Dec. 24, 1940. W. F. KNEBUSCH ET AL 2,225,642

MANUFACTURE OF THREAD OR THE LIKE

Filed Feb. 18, 1935 5 Sheets-Sheet 1

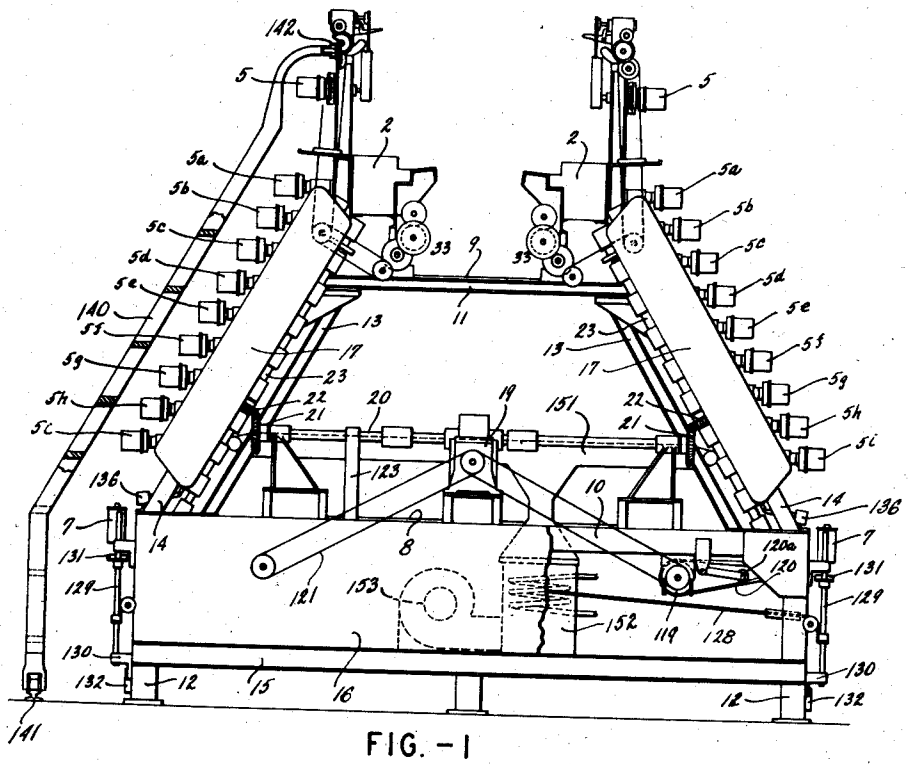


FIG. -1

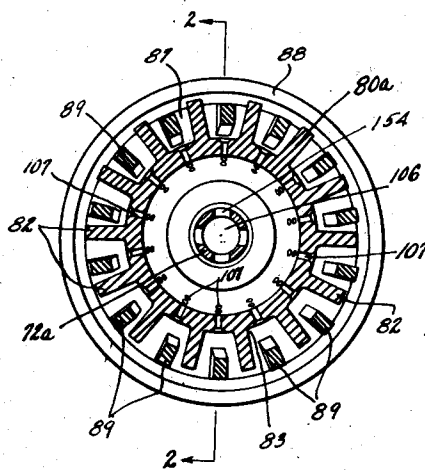


FIG. -3

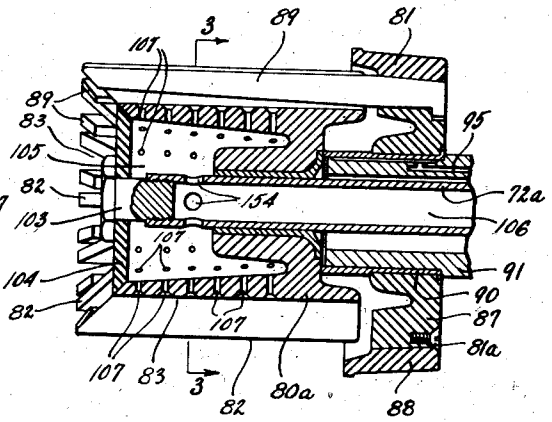


FIG. -2

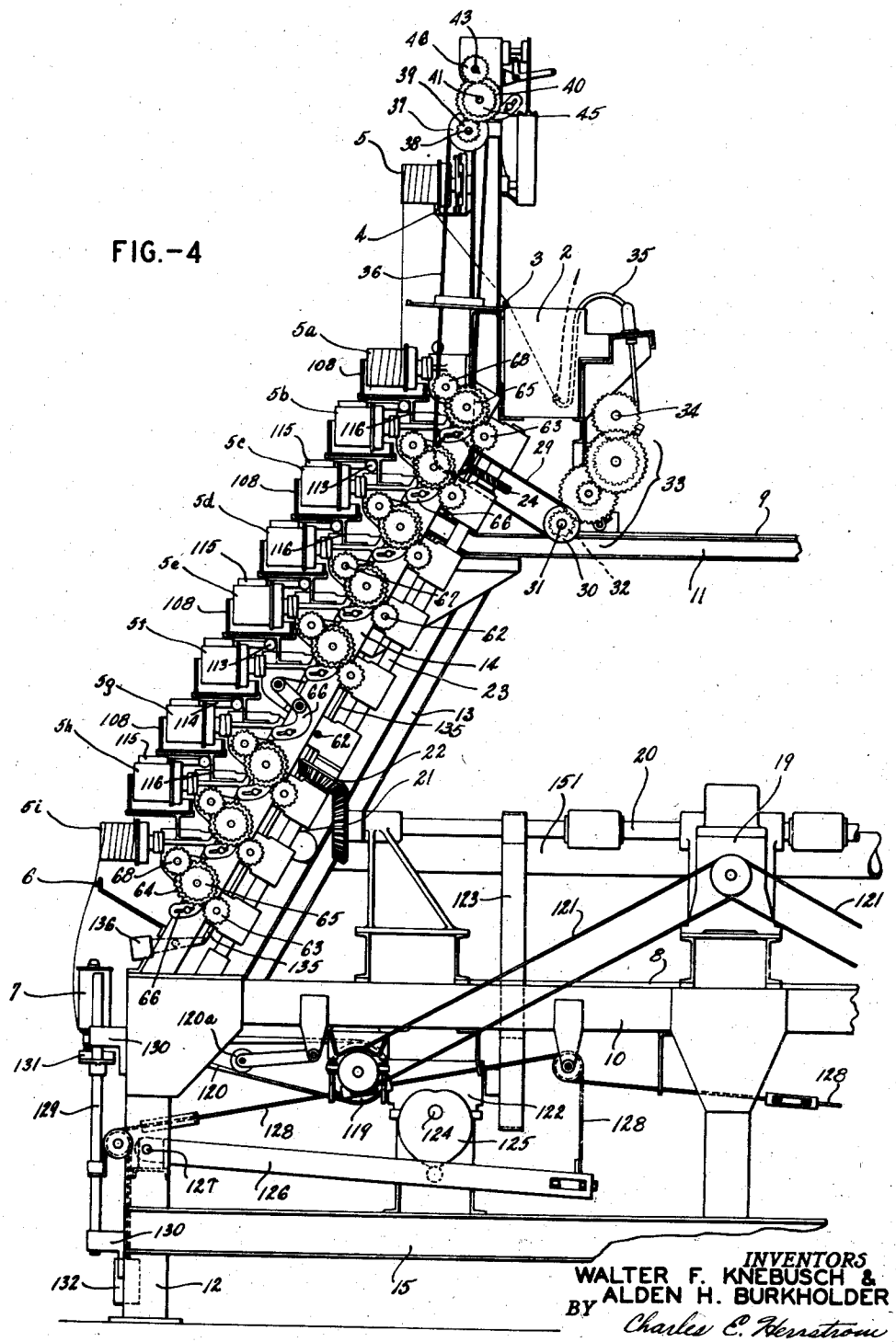
INVENTORS
WALTER F. KNEBUSCH &
BY ALDEN H. BURKHOLDER
Charles C. Herrstrom
ATTORNEY

