No. 752,829. PATENTED FEB. 23, 1904.

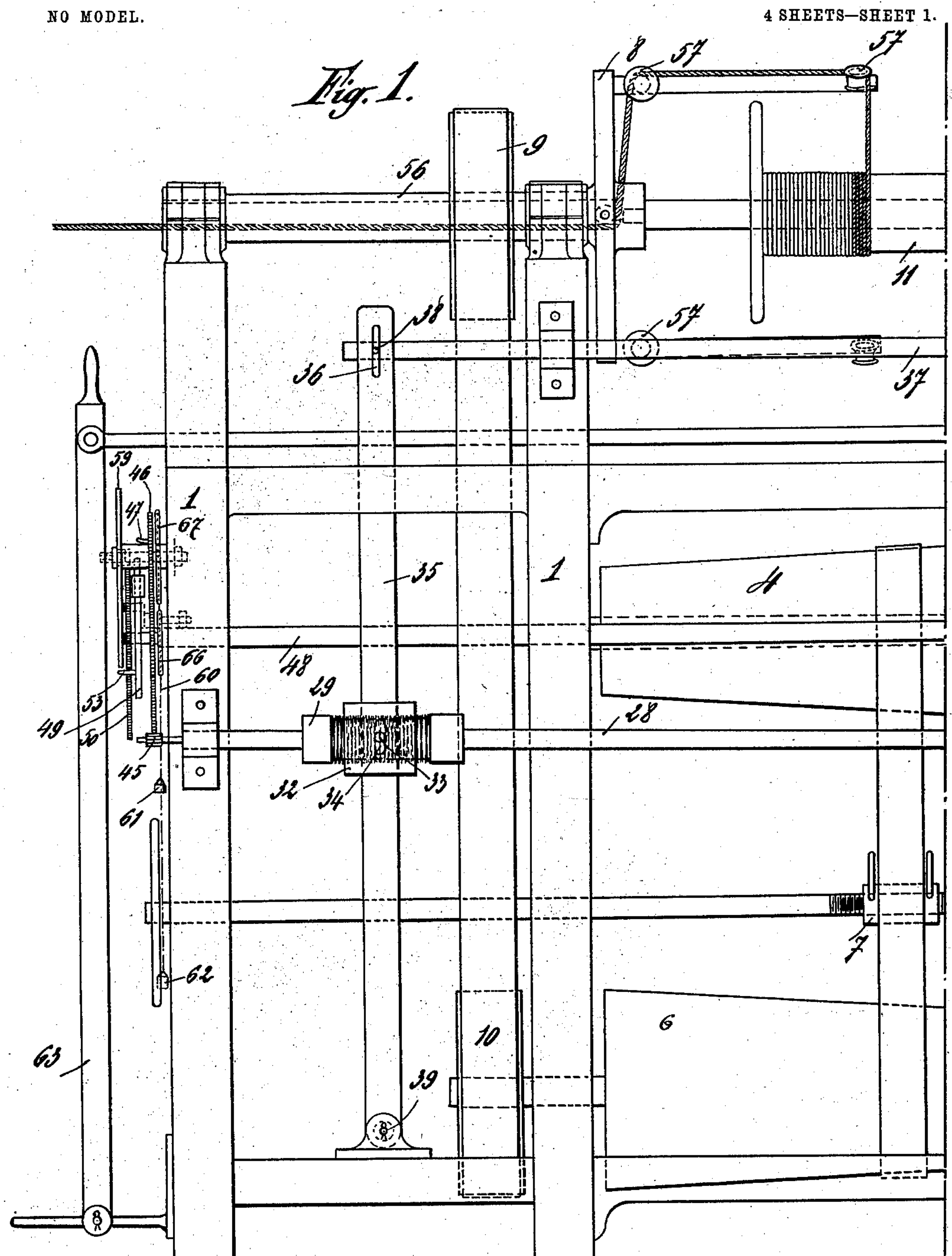
L. DUGAUQUIER.

SPINNING MACHINE.

APPLICATION FILED MAY 10, 1902.

NO MODEL. 4 SHEETS—SHEET 1.

Fig. 1.



Witnesses
[signature]
Carrie Judge

Inventor.
Leon Dugauquier.
By Richards & Co
Attorneys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 752,829. PATENTED FEB. 23, 1904.

