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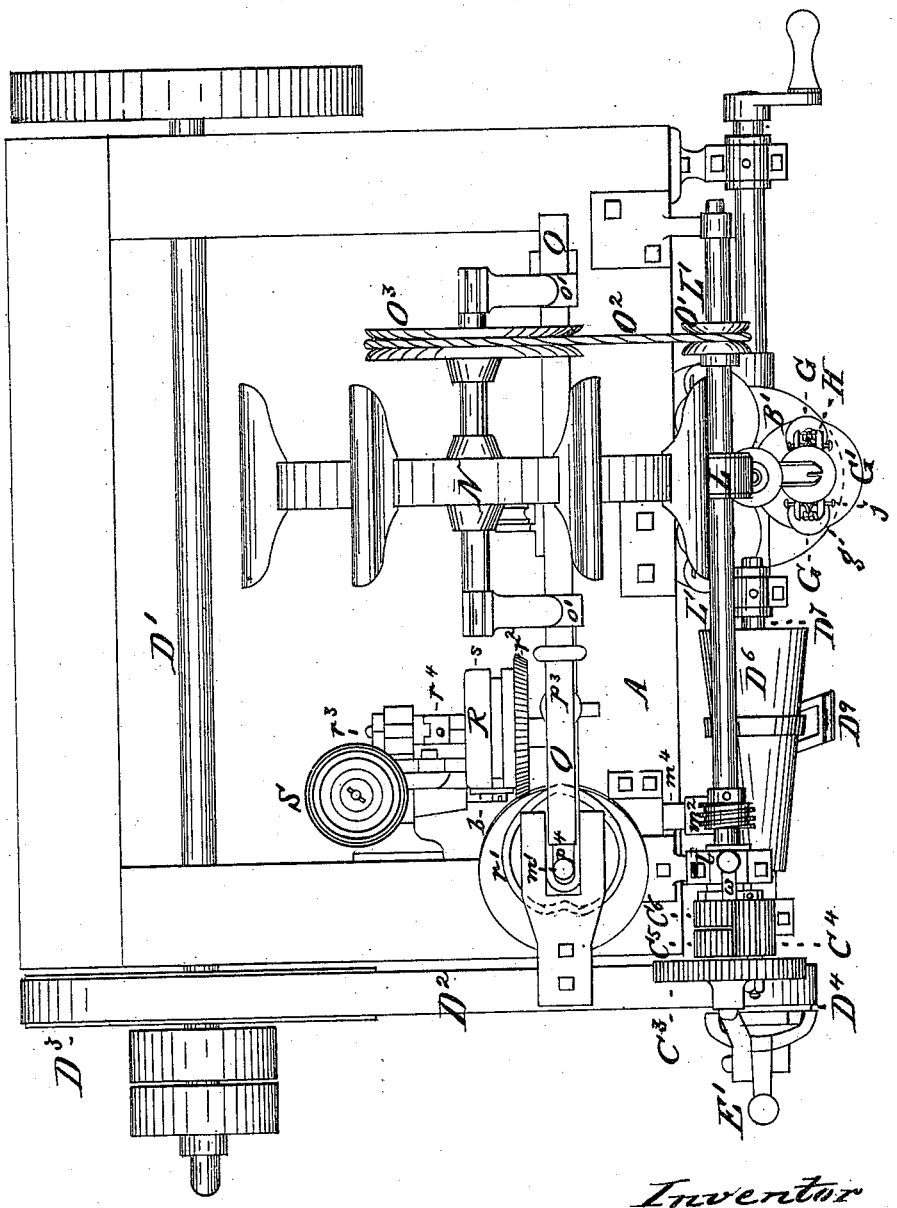
ART OF MAKING THREAD, &c.

No. 193,207. Patented July 17, 1877.

Fig. 1.



Witnesses
W. L. Bennett
W. H. Isaacs

Inventor
Andrew Reynolds Arnold
by his atty.
D. L. Renwick

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A. R. ARNOLD.

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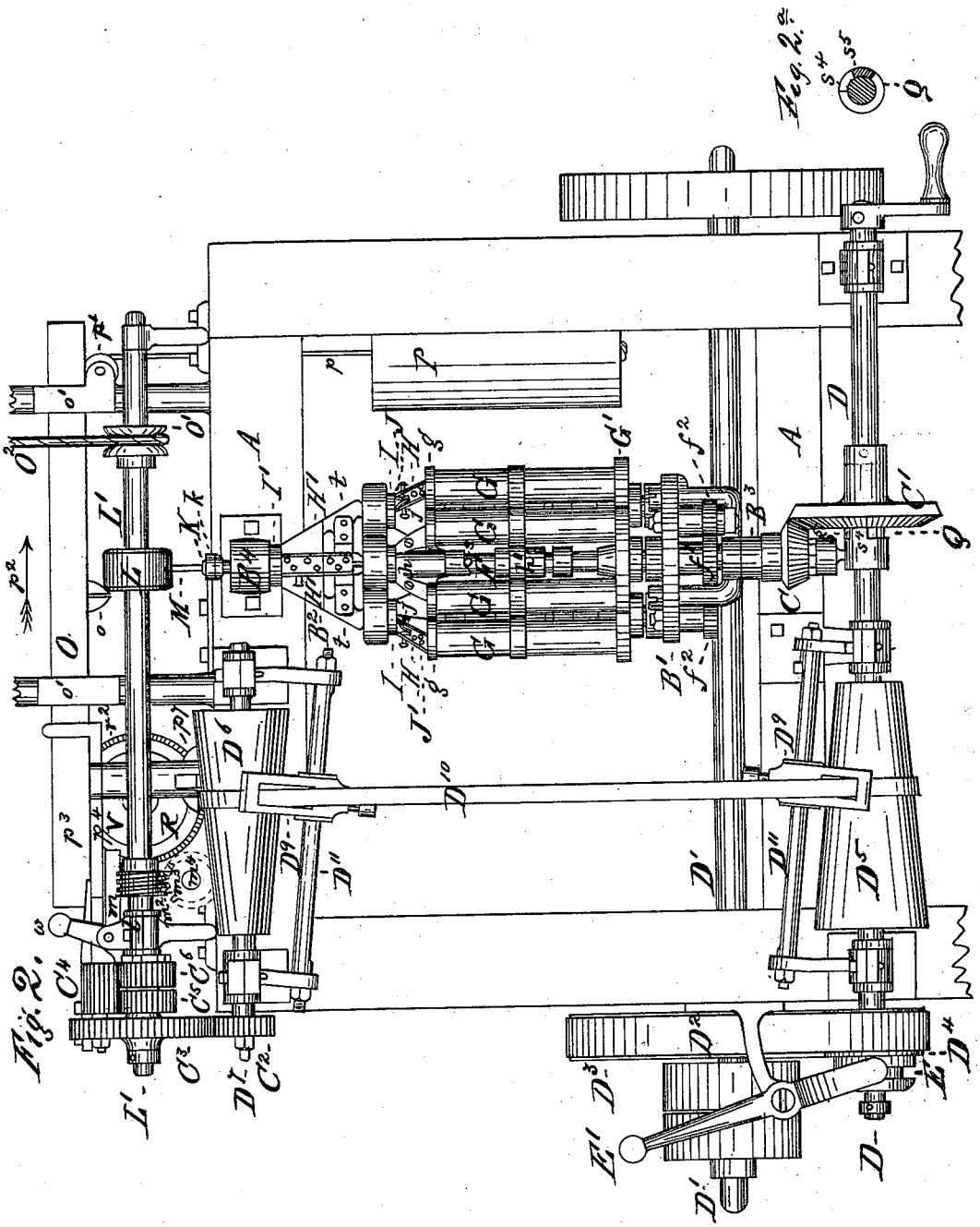

Witnesses
W. L. Bennett
W. H. Isaacs.