Dec. 24, 1940. W. F. KNEBUSCH ET AL 2,225,642

MANUFACTURE OF THREAD OR THE LIKE

Filed Feb. 18, 1935 5 Sheets-Sheet 2

FIG.-4



INVENTORS
WALTER F. KNEBUSCH &
ALDEN H. BURKHOLDER
BY Charles C. Hernstrom
ATTORNEY

Dec. 24, 1940. W. F. KNEBUSCH ET AL 2,225,642

MANUFACTURE OF THREAD OR THE LIKE

Filed Feb. 18, 1935 5 Sheets-Sheet 3

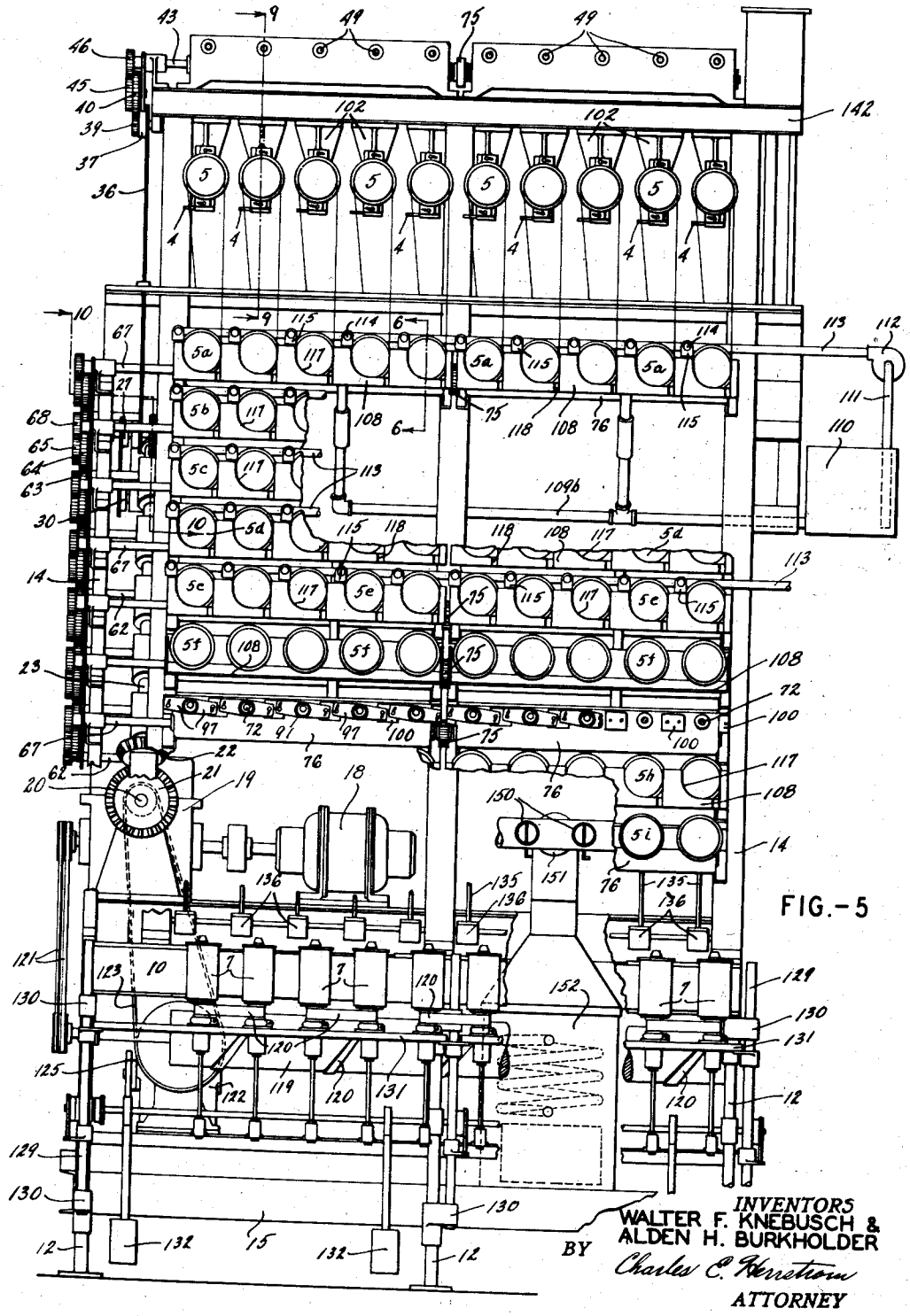


FIG.-5

INVENTORS
WALTER F. KNEBUSCH &
ALDEN H. BURKHOLDER
BY Charles E. Herrstrom
ATTORNEY