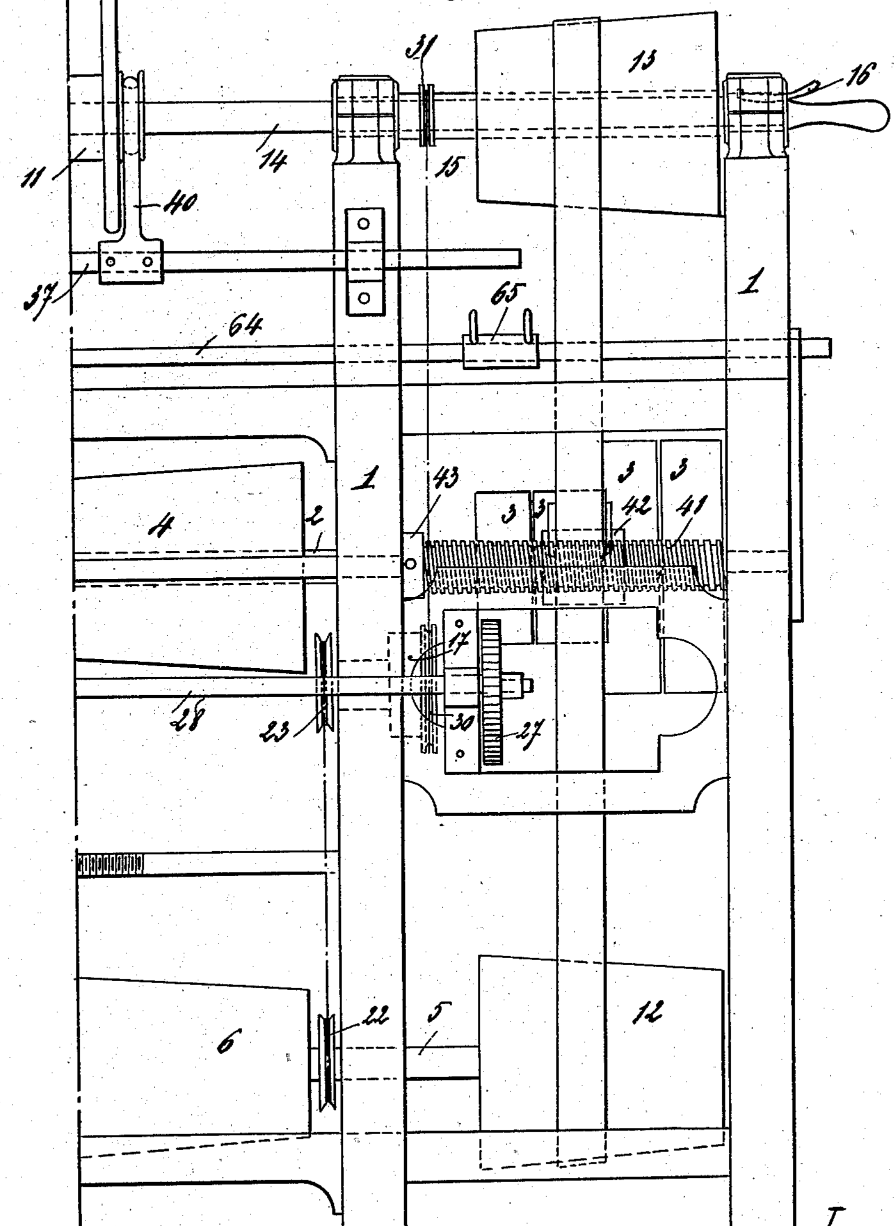
L. DUGAUQUIER.

SPINNING MACHINE.

APPLICATION FILED MAY 10, 1902.

NO MODEL. 4 SHEETS—SHEET 2.

Fig. 2.



Witnesses
Da W. Aldom
Carrie Judge

Inventor
Leon Dugauquier
By Richards & Co
Attorneys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 752,829. PATENTED FEB. 23, 1904.