Inventor
Andrew Reynolds Arnold
by his Atty.
E. L. Renwick.

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A. R. ARNOLD.

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Fig. 3.

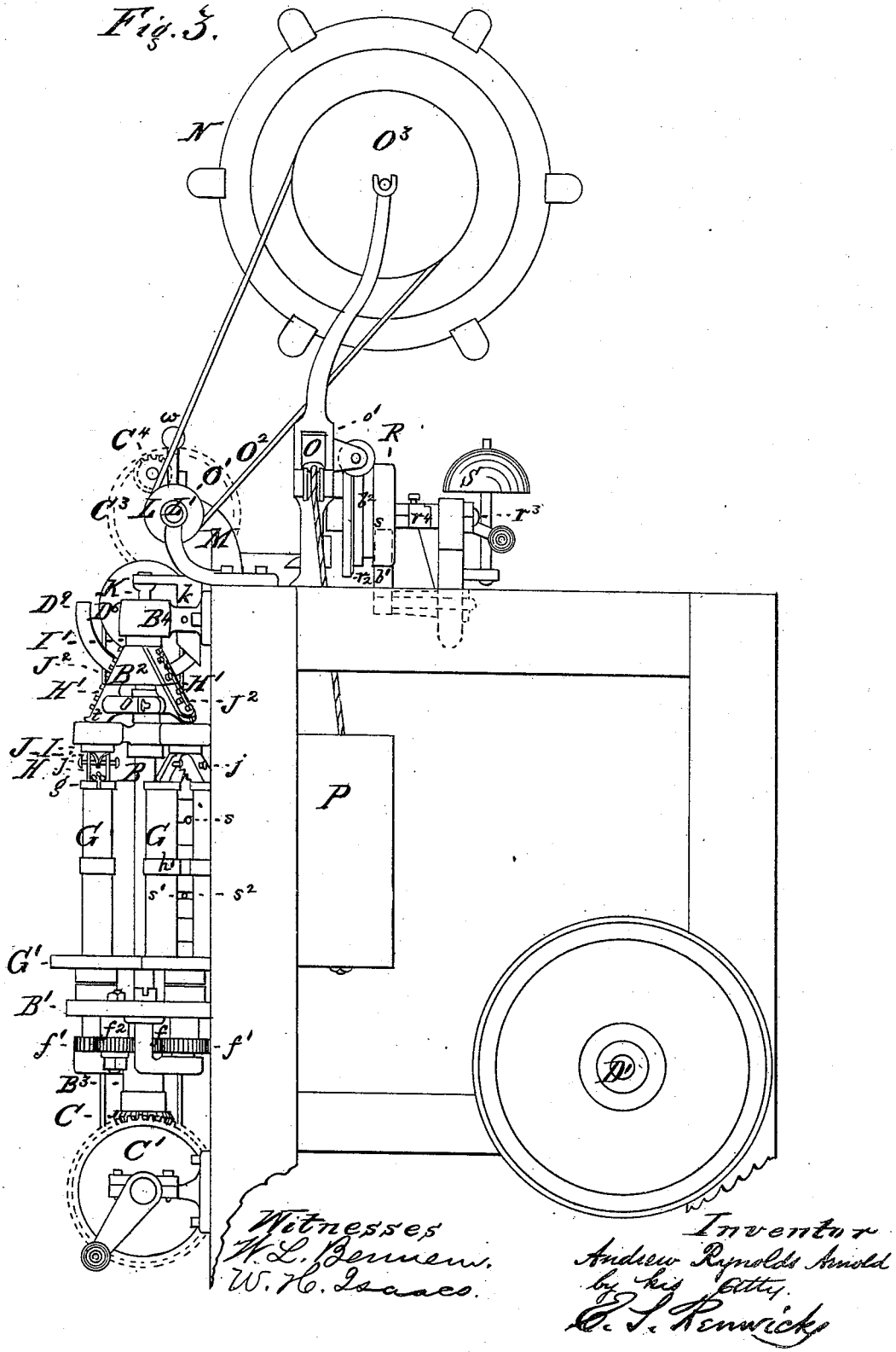

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Fig. 4

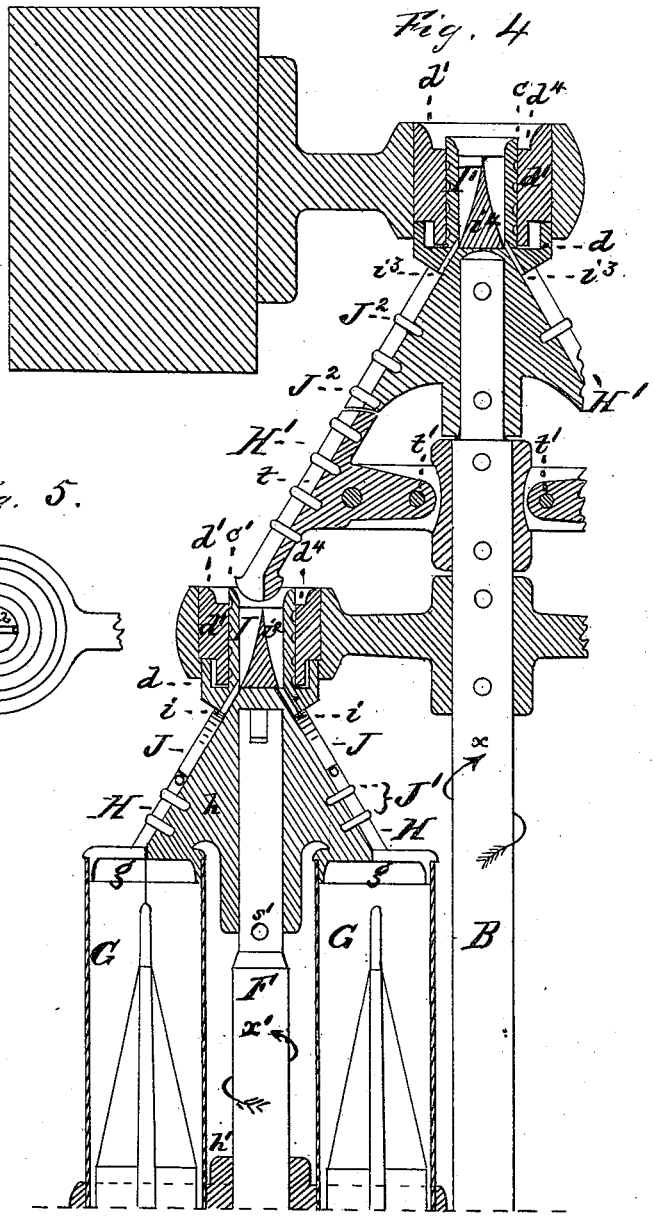

Fig. 5.

Witnesses
H. L. Bennett
W. H. Isaacs.

Inventor
Andrew Reynolds Arnold
by his Atty.
C. L. Pennick

6 Sheets—Sheet 5.

A. R. ARNOLD.

ART OF MAKING THREAD, &c.