Dec. 24, 1940. W. F. KNEBUSCH ET AL 2,225,642

MANUFACTURE OF THREAD OR THE LIKE

Filed Feb. 18, 1935 5 Sheets-Sheet 4

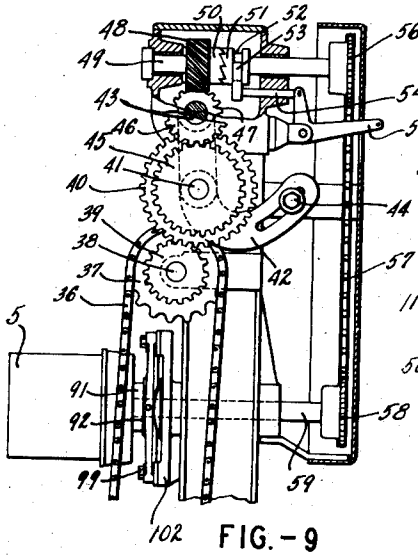


FIG.-9

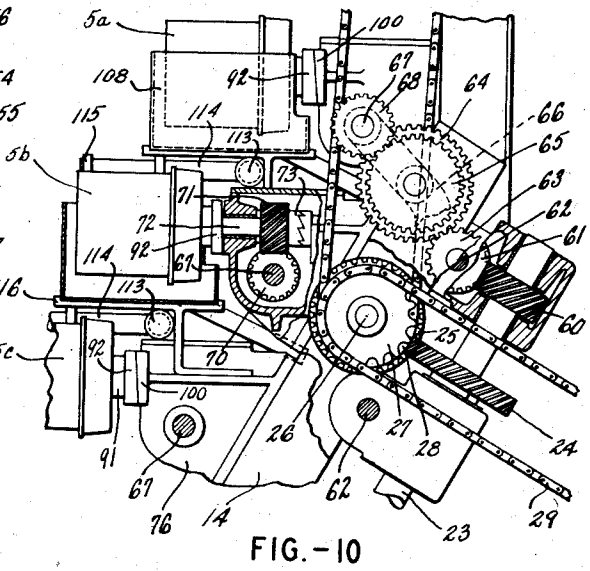


FIG.-10

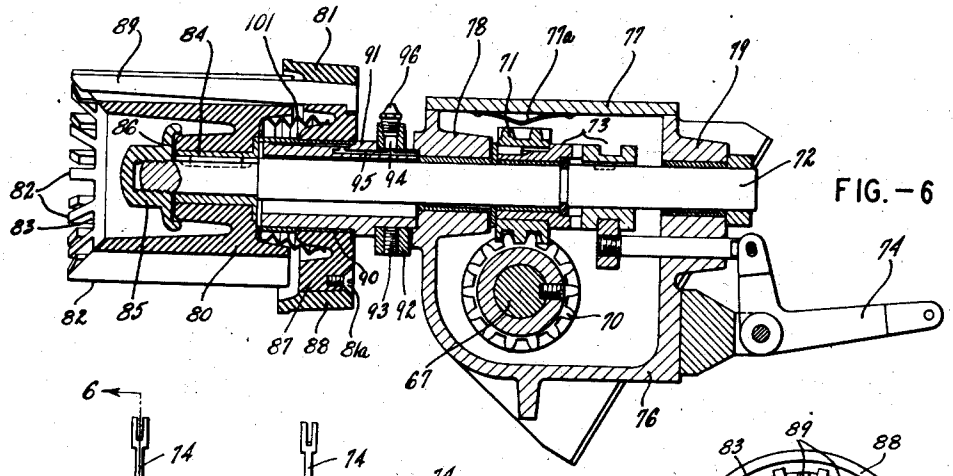


FIG.-6

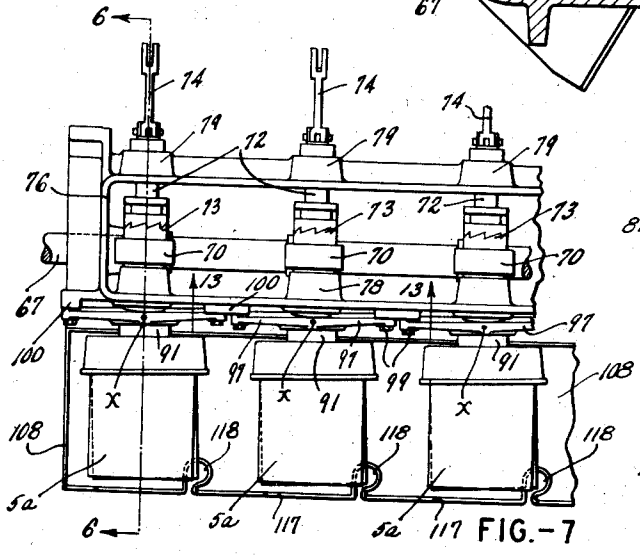


FIG.-7

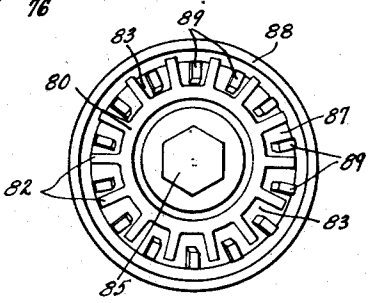


FIG.-8

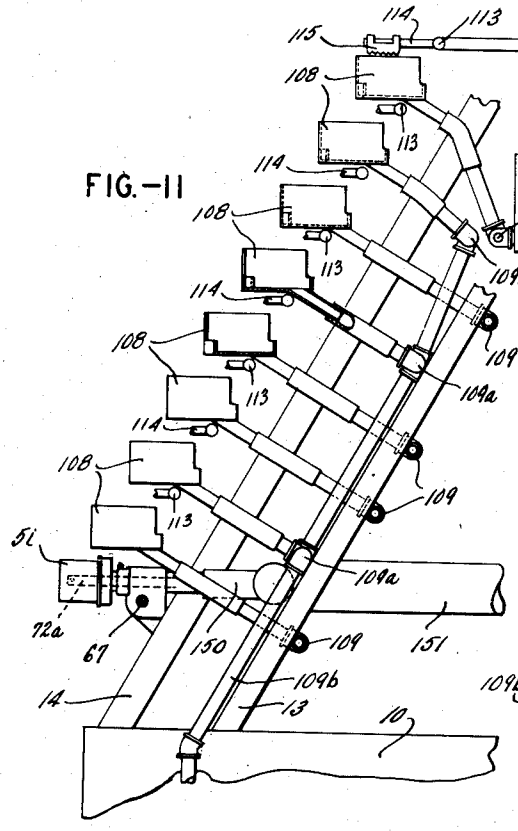
INVENTORS
WALTER F. KNEBUSCH &
ALDEN H. BURKHOLDER
BY Charles C. Hernstrom
ATTORNEY

Dec. 24, 1940. W. F. KNEBUSCH ET AL 2,225,642

MANUFACTURE OF THREAD OR THE LIKE

Filed Feb. 18, 1935 5 Sheets-Sheet 5

FIG.-11



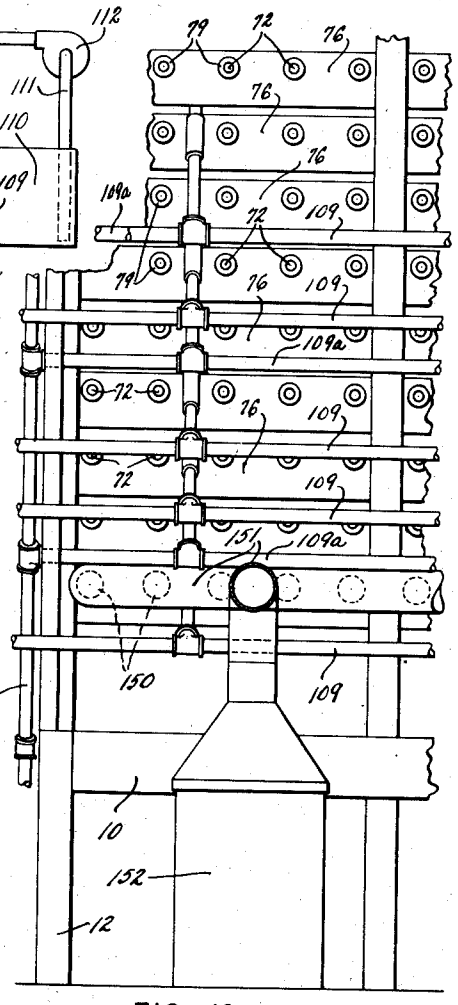


FIG.-12

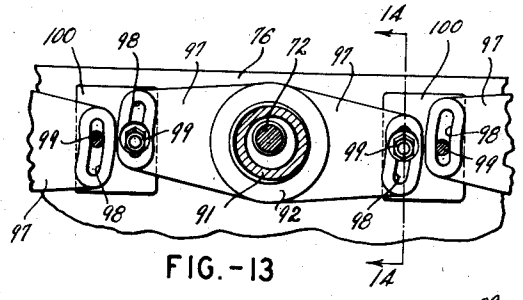


FIG.-13

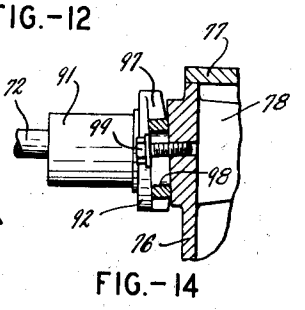


FIG.-14

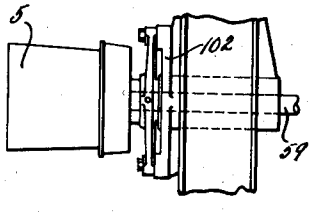


FIG.-15

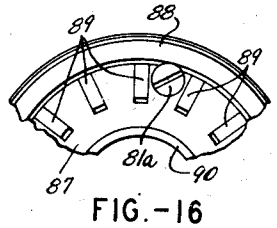


FIG.-16

INVENTORS
WALTER F. KNEBUSCH &
ALDEN H. BURKHOLDER
BY Charles C. Henstrom
ATTORNEY

Patented Dec. 24, 1940 2,225,642

UNITED STATES PATENT OFFICE

2,225,642

MANUFACTURE OF THREAD OR THE LIKE

Walter F. Knebusch and Alden H. Burkholder, Cleveland, Ohio, assignors to Industrial Rayon Corporation, Cleveland, Ohio, a corporation of Delaware

Application February 18, 1935, Serial No. 7,114

8 Claims. (Cl. 18—8)

This invention relates to the manufacture of thread or the like. More particularly, it relates to the manufacture of artificial silk thread ("rayon") by a continuous method in which, in a single machine or apparatus, a multiple filament thread may be spun and then suitably processed by subjecting it to any necessary or desirable treatments, and finally may be twisted and wound into package form ready for shipment or use. As will appear, the invention is not limited to the manufacture of artificial silk thread, but is applicable to the manufacture of various other thread or the like.