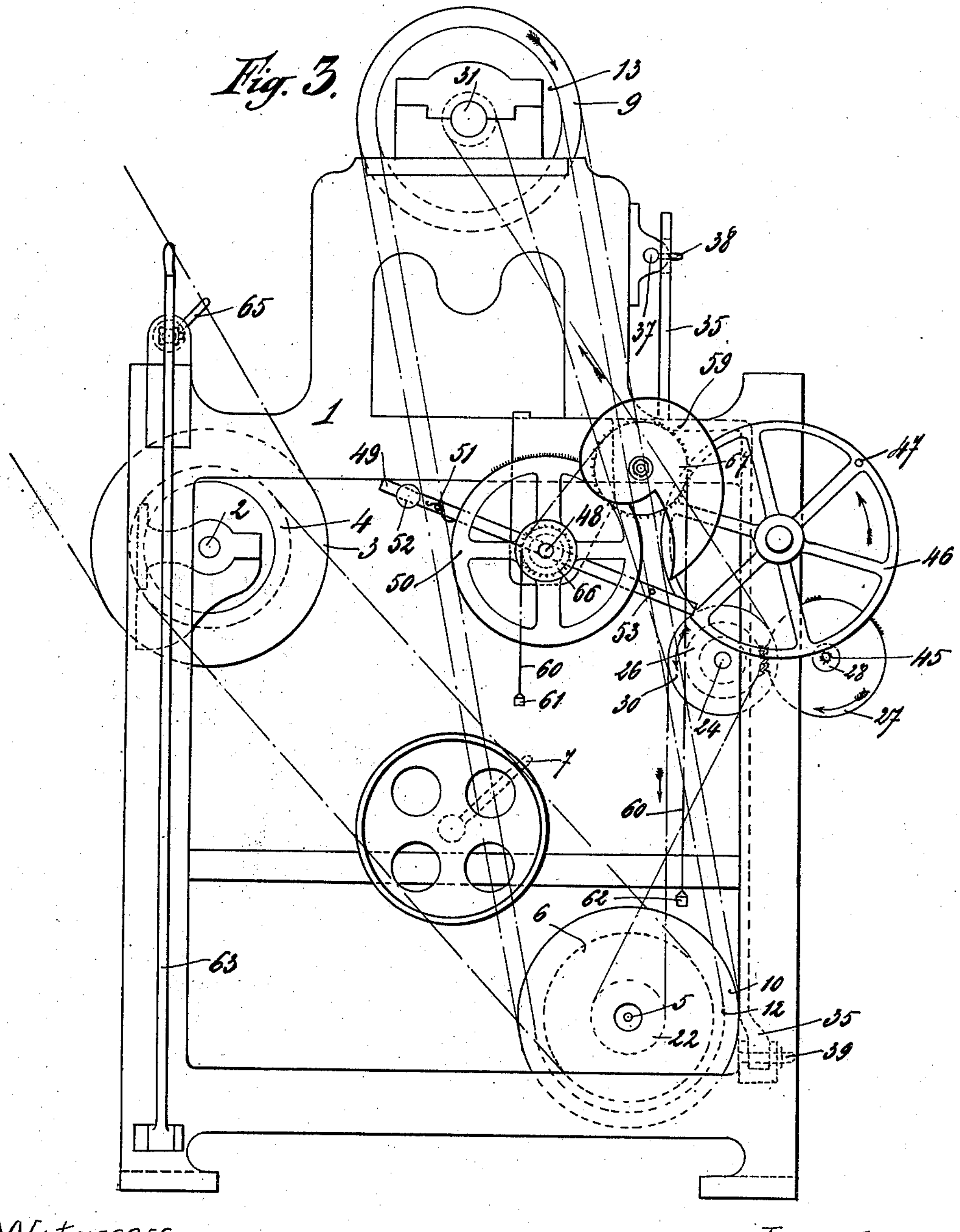
L. DUGAUQUIER.

SPINNING MACHINE.

APPLICATION FILED MAY 10, 1902.

NO MODEL. 4 SHEETS—SHEET 3.

Fig. 3.



Witnesses
Dat W. Aldom
Carrie Judge

Inventor
Leon Dugauquier
By Richards & Co
Attorneys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 752,829. PATENTED FEB. 23, 1904.

L. DUGAUQUIER.

SPINNING MACHINE.

APPLICATION FILED MAY 10, 1902.

NO MODEL. 4 SHEETS—SHEET 4.

Fig. 5.