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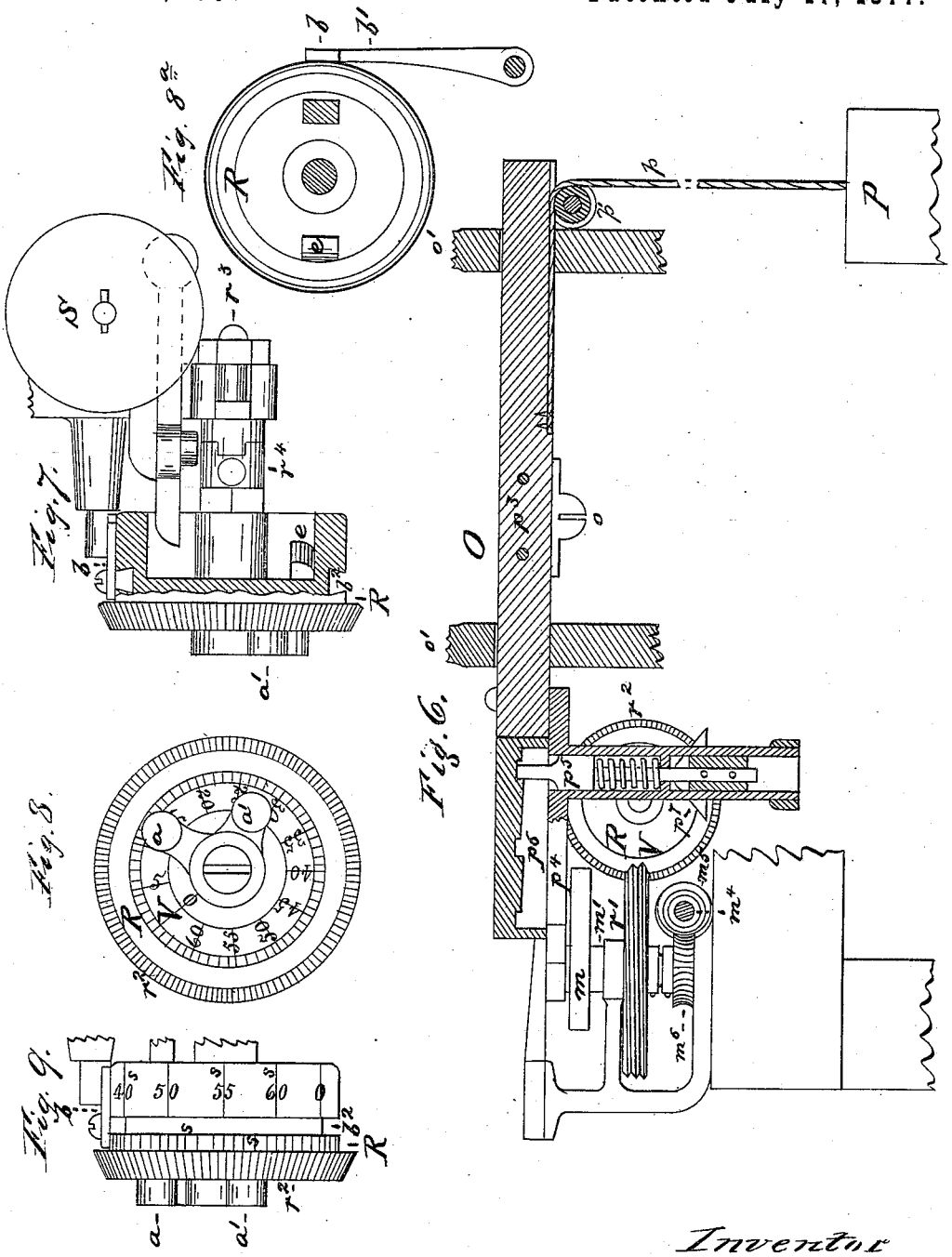

Witnesses
W. L. Bemen
W. H. Isaacs.

Inventor
Andrew Reynolds Arnold
by his Atty
C. L. Renwick

A. R. ARNOLD.

ART OF MAKING THREAD, &c.

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Fig. 4a

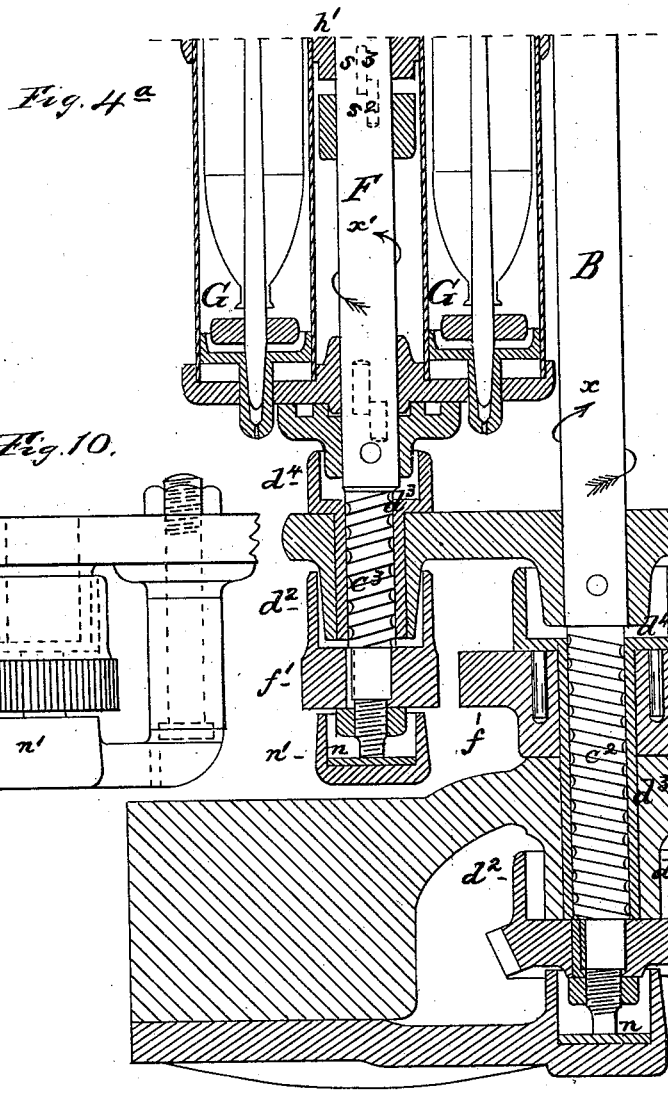


Fig. 10.

Fig. 11.

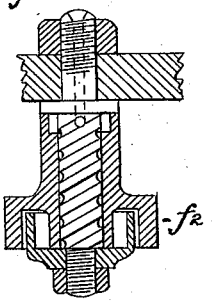
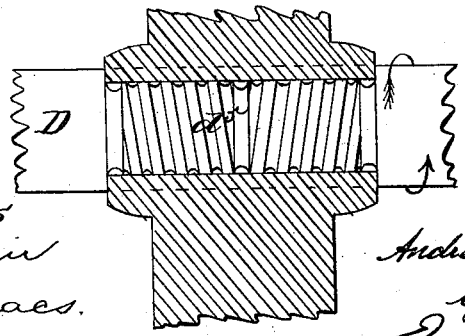


Fig. 12.



Witnesses
W. L. Bernain
W. H. Isaacs.

Inventor
Andrew Reynolds Arnold
by his Atty.
D. L. Fenwick

UNITED STATES PATENT OFFICE.