One object of the invention is to provide new and improved apparatus arranged to permit accurate and convenient control not only of the mechanism but also of the various steps of the process, for the purpose of securing a uniform product useful for both woven and knitted fabrics or materials.

A further object is to provide improved mechanism in which the thread is led in succession to and along a series of thread-storage, thread-advancing reels, on each of which many helical turns of thread or the like progress in order from the receiving to the discharge end with the possibility of thus carrying upon a reel a sufficient length of thread or the like to enable one or more process steps to be performed upon it while on that reel.

A further object is to provide such mechanism in which the several reels are so related to each other as to permit the thread or the like to be readily transferred from reel to reel and at the same time be exposed to the view and access of an attendant for convenient operative manipulation.

A further object is to provide mechanism of this kind built in units readily capable of multiplication so that a single machine can be made to produce a large number of separate threads or like products and at the same time provide convenient access to all parts of the mechanism for control and operating purposes.

A further object is to provide mechanism of this kind in which successive reels are arranged in stepped relation, each projecting endwise beyond its predecessor, with the possibility of presenting two similar sets of devices upon opposite faces of the same machine, for more convenient multiplication of units.

A further object is to provide mechanism of this kind in which the reels are of such form as to be capable of automatically causing transfer of the thread from reel to reel without any inherent necessity for special transfer mechanism or any requirement for special manipulation by highly skilled operators, although either or both of such mechanism and manipulation may be employed, if desired.

A further object is to provide improved reel mechanism of the character described in which the thread or the like, or a plurality of turns thereof, is automatically advanced from end to end of the reel, said reel embodying simple and improved means for adjusting the lead, or, in other words, the rate of travel of the thread or the like along the reel.

Further objects of the invention are in part obvious and in part will appear more in detail hereinafter.

In the drawings, which represent one suitable embodiment of the invention, Fig. 1 is an end view, partly broken out, of a complete machine embodying the invention. Fig. 2 is a longitudinal sectional elevation through the drying reel, on the line 2—2, Fig. 3. Fig. 3 is a cross section on the line 3—3, Fig. 2. Fig. 4 is an end elevation, corresponding to Fig. 1, but on a larger scale, with parts broken out and in section, to expose interior mechanism, the air and liquor supply and circulating systems being largely omitted, to avoid confusion in illustration. Fig. 5 is a front elevation, on the same scale as Fig. 4, but viewed from the right in Fig. 1, parts being broken out or omitted for simplicity of illustration.

Fig. 6 is a detail sectional elevation, on a larger scale, through one of the reels and its driving mechanism, on approximately the line 6—6, Figs. 5 and 7. Fig. 7 is a detail plan view, illustrating several of the devices shown in Fig. 6, the cover of the gear casing being omitted. Fig. 8 is an end view of the reel from the left in Fig. 6. Fig. 9 is a detail view, partly in elevation corresponding to Fig. 4 and partly in section on the line 9—9, Fig. 5. Fig. 10 is a similar view on approximately the line 10—10, Fig. 5. Figs. 11 and 12 are respectively an end elevation, partly in section, and a rear view, taken from the right in Fig. 4, illustrating the liquor circulation system, other parts being omitted for simplicity of illustration. Fig. 13 is a detail sectional elevation on the line 13—13, Fig. 7, but on a larger scale. Fig. 14 is a detail section on the line 14—14, Fig. 13. Fig. 15 is an elevation of one of the reels, in diagrammatic form, corresponding to Fig. 9, and showing a modification. Fig. 16 is a detail view of one of the reel members.

While the invention is capable of use in or in

connection with the production of rayon by any of the wet processes, such as the viscose, cuprammonium, or cellulose acetate processes, and should be understood as applying thereto, for convenience but in no sense of limitation the invention has been illustrated and will be described hereinafter in connection with the viscose process of manufacturing multiple filament artificial silk threads, where an alkaline solution of cellulose xanthate is extruded into a salt or acid spinning bath, is allowed to set up or coagulate, and is subsequently treated in various ways and by various reagents, such as with sulfuric or other acid, with a soluble sulfide, with bleaching solution, with an antichlor reagent, with soap solution, and with any desirable intervening washing steps with hot or cold water, or both, followed by drying, twisting and winding into package form.

Referring first to Fig. 4, the multiple filament thread is spun from the nozzle or spinneret 1 into a spinning bath in the trough 2, being then led over guides 3, 4 to and along a suitable thread storage reel 5, from which it passes in succession to any suitable or desirable number of following reels, upon which the succeeding steps of the process are performed. Nine such following reels are shown in the drawings for purposes of illustration, marked respectively 5a to 5i. The thread is led from the last reel 5i through a guide 6 to a suitable collecting and package forming device, such as the cap twister 7.

The production of each multiple filament thread requires a complete series of such parts, hereinafter referred to as a unit, including a nozzle, a series of reels in numbers sufficient to enable the necessary or desirable process steps to be performed upon the thread, and the final collecting device. However, as is usual in this art, a given machine may be built to provide for the simultaneous production of a multiplicity of threads, so that each machine usually includes a series of such units located and arranged with relation to each other in such manner as to enable the parts to be conveniently accessible for inspection or for any desired or necessary manipulation or control purposes, as well as to enable a plurality of units to be driven from the same power source or sources and therefore in timed relation with each other so that the product of all units is uniform.

In the present machine, for reasons and purposes which will more fully hereinafter appear, the several reels of each unit are located in progressive parallel relation to each other and in descending order, as shown in Fig. 4. In the form shown, the reels are all mounted upon substantially parallel horizontal axes, with the first reel of the series, say reel 5, at the top. They are also in progressive relation to each other in the sense that the receiving end of each reel is below the discharge end of the next preceding reel, all the way through the series. Also, the discharge ends of all reels are presented to the operator along a common front. As a result, the reels of the series are in what may be called stepped relation.

Therefore, by arranging units side by side, as shown in Fig. 5, it is possible to build a double sided machine with the reels of the various units banked upon its opposite sides, the machine as a whole resembling a gable roof and having two ends and two oppositely disposed inclined sides, as shown in Fig. 1. For convenience, Fig. 4 illustrates but one half of the machine, but it will be understood that the other half is of similar form so that it will require no additional description. Further, the elements of each unit of the machine are the same, so that description of a single unit will suffice for all, except of course that all or any number of units may be simultaneously driven from the same power source or sources, as will be readily understood.

