a majority of the pairs positively driven, the draft of the rolls having a ratio in proportion to the whole number of ends, next drawing the sliver in a slubber to produce a roving, next doubling and drawing the roving in a roving-frame, and finally spinning the last roving to produce the yarn or thread.

5. An improved method of preparing fibers for spinning in three steps or processes consisting in doubling the sliver at least eight ends up and drawing it between at least five pairs of rolls with a majority of both the top- and bottom-rolls positively driven, the draft of the rolls having a ratio in proportion to the whole number of ends, next drawing the resultant sliver between at least four pairs of rolls and converting it into roving, and finally doubling the roving and again drawing it between four pairs of rolls.

6. An improved method of preparing carded fibers for spinning consisting in doubling the sliver eight or more ends up and drawing it down to a single end with a series of drawing-rolls having a majority of the top-rolls positively driven and said rolls operating with a ratio of draft to obtain approximately the same weight as that of the individual strands, next drawing the single sliver with a draft of approximately six to eighteen and converting it into roving, and finally doubling the first roving and drawing it with a draft of approximately six to eighteen.

7. An improved method of preparing carded fibers for spinning consisting in doubling the sliver eight or more ends up and drawing it between at least five pairs of rolls having the top-rolls of a majority of the pairs positively driven and with a total draft of approximately twelve, next drawing the sliver between at least four pairs of rolls with a draft of from six to eighteen while converting it into roving, and finally doubling the first roving and again drawing it between at least four pairs of rolls with a draft of from six to eighteen.

8. An improved drawing-machine comprising at least five pairs of cooperating top- and bottom-drawing-rolls, means to drive the bottom rolls at different speeds, and means for positively driving the top-rolls at the same peripheral speed as that of their respective bottom-rolls.

9. In a drawing-machine, the combination of a series of at least five bottom-rolls, an equal number of top-rolls arranged in cooperative relation therewith to adapt them to contact with the sliver drawing across the bottom-rolls, means for driving the bottom-rolls at different speeds, and means for connecting the top-rolls to be driven from their respective bottom-rolls at the same peripheral speed.

10. In a drawing-machine, the combination of top- and bottom-drawing-rolls, means to drive the rolls at different speeds to apply a draft to the slivers passing therethrough, and means to feed the slivers to the rolls while maintaining them separate and free from contact comprising a fan-shaped guide-device having divergent partitions forming a plurality of chutes for the individual strands of sliver.

In testimony whereof I hereunto affix my signature.

ARTHUR N. SHELDON.