ANDREW REYNOLDS ARNOLD, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN ART OF MAKING THREAD, &c.

Specification forming part of Letters Patent No. **193,207**, dated July 17, 1877; application filed March 10, 1876.

To all whom it may concern:

Be it known that I, ANDREW REYNOLDS ARNOLD, of Newark, in the county of Essex and State of New Jersey, have made an invention of certain new and useful Improvements in the Art of Making Sewing-Thread, and in the machinery employed therein; and that the following is a full, clear, and exact description and specification of the same.

The common mode of manufacturing sewing-thread from the yarn, as I understand the same, is as follows, viz: The yarn on the cops or bobbins upon which it has been spun is taken to a spooling-machine, by whose action two threads of yarn are doubled and spooled together. Next, the spools of doubled yarn are put on to a ring twisting-machine, by whose action the doubled yarns are twisted together left-handed, and are wound upon small bobbins. Next, these doubled and twisted yarns are taken to a second spooling-machine, by whose action three of the yarns are brought together or "doubled," as it is technically called, and are wound upon larger spools. Next, the yarn on these larger spools are taken to a fly twisting-machine, are twisted together right-handed, and are wound upon small bobbins. Lastly, these bobbins are taken to a reeling-machine and are wound into skeins and hanks in a condition for bleaching and coloring.

The process of manufacture above described consists of five disconnected operations, viz., a first doubling, a first twisting, a second doubling, a second twisting, and a reeling operation. It involves also much hand-labor, and the employment of five disconnected machines.

Now, the object of my invention is to do away with the disconnected operations, and the treatment of the material in disconnected machines.

To this end my improvement in the art consists of the conversion of the single yarns into six (or other) cord thread in the condition of hanks of skeins ready for bleaching or coloring by a continuous process; and my improvements in machinery consists of certain combinations of mechanical devices by means of which the doubling, twisting, redoubling, retwisting, winding in the skein, and formation of the hank are performed simultaneously and continuously, so that the necessity of separating the operations, and of taking the yarn from one machine to another is dispensed with.

The various combinations of mechanical devices which I have invented are set forth in detail at the close of this specification.

In order that they may be fully understood I have represented in the accompanying drawings a machine embodying them in the best form at present known to me, and I will proceed to describe the same.

I declare, however, that I do not confine my invention to the precise construction of the machine I am about to describe, as the construction of the devices composing it may be varied as circumstances or the views of different manufacturers may render expedient, and parts of my invention may be used without others.

Figure 1 of the said drawings represents a plan of a machine embodying my invention. Fig. 2 represents a front view of the same. Fig. 3 represents a side view of same. Figs. 4 and 4^a represent a vertical section of a portion of the machine upon a larger scale than the preceding figures. Figs. 5 to 12, inclusive, represent views of some parts of the machine disconnected from the other parts, and designated by the same letters of reference as are used for the same parts in the other figures.

The said machine represents only one set of doubling, twisting, and reeling devices; but the number may be increased by arranging the sets in a row, or in two parallel rows back to back, all operated by the same horizontal shafts, or operated independently from the same main shaft.

The various moving members of the machine are all supported by a strong frame, having two front rails, A A, to which the brackets of the bearings of the main spindle B of the doubling and twisting devices are secured. This main spindle B is fitted with a beveled wheel, C, which is driven by a corresponding beveled wheel, C^1, secured to a counter-shaft, D, and the counter-shaft D is driven by the main shaft D^1, through the intervention of the belt D^2, and the belt-pulleys D^3 D^4, the latter

being connected with the counter-shaft through the intervention of a friction-clutch, E, so that the counter-shaft may be thrown out of gear or into gear by operating the clutch-lever E′.

The revolution of the main spindle effects the retwisting or last twisting of the redoubled yarns. It carries upon it a hub, B^1, and a twisting-head, B^2, which support the bearings of the secondary spindles F F F, that effect the first twisting of the yarns, and these secondary spindles carry in turn the tubes G G or other holding devices in or by which the cops or other masses of single yarns are contained—tubes being in my opinion the most convenient yarn-holders for such a machine. The main spindle is caused to revolve right-handed—that is to say, in the direction indicated by the arrow *x*, Fig. 4—so that the final twist of the thread is from left to right. The secondary spindles, on the other hand, are caused to revolve left-handed, (in the direction indicated by the arrow *x′*,) or in the reversed direction to the main spindle, so that the primary twist of the double yarns is from right to left. The direction of revolution of the main spindle is therefore counter to that of the secondary spindles, and the twist produced by the main spindle is a counter-twist as compared with the twist produced by the secondary spindles. In order that the secondary spindles may be caused to revolve, a cog-wheel, *f*, is secured to the bracket B^3 of the lower bearing of the main spindle, and each secondary spindle F is fitted at its lower end with a pinion, f^1. These spindle-pinions do not engage directly with the stationary or dead cog-wheel *f*, but are connected with it through the intervention of intermediate pinions f^2, one for each spindle. These intermediate pinions being constructed to revolve upon studs secured to hub B^1, and each engaging on one side with the stationary wheel *f*, and on the other with its respective secondary spindle-pinion f^1. The yarn-tubes G G are, in the present instance, two in number for each secondary spindle, but this number may be increased or diminished according to the kind of thread to be produced, two tubes for each secondary spindle being adapted to the manufacture of six-cord thread or of three-cord thread, one of the tubes in the latter case being left empty. The yarn from each tube passes through a slit in its cap *g*, up an inclined yarn-channel, H, to a tubular twisting-head, I, Fig. 4, into which each yarn enters through a passage, *i*, made for the purpose. Hence the yarns from the tubes of each secondary spindle are doubled together in its twisting-head, and by the revolution of that head with the spindle are twisted into a strand. In order that the yarns may be delivered to the twisting-point properly, each twisting-head is fitted with a core, i^2, (see Figs. 4 and 5,) having in it as many converging grooves as they are yarns, (two in the present case,) and each yarn is conducted through one of these grooves, so that it is prevented from kinking up to the point where the yarns unite.

In order that the strand of doubled and twisted yarn may have the proper hardness of twist, each yarn is prevented from feeding too freely to the twisting-heads by being subjected to tension. To this end a tension device is applied to each yarn-channel H, and the devices which I prefer to use for this purpose consist of a pair of adjustable pressure-springs, J, Figs. 2, 3, and 4, which are preceded by a series of pins, J^1, Fig. 4. The yarn from each tube G is passed first in a zigzag direction around the tension-pins J^1, and is then passed between the springs J. The force with which these springs J are caused to press upon the yarn between them may be regulated by adjusting-screws *j j*.

The tension-pins perform two functions—that is to say, they hold the yarn so as to prevent it from kinking while it is passing from the yarn-holders to the twisting-heads, and they also make tension upon it. I prefer to use both the pins and the adjustable pressure-springs or some other adjustable tension device which will permit the tension to be adjusted; but if the capacity of nice adjustment be not deemed important a sufficient number of pins may be used to produce the tension as well as hold the yarn from kinking.