Referring now more in detail to the supporting parts and operating mechanism, the machine as a whole comprises a suitable frame including lower and upper platforms 8, 9, supported respectively by cross beams 10, 11 secured to corner posts or columns 12, the platforms 8, 9 being connected by diagonal uprights 13, 14 which also serve to support the mechanism. In a full sized machine the beams 10, 11 may be spaced approximately five feet apart, so that an operator can work in a substantially upright position on the platform 8, where he has access to the back faces of the two fronts of the machine, while on platform 9 he has access to the rear portions of the upper mechanism. Below platform 8 are cross bars 15 which support the driving and other parts of the mechanism. The base of the machine may be enclosed, if desired, by plates 16 not only to protect the mechanism, but as a safeguard against injury to the operator. Similar plates or casings 17, preferably removable, may enclose other parts of the driving mechanism.

At one end of the machine is mounted a driving motor 18, Fig. 5, whose shaft actuates a suitable speed reducing device illustrated conventionally at 19 and operating a horizontal cross shaft 20 provided at its opposite ends with bevel gears 21 driving bevel gears 22 on diagonal shafts 23, one on each side of the machine. These diagonal shafts are provided at intervals with take-off drives for the reels at various levels, and the driving connections to the several reels include any suitable form of change speed mechanism. For convenience in manipulation of this mechanism the shafts 23 and the gear connections therefrom to the several reels are located at the end of the machine, as shown in Fig. 5, where they are easily accessible, and corresponding reels of a plurality of units are driven by the same horizontal shafts, as will more fully appear.

Referring to Fig. 10, each shaft 23, near its upper end, is provided with a spiral gear 24 driving a spiral gear 25 on a short horizontal shaft 26 parallel to the front of the machine. Shaft 26 is provided with two sprocket wheels, 27, 28, the first of which is connected by a chain 29 (Fig. 4) to a sprocket 30 on a short shaft 31 provided with a gear 32 which drives a series of gears marked generally 33. The last of said gears, which is on a horizontal shaft 34 which extends from end to end of the machine parallel to its front, is provided at each unit with suitable means for driving the viscose pump, not shown, which supplies viscose to the conduit 35 leading to the spinneret 1 at that unit of the machine. The pumps on all units are therefore driven by the same shaft and at a uniform rate of speed, which readily may be varied by changing the size of any or all of the change speed gears 33.

The second sprocket 28 on shaft 26 is connected by a chain 36 (Fig. 9) to a sprocket 37 on a short shaft 38 which is provided with a gear 39 driving a gear 40 on a shaft 41 mounted in a bracket 42 pivoted to turn about a shaft 43 and held in any adjusted position by a cap screw 44 passing into the frame through a curved slot in

said bracket. Shaft 41 also carries a gear 45 meshing with a gear 46 on the shaft 43. Shaft 43 extends horizontally from end to end of the machine and at each unit is provided with a suitable take-off drive member for the first reel of the unit, such as a spiral gear 47 meshing with a spiral gear 48 loosely rotatable upon a shaft 49, the spiral gear 48 being provided with a clutch member 50 cooperating with a clutch member 51 splined to the shaft 49 and having a grooved collar 52, in the groove of which is the fork 53 of a rod 54 connected to one arm of a controlling bell crank lever 55. Fig. 9 shows the clutch parts 50, 51 in engagement, so that shaft 49 is rotated.

Said shaft is provided at one end with a sprocket wheel 56 connected by a chain 57 to a sprocket wheel 58 upon the shaft 59 of the first of the thread storage reels 5 of the unit. Such reel is conventionally shown in Fig. 9, but is of suitable form, such as that shown in Fig. 6, so that by rotation of its shaft many turns of thread are advanced in order from its receiving to its discharge end, or, in other words, from right to left in Fig. 9. By turning the bell crank lever 55 clockwise in Fig. 9 the clutch may be disengaged to stop the rotation of said reel and, at any time, by loosening the cap screw 44 and swinging arm 42 to the right the driving gearing may be disengaged. By substitution of a gear of a different size for any one or more of the gears 39, 40, 45, 46, any desired speed ratio may be established between shafts 38 and 59, for change speed purposes, as will be readily understood.

Referring again to Fig. 10, shaft 23 is provided at intervals with take-off drives for the several reels of the series 5a to 5i inclusive, but as the drive connection from shaft 23 to each of said reels is the same, description of one will suffice for all. In this case, shaft 23 is again provided with a spiral gear 60 meshing with a spiral gear 61 on a short horizontal shaft 62 parallel to the shaft 38 and provided with a gear 63 driving gears 64, 65. The latter correspond to the gears 40, 45 and, like them, are mounted on an adjustable slotted bracket 66 mounted to swing around the axis of shaft 67, which is provided with a driven gear 68. Here also, by substituting a gear of different size for any one or more of the gears 63, 64, 65, 68 any desired speed ratio may be established between shafts 62 and 67.

Shaft 67 at intervals is provided with suitable take-off drive members for corresponding reels of the different units, such as a spiral gear 70 meshing with a spiral gear 71 loosely rotatable on the shaft 72. Said shaft, like shaft 49, is thrown into and out of operation by actuation of the clutch 73 by its bell crank lever 74. Shaft 72 directly drives one of the thread storage reels of the unit, the details of construction of such reel and its driving mechanism being illustrated in Figs. 6 and 7.

Of course, without further description, it will be understood that the same shaft 23 carries a plurality of the spiral gears 60 distributed along its length, each of said gears driving a set of change speed mechanism up to one of the shafts 67 which extend from end to end of the machine and at intervals are provided with take-off drive members for corresponding reels of the various units in the same manner just described.

This apparatus has been specially designed for simplicity in the multiplication of units embodied in the same mechanism. For convenience the parts are arranged to associate in one group a small number of units, say five, and the machine as a whole is thus increased in size by associating groups of five units side by side, the machine being expanded endwise, as it were. Each group, of course, embodies its sections of each of the shafts 34, 43 and 67, the shaft sections being connected end to end by couplings 75, a few only of which are shown in Fig. 5.

Figs. 6, 7 and 8 illustrate the construction and arrangement of a typical reel and its operating mechanism, including a gear box or casing 76 of elongated pan like form, provided with a removable cover 77, with a series of internal bearing bosses 78 on one of its walls and opposite to them with a series of external bearing bosses 79 upon its opposite wall. Cover 77 is provided on its inner surface with a depending plate or boss 77a having inclined sides or faces adapted to direct downwardly upon the gear 71 any lubricant splashed in the casing. Shaft 67 extends through the casing, its outwardly projecting opposite ends being connected by the couplings 75 to like ends of neighboring shaft sections. Shafts 72 are journalled in the bearing bosses before referred to, extending horizontally across and through the casing, the gears 70, 71, clutches and operating devices therefor being contained within the casing, which of course serves as a lubricant reservoir.

Similar casings and mountings are utilized for all of the groups of five take-off drives and their clutches, even for the driving mechanism for the first or uppermost reels of the series, where the bosses form bearings for the intermediate driving shafts 49 instead of the shafts 72 of the reels themselves. Consequently the gear casings are well adapted for quantity production. The same system of duplicating parts for multiple use and therefore for quantity production at low cost extends throughout the entire machine wherever possible.

The typical reel shown in Fig. 6, generally speaking, is of the same form and operates in the same manner as the reel shown, described, and claimed in a prior application for Winding reel for spinning machine, Serial No. 652,089, filed January 16, 1933, by Walter F. Knebusch, to which reference may be had for a more complete description, if desired. For the purposes of this application, it is sufficient to say that the present reel is open ended in the sense that the supports and driving connections for said reel are all connected to it at one end only of the reel, leaving the thread supporting and carrying bars free and open at the other end of the reel, where also the reel has no shaft extension. Therefore, by rotating the reel in the proper direction to cause the turns of thread to travel from its driven end to its free end, the task of transferring the thread from reel to reel is materially simplified, due particularly to the absence of a shaft extension and consequently to the freedom of the turns of thread discharged at the end of the reel, as compared with that form of reel in which the shaft extends through the reel from end to end, with bearings at both ends of the reel.