The three strands of doubled and twisted yarns pass from the ends of the secondary twisting-heads to the twisting-head I^1 of the main spindle B, through the inclined strand-channels H′, and enter the tubular bore of the main head through passages i^3, made for the purpose. The bore of this main head is fitted with a core, i^4, Fig. 4, having in it three grooves, which converge at their upper ends to a point, or thereabout, so as to control the strands and prevent them from kinking, up to the place where they unite to form the cord or complete thread. Above the cord-twisting head I^1 is a tubular cord-guide, K, which is concentric or thereabout with the axis of the cord-spindle B, and is supported by an adjustable arm, *k*. This guide-arm *k* is constructed to slide in the bracket B^4, so that the lower end of the cord-guide may be set nearer to or farther from the end of the main or cord spindle, and the stem of the arm is perforated with holes, in any one of which a pin may be inserted to hold the cord-guide in the desired position. The cord-guide is thus made adjustable endwise of the main spindle, to the requirements of the work. It is also movable in the same endwise direction, so that, in case of the breakage of the strands, it may be readily loosed and slipped up the cord, so as to be out of the way when the piecing is done.

In order that the strands may be subjected to the requisite tension to insure their proper twisting, a tension device is provided for each strand. The tension device which I prefer to employ for this purpose consists of a series of pins, J^2, arranged in the strand-channel, so

that the strand may be applied in a zigzag direction to more or less of the pins, as required, to afford sufficient frictional resistance to the motion of the strand to produce the required tension.

In order that the yarns may be drawn through the doubling and twisting devices at a regulated speed, so that the twist may be uniform, a draft-roll, L, is provided. This draft-roll is fitted to a shaft, L′, which receives the motion from the counter-shaft D, through the intervention of the following mechanism: The counter-shaft D is fitted with a belt-pulley, D^5, and a corresponding belt-pulley, D^6, is applied to an intermediate shaft, D^7. The latter shaft is fitted with a pinion, C^2, which engages with a carrier-wheel, C^3, that is fitted to turn freely upon the draft-roll shaft L′, and this carrier-wheel is fitted with a stud, to which a long pinion, C^4, is applied, so that this pinion is caused to travel round with the carrier-wheel. The teeth of this traveling pinion engage simultaneously in the teeth of two cog-wheels, C^5 C^6, the one, C^5, secured to the draft-roll shaft L′, and the other cog-wheel, C^6, arranged axially of that shaft, but held in a stationary position thereto. The numbers of teeth in the stationary cog-wheel C^6 and in the draft-roll cog-wheel C^5 are unequal, the number of the teeth in the latter cog-wheel being one the smaller; consequently, as the carrier-wheel C^3 revolves in the direction which is the reverse of that required of the draft-roll, the draft-roll is caused to revolve in the required direction, but at a very slow speed. The fixed and draft roll cog-wheels, with the traveling pinion, thus constitute differential gearing, by which the draft-roll is caused to turn with the required speed to draw the thread through the doubling and twisting devices.

In order that the speed of draft may be varied according to the quality of thread to be produced, the pulleys D^5 D^6 of the counter-shaft D and intermediate shaft D^7 are reversed cone-pulleys, and adjustable belt-guides D^9 are provided to adjust the position of the belt D^{10} on these cone-pulleys. Each of these belt-guides is fitted to slide upon a rail, D^{11}, to which it may be clamped by a set-screw, so that the belt-guides may hold the belt in any position in which it may be adjusted.

In order that the draft-roll may draw the thread, the latter is passed several times around the roll, so as to produce sufficient surface-contact therewith for the purpose. As each turn of the draft-roll produces a new coil of thread thereon toward one of its heads, and delivers the last coil, which is nearest the opposite head, the coils tend to run along the barrel of the draft-roll.

In order that this tendency may be prevented a coil-guide, M, is provided. This coil-guide consists of a polished curved blade whose acting face is crosswise of the axial line of the draft-roll, and is slightly inclined thereto. The shank of this coil-guide is made fast to the frame of the machine, so that it cannot move; hence, as the thread is coiled upon the draft-roll it enters between the last coil and the face of the coil-guide, and consequently the coils of thread upon the draft-roll are progressively pushed along its barrel by the contact of the coil that is being formed with the inclined surface of the coil-guide.

The thread delivered from the draft-roll is at once reeled into skeins and formed into hanks. For this purpose a reel, N, is mounted upon the frame of the machine, and a traverser, O, is provided to distribute the thread upon the reel. The reel is driven from the draft-roll shaft L′ by means of a pulley, O^1, a band, O^2, and a second pulley, O^3, secured to the shaft of the reel.

In order that the thread may be wound properly, and also that there may be sufficient strain upon the thread to keep it tight enough on the draft-roll to cause it to be drawn thereby, the relative diameters of the pulleys O^1 O^3 are so proportioned that the speed of the periphery of the reel N would be about forty per cent. faster than that of the periphery of the draft-roll. Hence the reel is continually pulling the thread; but as the reel is driven by the frictional contact of the band O^2 with its pulleys O^1 O^3, and as the band can slip upon its pulleys, the pulling-strain is merely sufficient to keep the thread taut.

While the thread is being wound upon the reel it is traversed thereon, so as to be laid properly, by means of the traverser O, which is fitted with a guide, *o*, through which the thread passes. This traverser is constructed to slide in guides *o*′, and is moved to and fro, for the purpose of distributing the thread in the skein by means of a heart-formed cam, *m*, in the groove of which a friction wheel or truck, pivoted to the under side of the traverser, is fitted. This heart-cam *m* is fitted to the upper end of an upright shaft, m^1, which is driven from the draft-roll shaft through the intervention of the screw m^2, the worm-wheel m^3, the shaft m^4, the screw m^5, and the worm-wheel m^6. In order that several skeins may be wound upon the reel separately from each other, the traverse-bar O is shifted along the reel, so that the guide *o* will traverse opposite different portions thereof, and will shift the yarn from one of such portions to another, thus dividing the mass of thread into several skeins. This shifting is done by means of a weight, P, which is connected with the traverse-bar by means of a cord, *p*, that is passed over a pulley, p^1, and is secured to the traverse-bar, so that the weight tends constantly to move the traverse-bar in the direction of the arrow p^2, Fig. 2.

The traverse-bar is constructed in two parts, p^3 p^4, which are connected with each other by means of a latch or spring-bolt, p^5, Fig. 6, upon one part, p^4 operating in connection with as many recesses, p^6, Fig. 6, on the other part as there are skeins to be wound upon the reel N, the pitch of the said recesses being the same as the distance from the cen-

ter of one skein to the center of the next on the reel. In the present case the machine is adapted to wind the thread in three skeins; hence there are three recesses p^6. When the machine is started the guide-part p^3 of the traverse-bar is pushed in the reverse of the direction indicated by the arrow p^2 until the innermost recess is engaged with the latch. As soon as one skein is wound upon the left-hand side of the reel the latch is depressed to free the guide part of the traverse-bar and permit the weight to shift it until the end of the latch strikes into the central recess, thus shifting the thread-guide to the central part of the reel. When the second or central skein has been wound the latch is depressed a second time, and the weight is permitted to shift the guide part of the traverse-bar until the end of the latch strikes into the last recess, thus shifting the thread-guide to the right-hand side of the reel, where the third skein is wound. In order that the latch may be operated automatically, and after a predetermined number of yards of thread have been wound in each skein, the latch is fitted with a projection, p^7, which is acted upon at the proper time by cams or latch-dogs, *a a'*, Figs. 8 and 9, that are carried by the dog-carrier R. This dog-carrier R is caused to revolve by being connected with the traverse-shaft m^1 by means of a screw, r^1, on the said shaft and a worm-wheel, r^2, formed upon the rim of the dog-carrier R. The revolution of the dog-carrier causes the dogs to strike and operate the traverser-latch. As the latch in the present instance has to be operated twice for the winding of three skeins, two latch-dogs are provided. After the three skeins have been reeled the machine is stopped, the three skeins are tied separately, and are removed from the reel. If the thread is not cut between the skeins the three remain connected, constituting a hank of three skeins, in which case the three should be tied together after having been tied separately.

It is desirable that the machine should wind a specific predetermined number of yards in a hank of skeins. In order that this may be effected automatically the dog-carrier R is fitted at its rear side with a stop-dog, *e*, Fig. 7, which is fitted to operate either upon a stop-motion (for disconnecting the driving-shaft D^1 from the line-shafting of the factory,) or upon a bell to notify the attendant; or it may be arranged to operate upon the friction-clutch E of the counter-shaft. In the present example the stop-dog is fitted to operate the lever-hammer of a bell, S, whenever the stop-dog arrives at the proper position for the purpose. As the screw-gear for driving the dog-carrier causes the latter to revolve very slowly, it is never called upon to make a single revolution for a complete hank of three skeins of thread; consequently, when a hank has been reeled, the dog-carrier must be turned by hand to set the dogs in their starting positions before a new hank is wound. In order that the dog-carrier may be turned by hand it is fitted to slide endwise upon its shaft r^3, and it is held in a forward position with the teeth of its worm-wheel in gear with the screw r^1, by means of a removable holder, r^4. When this holder r^4 is withdrawn the dog-carrier may be moved backward on its shaft so as to disengage the teeth of the worm-wheel r^2 from the screw. After this the dog-carrier may be turned by hand to reset the dogs at their starting positions. When the dogs have been so reset, the dog-carrier is moved forward on its shaft to re-engage the driving-gear, and the holder r^4 is reinserted to hold the parts in gear.

As the dog-carrier is driven from the shaft L' of the draft-roll L, each revolution of the dog-carrier corresponds with a specific number of revolutions of the draft-roll, and if the diameter of the draft-roll be such as to deliver a certain fraction of a yard of thread at each revolution, the movement of the dog-carrier will indicate the number of yards of thread reeled in a hank. In order that the attendant may be able to set the dog-carrier in a position to reel a predetermined number of yards in a hank, and to vary the sizes of the hanks, the rim of the dog-carrier is divided into divisions corresponding with a specific number of yards delivered by the draft-roll and wound upon the reel. These divisions *s* are numbered (as seen in Fig. 9) from the one that corresponds with the position of the dog-carrier at the time the stop-dog *e* operates. Moreover, an index, *b*, is fitted to the periphery of the dog-carrier, and a stop, b^1, is fixed upon the machine in such a position that the index can be brought in contact with it when the dog-carrier is turned by hand to reset the dogs. The index *b* is connected with the dog-carrier by means of a screw and a clamp-block. The latter is fitted into a dovetailed groove, b^2, made in the barrel of the dog-carrier, and the screw holds the index to the clamp-block. The slacking of the screw loosens the index, so that it may be set to the division of the numbering corresponding with the number of yards in the hank; and the tightening of the screw secures the index to its place. When, therefore, a complete hank has been wound, the attendant can readily reset the dogs for winding a new hank of the same size by turning the dog-carrier by hand until the index *b* is placed in contact with the index-stop b^1. The divided and numbered barrel of the dog-carrier thus becomes a counting device for counting the number of yards that are reeled. For convenience, the shank of the index-stop is pivoted to its support, so that it may be turned out of the way of the index when necessary.

In order that the hank may be divided into three skeins of equal size, notwithstanding the greater or less number of yards reeled in the hank, the traverse latch-dogs *a a'* are made adjustable upon the face of the dog-carrier R, and this face is divided into divisions which

are numbered, as seen in Fig. 8, thus forming a dial, V. When, therefore, the attendant changes the position of the index *b*, in order to change the number of yards to be wound in a hank, he also changes the positions of the traverse latch-dogs *a a'* to the numbered divisions of the dial V corresponding respectively with one-third and two-thirds of the number at which the index is set, so as to divide the hank into equal parts.

In the operation of the machine it sometimes becomes necessary to piece yarns which are broken, or to piece the yarns from new cops to those from emptied cops, and in such cases it may be expedient to twist the thread without drawing it forward, until the portion in which the piecing occurs is sufficiently twisted. In order that the drawing of the thread through the machine may be intermitted, when necessary, the stationary or dead-wheel C^6 is not secured permanently in its place, but it is constructed to turn upon the shaft L'. Moreover, the rear face of the wheel is fitted with clutch-teeth, and a latch, *w*, is provided, to engage with the said teeth, the latch being pivoted, in this instance, to the box *l* of the draft-wheel shaft. As long as the latch *w* is engaged with the clutch-teeth of the stationary wheel C^6 that wheel remains stationary, and consequently the draft-roll L is caused to revolve and draw the cord as it is twisted. When the drawing is to be intermitted the latch *w* is disengaged from the clutch-teeth of the stationary wheel, leaving it free to turn; consequently the draft-roll is no longer driven, its motion being for the time intermitted; the reel, traverser, and counting-mechanism, also, which, in the present case, receive motion through the intervention of the differential gear, cease to move or have their motion intermitted. The movement of the above-mentioned parts is recommenced when the latch is re-engaged by the operator with the clutch-teeth of the stationary wheel by the action of the attendant.

As the spindles of the machine run at a high speed, it is important that they be thoroughly lubricated, so that they may not heat. In order that this result may be attained an oil-reservoir is provided for each fast-running journal, and the journal is constructed with a screw-formed or helical groove (see Figs. 4^a, 11, and 12) in its periphery, so that the revolution of the journal tends to screw the oil from the reservoir along the journal, and thus feed the entire length of the journal with the lubricating material. In the case of the upper journals *c* c^1, Fig. 4, of the spindles B F, which are vertical, the oil-reservoir *d* is of annular form, and is constructed at the head of the spindle; and as this reservoir causes an enlargement of the spindle, which would prevent it from being introduced and withdrawn through a solid box, the eye of the arm which sustains the upper end of the spindle is made large enough for the head of the journal to pass through it, and is fitted with a ring-box or bush, d^1. The employment of this bush is advantageous in another respect, as it may be readily withdrawn and replaced by another when worn. In the case of the lower journals c^2 c^3 of the spindles B F F F, the oil-reservoir d^2 is formed upon the spindle-pinions C and *f*, and the bearings are fitted with bushes d^3. At the upper end of each upright journal there is a receiving-reservoir, d^4, to receive any surplus of oil and hold it until it flows down between the journal and its bearings or bush. The intermediate pinions f^2 revolve upon their studs, and the latter are constructed with helical grooves, (see Fig. 11,) to which the oil is supplied by an oil-hole at the upper end of the stud. In this case the revolution of the hub of the pinion upon the grooved stud tends to move the oil upward. In the case of the horizontal journal d^5 of the shaft D, the helical oil-feed groove is made in two sections, right and left handed, (as seen in Fig. 12,) so that the oil is conveyed or fed from each end of the spindle toward its middle. The lower end of the spindles F F F are stepped upon hardened disks *n*, Fig. 4^a, which are inserted in oil reservoirs in the brackets *n'* which support the spindles.