In the typical form shown in Fig. 6 the reel includes two rigid members, marked respectively 80, 81. Member 80 may be termed the concentric member, because it is fixed to and rotates with the shaft 72 and in form is symmetrical about the axis of said shaft and therefore is concentric therewith. This reel member includes a body portion of generally cylindrical form with its periphery slotted to form a series of alternat-

ing bars 82 and recesses 83, the body being mounted upon a sleeve 84, keyed to the shaft 72 and held in place thereon by a nut 85 threaded upon the end of the shaft against a rubber or other suitable sealing washer 86. The other member 81 of the reel may be called its eccentric member, because while it is generally of cylindrical form it is mounted with its axis both offset slightly from and also askew or inclined to the axis of the shaft 72, for reasons described more fully in said Knebusch application above referred to. The member 81 as shown comprises a head formed of inner and outer rings 87, 88, the former of which has peripheral slots to receive bars 89. Rings 87 and 88 are respectively externally and internally tapered, being held together in their home position by screws 81a (Fig. 16) to firmly and rigidly clamp between them the bars 89, and the inner ring 87 is mounted upon a sleeve 90 journalled to rotate upon a supporting tubular member 91 which surrounds shaft 72 and is spaced therefrom.

Member 91 is supported with its axis slightly offset from and also askew or inclined with relation to the axis of shaft 72, the supporting means being preferably of a form enabling the degree of the askew or inclined relation to be adjusted or varied, not so much for the purpose of varying such inclination during operation of the machine as for adjusting it to the same value on all corresponding reels in the same machine, during the original or initial setting up or assembling of such machine, for securing uniformity in operation of the several units. As shown, the rear end portion of each tubular support 91 enters an opening in a bridge like supporting member 92, to which it is rigidly secured, such as by set screw 93. Said supporting member is provided with a channel 94 communicating with a passage 95 in member 91 leading to the bearing surfaces between member 91 and the sleeve 90, channel 94 being provided at its outer end with the usual grease gun receiving nipple device 96 for supplying lubricating grease.

Member 92 is provided with oppositely disposed arms 97, each of which near its outer end has a curved slot 98 (Fig. 13) to receive a cap screw 99 threaded through said slot into an opening in a block 100 integral with and forming a part of the gear casing 76. Each block 100 is wide enough to receive the ends of the arms 97 of two adjacent reel supports. Further, each block has its front vertical face which is presented to an operator standing at the front of the machine inclined or beveled in the vertical direction. To state it accurately, looking at the front of the machine or from the left in Fig. 6, the front surface of the block is inclined downwardly and away from the observer. That is true on all inclined faces of all blocks, except as hereafter noted. The rear faces of the end portions of arms 97 which contact with the blocks are correspondingly beveled.

The parts are so formed that when the tubular member 91 is secured in its bridge support 92 and said support is clamped to the gear box with its arms 97 extending horizontally, the axis of the member 91 (and consequently the true axis of the eccentric reel member 81) extends horizontally in a plane parallel to the horizontal plane passing through the axis of shaft 72, and is therefore slightly offset vertically therefrom, and is also slightly askew or inclined with relation thereto. The degree of the askew relation determines the lead or pitch of the turns of thread wound in spiral form upon the reel and progressively advanced along it, and a very slight variation in the degree of inclination produces material variation in pitch and consequently of the spaces between turns of thread.

With the arrangement described, by loosening the cap screws in the opposite arms of a given supporting member 92 and turning said arm substantially about the axis of shaft 72, thus raising one of its arms and lowering another, the degree of inclination may be increased or diminished so as to adjust it to a predetermined standard value on all corresponding reels. Specifically, referring to a single reel and to its member 92 and assuming an operator facing said reel from the left in Fig. 6, if member 92 is adjusted so as to drop its right hand arm and raise its left hand arm the effect will be to swing the member 81 to the right in Fig. 7, or, in other words, to turn it in a counterclockwise direction about a vertical axis at substantially the point marked X, Fig. 7.

Not only the liquor tank or troughs and the conducting pipes therefor, but also the reel parts, and particularly those portions thereof which come in contact with the thread or with any liquor or bath to the effect of which the thread is subjected for treating purposes, are preferably made of some material which is not corroded or affected by the bath itself and which also will not dissolve or otherwise contaminate or harm the bath liquor. Any suitable material may be used for this purpose, such as special enamels or vitreous materials used in solid forms or as coatings upon a metal or other base, or the reel members or the parts thereof exposed to the liquid may be made of Bakelite or other phenolic condensation product, or of special metals, such as aluminum or Monel metal. Further, the inner working parts of the reel are shielded from the liquid, such as by the use of the rubber washer 86 and a flexible bellows like rubber boot 101 extending from one to the other of the reel members. The nut 85 is also made of or coated with non-corrodible material.

Reels of the form shown in Fig. 6 may be employed for each of the reels 5a to 5h inclusive, Fig. 4, and also for the first or set-up reel 5, with the exception that at the reels 5 the supports 92 are mounted so that their arms extend vertically one above and one below each reel member and the pads to which said arms are connected are mounted upon or form portions of brackets 102 secured to or forming a part of the frame. Here the sloping or tapering of the pads or blocks to which the arms are secured is in the horizontal direction instead of in the vertical, but the slope on all pads will be in the same direction, such as sloping away and to the right from an operator standing at the front of the machine, and rotating adjustment of the member 92 will tilt the eccentric reel member up or down instead of to the right or to the left.

The reels 5i are specially formed for drying purposes, in the manner shown in Figs. 2 and 3, which views, incidentally, well illustrate the interleaved or staggered relation of the bars of the two reel members. In this drying reel the parts are of the same form as those shown in Fig. 6, with exceptions as follows:

The driving shaft, marked 72a, is hollow and at its rear end is suitably connected to a source of supply of heated air under pressure, such as by a conduit 150 communicating with a manifold 151 fed by a heater 152 through which air is forced by a fan or blower 153. At its front end,

beyond the hub of the concentric reel member 80a, the tubular shaft is provided with openings 102, and the end of the shaft is closed by a cap screw 103 which secures in place a closure 104 having a tapered periphery fitting a like seat on member 80a and therefore closing the end of said member and forming a chamber 105 communicating with the channel 106 within the tube. The body of member 80a is also provided with a series of through openings 107 opposite the recesses or channels between its bars. Consequently, by supplying heated air to the channel 106 it issues through the openings 102 into chamber 105 from which it is distributed to the various ports or passages 107 and is discharged radially outwardly to all parts of and along the full length of the reel while it is rotating, thereby gradually drying the turns of thread progressing along said reel so that when they leave it the thread is in dry or substantially dry form and may be directly wound and even twisted into package form, as will be readily understood.

In all of the reels used in this machine, the concentric member 80 may also be termed the "driving" member, and the eccentric member 81 the "driven" member, because member 80 is fastened to and rotates with the driving shaft 72 and drives the eccentric member 81 by driving engagement between the longitudinal bars of the two reel members, as more fully described in the aforesaid Knebusch application. Any driving relation between the two reel members may be used, however, and indeed, the phrase "thread storage reel," as used herein, is intended to include not only the specific reels shown and described herein and in said Knebusch application, but indeed, any form of reel so constructed and operated as to receive the thread being formed, form it into a series, usually a large number, of successive helical turns of thread which are advanced along the reel from its receiving to its discharge end, thus providing not only a means for continuously advancing the thread, but also a means which on the single reel carries a sufficient length of thread to enable any given step or steps of a process to progress to completion while the thread is on the reel.