In order that the yarn-tubes may be readily supplied with cops, and that the empty cop-spindles may be withdrawn from them, the tube caps or covers and twisting-head of each secondary spindle are not fixed permanently to it, but are fitted to a sleeve, *h*, Figs. 2 and 4, which is constructed to slide up and down upon the spindles, so that the caps may be raised from the heads of the tubes, and are driven by a driving-pin, s^1, acting upon a tooth of the sleeve *h*. The tubes also are not secured permanently to their spindle, but are connected with it by a sleeve, *h'*, and driving-pins s^3 s^2, Fig. 4^a, so that the tubes with their base G' may be turned forward upon the spindle after the caps are raised, for the purpose of moving tubes from beneath their caps, and thus exposing the cops within them.

In order that the twisting-head and tube-caps may be raised, the strand-channel above them is constructed in two sections, the lower, *t*, of which is fitted to tip upon a pivot, as represented at Figs. 2, 3, and 4. When the section is so tipped, space is afforded for the upward movement of the twisting-head of the secondary spindle; and when the section *t* of the strand-guide is in its proper position for operating it is secured there by a pin, *t'*, Fig. 4.

In order that the movement of the yarn-tubes from beneath their caps may be permitted without moving every part of the machine, the tubes are driven from the spindles through the intervention of the driving-pins or teeth s^3 s^2, which occupy only a part of the circumference of a circle, so that space is afforded for turning the tubes forward without turning the spindle F.

In order that the main spindle B may be turned in like manner, the beveled driving-

wheel C^1 is not secured permanently to its shaft D, but is fitted to turn upon that shaft, and is connected with it through the intervention of a clutch, Q, having teeth s^4 s^5, (see Figs. 2 2^a,) which occupy only a portion of the circumference of a circle, so that the clutch-tooth upon the wheel C^1 may be turned forward a portion of a revolution before the back edges of the clutch-teeth come in contact. This turning of the wheel with its clutch-tooth permits a corresponding turning of the main spindle without a movement of the counter-shaft D, or of the draft-roll, counting, and reeling mechanisms. Hence, the main spindle may be turned in a forward direction, for the purpose of placing each secondary spindle at the front of the machine, in a convenient position for the attendant, without affecting the draft-roll, reeling, and counting mechanisms.

In the practical construction of the machine the following proportional sizes and speeds of the different parts have given good results. The main spindle B has been caused to revolve or run from sixteen and fifty-nine hundredths revolutions for each inch in length of thread produced for coarse thread to fifty or more for fine thread. The secondary spindles F run at a speed of eleven and eleven one-hundredths per cent. faster than the main spindle, but in the reverse direction. The stationary or dead-central wheel *f* has fifty-seven teeth, and the spindle-wheels f^1 f^1 f^1 have twenty-seven teeth. I have, however, provided a dead-central wheel of sixty teeth, and another of fifty-four teeth.

When the former is used the speed of the secondary spindles is twenty-two and twenty-two hundredths per cent. faster than that of the main spindle, and when the wheel of fifty-four teeth is used, the spindles all run with the same speed. The beveled wheels C C^1 have thirty and seventy-two teeth, respectively. The wheels C^2 C^3, between the upper cone-pulley D^6 and the shaft L′, have thirty-one and ninety-three teeth, respectively. The stationary wheel C^6 of the differential gear has forty-six teeth, and the draft-roll wheel C^5 has forty-five teeth. The worm-wheels m^3 m^6 have each twenty teeth. The horizontal worm r^1 is double-threaded, and the worm-wheel r^2 has one hundred and fifty teeth. The draft-roll delivers a quarter of a yard of thread for each revolution, and a complete revolution of the count-wheel R corresponds with seven thousand five hundred yards of thread wound by the reel.

Although the above speeds and proportions give good results, the invention is not restricted to them, as changes may be made to suit the views of particular manufacturers or the peculiarities of the work to be produced.

If the yarn to be manufactured into thread is wound upon bobbins, spindles, or other yarn-holders suitable for holding bobbins, should be used in place of the yarn-tubes, and such holders would be substitutes or equivalents for the tubes in the combinations of which they form members. I prefer, however, to employ tubes or some other form of casing to inclose the yarn, as a casing protects the yarn from the action of the atmosphere.

In the foregoing description I have described the yarn as spun left-handed; the secondary spindles as being caused to revolve left-handed; and the main spindle as being caused to revolve right-handed.

If the yarn be originally spun right-handed, then the directions of revolution of the spindles should be respectively reversed, as it is desirable that the first twist after doubling should be in the same direction as that in which the yarn is spun, and that the second twisting should be counter to the first.

In the foregoing description I have described the hank as composed of three skeins. As a general rule the length of thread in the hank may be such as can be formed by the contents of a set of bobbins or cops; but this length may be varied as found expedient.

In place of moving the traverser with its guide along the reel, the reel itself may be connected with the traverser, so as to traverse past a stationary guide; the reel also may be shifted to place different portions of it opposite the guide; but I do not recommend this modification of my machine. So also the draft-roll may be dispensed with if the reel be driven by gearing, so that it will operate to draw the thread along at a definite speed; but, as in such case the thread would be reeled very tightly, I do not recommend this modification of the machine.

In place of using a single draft-roll and coiling the thread upon it, the thread may be passed between two draft-rolls, the one elastic and pressed toward the other with a yielding pressure, so that the thread may be griped between the two.

In some cases the tension device may be constructed so as to both apply tension to the yarn or to the strand, and also to support the yarn or strand in its movement to the twisting-head of the spindle; and in such case the yarn-channels or the thread-channels may be dispensed with, the tension device or devices being supported by a stock or holder which is not a channel. I prefer, however, to employ both the yarn-channels, as the sides of these channels perform an important office in protecting the yarns and strands from the action of the atmosphere when the machine is in operation.

When the machine is to be used the yarn-tubes G are charged with full cops of yarn. The yarn from each cop is conducted through the slot of the tube-cap and up the yarn-channel to the twisting-head of the spindle. Each yarn is applied to the tension-pins of the yarn-channel and is passed between the tension-springs. The doubled yarns from the twisting-heads of the spindle are conducted up the strand-channels to the twisting-head of the main spindle, and are applied in the strand-channels to the ten-

sion-pins thereof. From the twisting-head of the main spindle the united yarns are passed through the cord-guide and conducted to the draft-roll. After being coiled upon the draft-roll the united yarns are attached to the reel. The draft-roll latch *w* having been disengaged so as to prevent the draft of yarns, the spindles are put in motion by throwing the clutch E into gear, and twisting proceeds until the portions of the yarns between the draft-roll and the cops are twisted to the required extent; then the draft-roll, reeling, and counting mechanisms are thrown into gear by engaging the draft-roll latch *w* with the clutch-teeth of the stationary wheel C^6. The work then proceeds regularly, the thread being drawn from the twisting-head of the main spindle as fast as it is twisted, the strands moving forward to form the thread, and the yarns delivering from the cops in the yarn tubes or holders to form the strands. The yarns for the thread are, by preference, spun left-handed, and, as the cops in the cop-tubes are carried in a left-handed direction around the secondary spindles, the yarns of the cop-tubes carried by each secondary spindle are not only twisted into a strand, but receive additional twist, from the well-known fact that the twisting of two or more yarns together causes the additional twisting of each yarn before it unites with the others. Moreover, inasmuch as each yarn is drawn from the cop endwise thereof, (toward the guide-slot in the tube-cap,) and inasmuch as the cops do not revolve to unwind the yarns, each yarn in uncoiling receives an additional or preliminary twist, one turn for each coil drawn endwise from the cop, such preliminary twist being additional to that possessed by it when placed in the machine. This preliminary twist tends to condense and harden the yarn previous to its formation into the strands. The secondary spindles revolve left-handed, so that each strand is twisted left-handed previous to its formation into thread. The main spindle revolves right-handed, so that the thread produced is twisted right-handed, or counter-twisted as compared with the first twisting, and each revolution of the main spindle extracts one twist from the doubled strands and also from each yarn.

From these operations it results that the thread or cord remains straight, and does not tend to kink when taken from the reel. If the fifty-four-tooth dead-central wheel be used the ultimate twist of the yarn in the thread remains the same as it was originally. If the fifty-seven or sixty toothed wheel be used the thread retains an increase of twist as compared with the twist its yarns had when applied to the machine.

From the foregoing description it will be perceived that the yarn is doubled, twisted into strands, redoubled, counter-twisted into thread, reeled into skeins, and put into hanks of skeins, by a continuous process as distinguished from the separate operations heretofore employed. The machine above described is adapted to the production of thread in the hank from two to six yarns, both inclusive, according to the number of the tubes or yarn-holders which are charged with yarn. If a thread composed of a larger number of yarns than six is required, the machine must be constructed with an additional number of tubes, or yarn-holders, unless the yarns charged in to the tubes be doubled and twisted by a preliminary operation.

As regards my improvement in the art of manufacturing thread from yarn, I claim as novel only the peculiar mode of procedure set forth, being aware that other modes, in some respects similar to mine, are well known in the art.

What I claim as my invention is—

1. The improvement in the art of manufacturing thread from yarn, consisting of the continuous preliminary twisting of the yarns, (previous to the first doubling,) the doubling, and twisting of the yarns into a strand in the direction in which they are spun, substantially as before set forth.

2. The improvement in the art of manufacturing thread from yarn, consisting of the continuous preliminary twisting of the yarns, (previous to their first doubling,) the doubling, the twisting into strands in the direction in which the yarns are spun, redoubling, and counter-twisting of the material, substantially as before set forth.

3. The combination, substantially as before set forth, of the yarn-tubes, yarn-channels, secondary spindle, and the twisting-head of said spindle.

4. The combination, substantially as before set forth, of the yarn-tubes, the set of tension-pins for each yarn-tube, a suitable support for such tension-pins, the secondary spindle, and the twisting-head of said spindle.

5. The combination, substantially as before set forth, of the yarn-tubes, the set of tension-pins for each yarn-tube, a suitable support for such tension-pins, the adjustable tension device for each yarn-tube, the secondary spindle, and the twisting-head of said spindle.

6. The combination, substantially as before set forth, of the yarn-tubes, the set of tension-pins for each yarn-tube, a suitable support for such tension-pins, the secondary spindle, and the main spindle.

7. The combination, substantially as before set forth, of the yarn-tubes, the set of tension-pins for each yarn-tube, a suitable support for such tension-pins, the adjustable tension device for each yarn-tube, the secondary spindle, and the main spindle.

8. The combination, substantially as before set forth, of the yarn-tubes, the secondary spindles, the strand-channels, the main spindle, and the twisting-head of said main spindle.

9. The combination, substantially as before set forth, of the yarn-tubes, the secondary spindles, the strand-tension devices, (one for each secondary spindle,) the main spindle, and the twisting-head of said main spindle, the

whole arranged as before described, whereby, as a distinguishing characteristic in the mode of operation of the combination, the yarns are drawn endwise of the yarn-tubes to the secondary spindles, and receive a preliminary twist before being twisted into the strand.

10. The combination, substantially as before set forth, of the yarn-tubes, a yarn-tension device for each yarn-tube, the secondary spindles, the twisting-heads thereof, the strand-tension devices, (one for each secondary spindle,) the main spindle, and the twisting-head thereof.

11. The combination, substantially as before set forth, of the yarn-tubes, the secondary spindles, the main spindle, and the adjustable cord-guide, which is movable endwise of the main spindle and receives the cord as it leaves the said main spindle.

12. The combination, substantially as before set forth, of the yarn-tubes, the secondary spindles, the main spindle, the draft-roll, and the coil-guide for said draft-roll.

13. The combination, substantially as before set forth, of the yarn-tubes, the secondary spindles, the main spindle, the draft-roll, the coil-guide, and the reel.

14. The combination, substantially as before set forth, of the yarn-tubes, the secondary spindles, the main spindle, the draft-roll, the reel for winding thread in a skein, and the traverser, the whole arranged as before described, whereby, as a distinguishing characteristic in the mode of operation of the combination, the yarns are drawn endwise of the yarn-tubes to the secondary spindles, and receive a preliminary twist before being twisted into strands.

15. The combination, substantially as before set forth, of the yarn-tubes, the secondary spindles, the main spindle, the draft-roll, the reel, the traverser, and the shifting mechanism for shifting the traverser relatively to the reel.

16. The combination, substantially as before set forth, of the yarn-tubes, the secondary spindles, the main spindle, the reel, and the counting device for counting the number of yards reeled.

17. The combination, substantially as before set forth, of the yarn-tubes, the secondary spindles, the main spindle, the reel, the counting device, and the stop-dog.

18. The combination, substantially as before set forth, of the yarn-tubes, the secondary spindles, the main spindle, the reel, the count-wheel, the index, and the index-stop.

19. The combination, substantially as before set forth, of the yarn-tubes, the secondary spindles, the main spindle, the reel, the traverse latch-dogs, and the traverser.

20. The combination, substantially as before set forth, of the yarn-tubes, the secondary spindles, the main spindle, the reel, the counting device, the stop-dog, the adjustable traverse latch-dogs, and the dial.

21. The combination, substantially as before set forth, of the reel, the traverser, the counting device, the stop-dog, the traverse latch-dogs, and the dial.

22. The combination, substantially as before set forth, of the counting device, the index, the index-dog, the wheels for transmitting motion to the counting device, and the movable holder for holding the counting device in gear, and permitting it to be thrown out of gear for resetting.

23. The combination, substantially as before set forth, of the yarn-tube, the movable cap thereof, the twisting-head of the secondary spindle, and the movable section of the strand-channel.

24. The combination, substantially as before set forth, of the secondary spindle, the yarn-tube, and the driving-pins, which permit the yarn-tube to be turned without turning the spindle.

25. The combination, substantially as before set forth, of the main spindle, the counter-shaft for imparting motion to it, and the clutch-teeth, which permit the main spindle to be turned without turning the shaft.

26. The combination, substantially as before set forth, of the main spindle, the draft-roll, and the clutch-teeth and latch, whereby the movement of the draft-roll may be intermitted, while the main spindle continues to twist the thread.

27. The combination, substantially as before set forth, of the main spindle, the reel, the differential gear, through which a slow motion is transmitted to the reel, and the clutch-teeth and latch, whereby the movement of the reel can be intermitted while the main spindle continues to twist the thread.

28. The combination, substantially as before set forth, of the oil-reservoir and the revolving journal, constructed with the helical oil-feed groove.

29. The combination, substantially as before set forth, of the oil-reservoir, the revolving journal, constructed with the helical oil-feed groove, and the receiving-reservoir.

Witness my hand this 19th day of February, A. D. 1876.

ANDREW REYNOLDS ARNOLD.

Witnesses:
EDWARD F. BALDWIN,
HORACE F. BALDWIN.