Suitable means is provided for subjecting the thread at any one or more of the reels 5a to 5h of a unit to one or more of the processing operations or treatments before referred to. These treatments usually involve subjection of the thread to the effect of a liquid bath. Therefore, this apparatus, at each of said reels 5a to 5h inclusive, includes means for supplying to and distributing over said reel a spray or a series of small streams or sheets of the liquid bath, together with means for collecting said bath as it drains from the reel, and for recirculating it or conducting it to storage or to the sewer.

This means is also of a form suitable for convenient multiplication in a large machine and also for quantity production; however, the bath circulating means for all units is of the same general form and construction, description of one will suffice for all. Because the units are arranged in groups of five, certain portions of the bath circulating devices are likewise arranged. For example, the drainage collecting troughs are made in sections each of proper size and shape to accommodate five corresponding reels on the units of a group.

Referring to Figs. 4, 5 and 11, each such trough comprises a pan shaped body member 108 provided with an open top, and with rear, front and end walls and a bottom, the latter being provided with connection to a drain pipe 109. The several drain pipes 109 from corresponding group trough members down the full length of the machine communicate with one or more manifolds 109a connected to a pipe 109b leading directly to the sewer, as in the case of wash water or other liquid which is thrown away or sent to waste, or which, as in the case of liquids which it is desired to save and use repeatedly, such as sulfuric acid applied to the reels 5a, may lead to an individual collecting receptacle 110 for that particular liquid, where the mixture is made up and replenished with additional fresh material or adjusted as to concentration or the like from time to time.

From each such receptacle an intake pipe 111 leads to and communicates with a suitable pump 112 supplying the particular bath liquor to a manifold 113 extending down the entire length of the machine, or to such part of it as may be supplied by this particular pump, said manifold, opposite each of the reels, being provided with a supply pipe 114 leading to a reagent distributor 115 so mounted as to distribute its liquid in spray, sheet or multiple stream form over the length of the rotating reel which it supplies and therefore into contact with the thread upon it.

The reagent distributors 115 may be of any suitable form, for example, that shown in the prior application for Reagent distributor, Serial No. 688,026, filed September 2, 1933, by Knebusch and Hillix, to which reference may be had for a more complete description, if desirable or necessary. In Fig. 4 of the drawings, collecting troughs 108 are shown, one for each of the reels 5a to 5h inclusive, all thereof being mounted upon suitable brackets on supports 116 carried by the main frame. Each of the trough members has its front wall, shown in elevation in Fig. 5, cut out or recessed as at 117 to more or less expose the end of the reel presented to it, and, as illustrated in the plan view, Fig. 7, the front wall is provided with re-entrant portions 118 located to lie directly beneath one side of the reel just above it, adjacent its discharge end, thus providing an open notch or recess in the pan and through its bottom, through which the thread is led from reel to reel.

Referring now to Figs. 1, 4 and 5, it has been stated that 7 represents the collecting device for the finished thread, shown in this instance as a cap twister of substantially standard form. Each unit includes one of said twisters, a plurality thereof, however, being driven in parallel or by the same power source. As illustrated, and in accordance with common practice, the machine is provided with a long drum or pulley 119 connected by belts 120 to the cap twister spindles, for rotating them, belts 120 having belt tighteners 120a and said drum being driven by a belt 121 actuated by direct drive from the shaft of motor 18 or from some part of the speed reducing mechanism or device 19.

For reciprocating the twister spindles the machine is provided with a speed reducing gear device 122 driven by a belt 123 from a pulley on shaft 20, and the shaft 124 of which device is provided with a cam 125 actuating a lever 126 pivoted on the frame at 127 and connected by tension members 128 to spindle lifting rods 129, slidable vertically in frame guides 130 and connected by bars 131 which carry the spindles and in which they are journalled, the vertically movable parts being partly counterbalanced by

weights 132. The effect of the drums 119 and cams 125 is to rapidly rotate and vertically reciprocate the spindles of the several cap twisters, so that the thread is twisted and at the same time wound in regular pattern form upon the spool or bobbin. Any other form of collecting device might be used, however.

Considering the entire machine, its operation, briefly described, is as follows:

Referring first to a single unit, it will of course be understood that such unit will include in operative relation only such reels as are necessary for the performance upon the thread of the various steps of the particular process to which it is to be subjected. Of course, by proper arrangement of the reagent distributors and liquids, two or even more steps might be performed upon the thread while travelling along a single reel, such as by supplying to it first an acid bath and then wash water. Assuming then that the machine includes only those reels necessary for the particular purpose, together with reagent distributors, and that the clutch drives for all reels are connected so that the reels are rotating, the spinneret for the unit is immersed in the spin bath and a supply of viscose is permitted to exude therefrom in the usual multiple filament form, the multiple filament thread being threaded by hand through the guides 3 and 4 and being applied to the thread receiving end (the right hand end, Fig. 4) of the first or set-up reel 5.

As this reel rotates, successive turns of thread are produced in helical form and progress along the reel toward its discharge end until finally one or several thread turns are actually discharged or pushed off from the free ends of the bars of the reel members at its open end. In many instances in a machine of this kind, where the reels are open-ended, as described, transfer of the thread from reel to reel occurs automatically without either special manipulation by the operator or any necessity for use of special transfer mechanism, the discharged turn or turns of thread which first come off from the free end of one reel being thrown out by centrifugal force or dropping by gravity until they contact with the next reel and immediately begin to wind upon it. Such operation usually occurs in the transfer from the initial or set-up reel 5 to the next reel 5*a* in the machine shown.

However, if desired, any suitable form of transfer mechanism or device may be used, such as one in which the thread is conveyed mechanically or by a stream of air or liquid or by any suitable force from one reel to the next, or, the thread may be transferred by manipulation of the operator. In this case, the discharged turns are grasped in the fingers and are led down to and wrapped once in the proper direction around the second reel 5*a* of the unit. During this operation thread is discharged from the first reel 5 a little faster than the hand can carry it down to the next reel 5*a*, so that a loop of the thread bows or bellies out, as it were, in the space between reels 5 and 5*a*. Reel 5*a* of course is rotating and winds upon it the thread issuing from reel 5 and in a short time overhauls reel 5, as it were, so that the stretch of thread between the two reels becomes more and more taut, finally lining itself up automatically in a direct line from reel to reel.

A similar operation is performed when the first turns of thread are discharged from the end of reel 5*a*, for the purpose of transferring it to reel 5*b*. Here also the thread bows or bellies out and then gradually becomes more and more taut. At first the thread drags over the front wall of the trough for reel 5*a*, but gradually moves along said front wall until of itself it enters the notch 118, whereupon the thread travels back to the receiving end of reel 5*b* and automatically lines itself up so as to pass in a direct line from a point at the discharge end of reel 5*a* to a point at the receiving end of reel 5*b*.

Up to this time, a matter of seconds, the thread has wound hit or miss or helter-skelter upon reel 5*b*. The winding operation now proceeds, turn after turn being formed and progressing along reel 5*b* until finally the leading turns of thread (those wound hit or miss) are discharged from the free end of reel 5*b*, whereupon they are grasped by the fingers and the thread is led by hand down to and around the third reel 5*c*, where the operation proceeds as before, with the thread finally finding its own way into the recess 118 in the second trough. Similar operations are performed in succession to transfer the thread from reel to reel down the entire series until finally the thread is led to the drying reel 5*i* and is discharged therefrom, whereupon it is led through the guide 6 and is applied to the spool on the take-up device 7, where it begins to be wound in pattern form in the usual manner.

Each reel is provided with its individual clutch, and the levers 74 for all of the reels may be individually operatable. However, for convenience, the levers 74 for reels 5*a* to 5*i* of a unit may be connected by a bar 135 having an operating handle 136 at a convenient point so that all of these reels in one unit may be started and stopped simultaneously.

Further, it will be understood that the change speed mechanism in the transmissions to the various sets of corresponding reels in neighboring units readily enables the speed of any particular group of corresponding reels to be made greater or less than that of the corresponding reels which precede or follow them. In this way, for example, it is possible to give following reels, say the reels 5*a*, a peripheral speed slightly greater than that of the reels next preceding them, say the reels 5, so that at any point along the travel of a thread in a unit, and particularly at any point where the thread retains any degree of plasticity, it is possible to stretch it or increase its length for the practice of the well known process of stretch spinning, with the valuable results ensuing therefrom.

Likewise, a limited amount of stretching may be accomplished on any one reel alone by making its reel members of generally tapered form, instead of generally cylindrical as shown in Fig. 4, the reel gradually increasing in diameter from its receiving to its discharge end, as shown in Fig. 15, thereby gradually increasing the reel diameter toward the discharge end and stretching and thereby lengthening each turn of thread as it progresses along the reel.

Obviously, as these machines are increased in length by the addition of more and more units placed end to end or side by side, the operating shafts, particularly shafts 34, 43 and 67, made up of sections fastened to section as they are, become of considerable length. As a consequence, it may be desirable in very long machines to duplicate the driving and change speed mechanism to said shafts not only at opposite ends of the machine, but also to use extra sets of such motion transmitting and speed changing mechanism at intervals down the length of the ma-

chine, to distribute the driving strain and reduce torque and liability of breakage in said shafts.

The mechanism described is shown as driven by a single motor 18, but of course any given machine can be divided up into sections with individual motors driving different sections which may be separate or may even be connected together, in which case of course the motors would necessarily be of such form or so associated as to operate in synchronous relation.

With the arrangement described ready and convenient access is had to both the front and rear of all of the operating mechanism in the inclined bank on each side of the machine. At the front operators will work on platforms, either stationary or movable, or on a rolling ladder or frame, such as shown at 140, Fig. 1, its lower end provided with rollers traveling on floor rails 141 and its upper end having rollers traveling along a frame rail 142. On the inside of the machine, between its two banks, there are two platforms on which the workmen can gain access to any of the mechanism. The machine as a whole can be readily adapted for various kinds or sizes of thread with any degree of stretch and with the assurance that by proper setting and adjustment of parts uniform characteristics will be imparted to every foot of every thread. As a consequence, all product of the machine will have the same dyeing and other physical and chemical characteristics, making it suitable for use in both woven and knitted textile fabrics.

Other advantages of the invention will readily be apparent to those skilled in the art.

It will be obvious that, within the scope of the appended claims, numerous modifications may be made in the hereinabove-described apparatus without in any way departing from the spirit of the invention. As used in the claims, the term "thread-advancing thread store device" has reference to any device, whether or not taking the form of a thread-storage thread-advancing reel, which is adapted to advance the thread or the like positively in generally helical turns in a direction lengthwise of the device as a whole. The term "catena" has reference to a series of such devices to each of which the thread or the like proceeds in turn; that is to say, to a succession of two or more functionally dependent thread-advancing thread store devices.

What we claim is:

1. Apparatus for the manufacture of thread or the like comprising a series of thread-storage, thread-advancing reels disposed with the receiving end of each reel other than the first in opposite relation to the discharge end of the next preceding reel, said reels being in stepped relation to each other with each thereof projecting endwise beyond its predecessor.

2. Apparatus of the character described in claim 1, in which all reels are mounted with their axes substantially horizontally disposed.

3. Apparatus of the character described in claim 1, in which the axes of all reels are in the same vertical plane.

4. Apparatus for the manufacture of thread or the like comprising a series of thread-storage, thread-advancing reels disposed with the receiving end of each reel other than the first in opposite relation to the discharge end of the next preceding reel, the reels being arranged in bank form with the discharge ends of all reels presented to a common front.

5. In the manufacture of thread or the like, apparatus for the simultaneous production of substantially identical products on the same machine comprising a plurality of parallel thread-handling catenae individually embodying two or more thread-storage, thread-advancing reels to which the thread or the like passes in sequence each of which reels is supported from one end only thereof, the other end being unobstructed, and each of which reels is adapted to advance the thread or the like toward the unsupported end thereof in a series of substantially helical turns, the thread-storage, thread-advancing reels of each catena being disposed with their unsupported ends extending in the same direction, with the discharge ends of all reels presented to a common front, and with adjacent reels arranged to permit passing the thread or the like from the discharge end of one reel to the receiving end of the succeeding reel, whereby to facilitate the threading up of the reels of each catena and permit simultaneous observation of the conditions of the thread or the like at the unsupported ends of the reels of several catenae.

6. In the manufacture of thread or the like, apparatus for the simultaneous production of substantially identical products on the same machine comprising a plurality of parallel thread-handling catenae individually embodying two or more thread-storage, thread-advancing reels to which the thread or the like passes in sequence each of which reels is supported from one end only thereof, the other end being unobstructed, and each of which reels is adapted to advance the thread or the like toward the unsupported end thereof in a series of substantially helical turns, the thread-storage, thread-advancing reels of each catena being disposed in vertically spaced arrangement with their unsupported ends extending in the same direction, with the discharge ends of all reels presented to a common front, and with adjacent reels arranged to permit passing the thread or the like from the discharge end of one reel to the receiving end of the succeeding reel, whereby to facilitate the threading up of the reels of each catena and permit simultaneous observation of the condition of the thread or the like at the unsupported ends of the reels of several catenae.

7. In the manufacture of thread or the like, apparatus for the simultaneous production of substantially identical products on the same machine comprising a plurality of parallel thread-handling catenae individually embodying two or more thread-advancing thread store devices to which the thread or the like passes in sequence each of which devices is supported from one end only thereof, the other end being unobstructed, and each of which devices is adapted to advance the thread or the like toward the unsupported end thereof, the thread-advancing thread store devices of each catena being disposed in the form of a descending series with their unsupported ends extending in the same direction, with the discharge ends of all devices presented to a common front, and with adjacent devices arranged to permit passing the thread or the like from the discharge end of one device to the receiving end of the succeeding device, whereby to facilitate the threading up of the devices of each catena and permit simultaneous observation of the condition of the thread or the like at the unsupported ends of the devices of several catenae.

8. Apparatus for the manufacture of thread or the like comprising a plurality of self-threading thread-advancing thread store devices to which the thread or the like passes in sequence each of which is supported from one end only thereof, the

other end being unobstructed, and each of which is adapted to advance the thread or the like toward the unsupported end thereof, said thread-advancing thread store devices being disposed lengthwise of each other in offset arrangement with the supported end of each device other than the first in apposite relation to the unsupported end of the next preceding device, with the unsupported end of each device other than the first projecting beyond that of its predecessor, and with the unsupported ends of all devices extending in the same direction.

WALTER F. KNEBUSCH.
ALDEN H. BURKHOLDER.

CERTIFICATE OF CORRECTION.

Patent No. 2,225,642. December 24, 1940.

WALTER F. KNEBUSCH, ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 24, after the word "reels" strike out the comma; page 2, first column, line 9, for "threads" read --thread--; page 4, second column, line 22, for "tank" read --tanks--; page 7, first column, line 55-56 and line 69-70, claims 1 and 4 respectively, for "opposite" read --apposite--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 15th day of April, A. D. 1941.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.