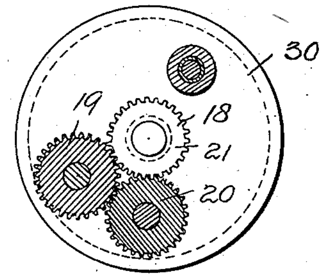
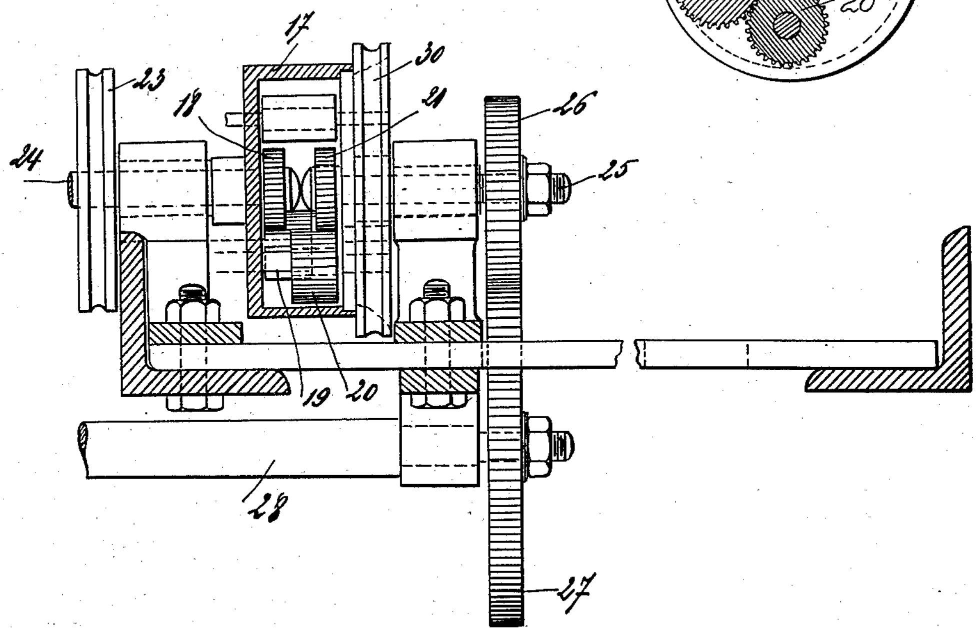


Fig. 4.



Witnesses

Inventor

Leon Dugauquier

By Richards & Co

Attorneys

No. 752,829. Patented February 23, 1904.

UNITED STATES PATENT OFFICE.

LEON DUGAUQUIER, OF HOUDENG-GOEGNIES, BELGIUM.

SPINNING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 752,829, dated February 23, 1904.

Application filed May 10, 1902. Serial No. 106,810. (No model.)

To all whom it may concern:

Be it known that I, LEON DUGAUQUIER, a subject of the King of Belgium, residing at Houdeng-Goegnies, Belgium, have invented certain new and useful Improvements in Spinning-Machines, of which the following is a specification.

Many spinning-machines of various kinds exist, but they are all defective, as the winding is effected by friction or otherwise. Indeed, it is not with organs so capricious as those which act by friction that regular and rapid operation can be hoped for. Hence come fractures of the thread or interruptions of the winding or irregularities of twist or output. It is the same in cases where the winding is performed without friction, for hitherto it has been impossible to regulate the winding so as to make it correspond mathematically with the production and the twist. This defect results from the fact that methods of effecting this regulation have always been based on a false principle—namely, that the speed of rotation of the bobbin should be modified after every layer of winding by an amount regular or progressively regular. Now in order that the winding on the bobbin may be regular the bobbin should wind for every turn of the flier (the speed of which is uniform) a constant length of thread. Therefore for each revolution of the flier the bobbin must make besides the flier's motion a fraction of a revolution which bears to a complete revolution the ratio which the length to be wound per revolution of the flier bears to a complete winding. Supposing the length to be wound per revolution of the flier to be π, we have the following ratio:

$$\frac{\pi}{\text{one convolution}} = \frac{\pi}{\pi\,\mathrm{D}} = \frac{1}{\mathrm{D}}.$$

In applying this value to several successive superposed convolutions it is to be observed, first, the retardation of the bobbin is different for each layer and goes on decreasing as the bobbin fills; secondly, that this decrease does not follow a regular law. It is the same in all cases, for every length of twist of the thread may be supposed to be a fraction of π. The object of my invention is to regulate mathematically at will, first, the amount of winding per twist of thread, and, secondly, the number of twists per minute. If I obtain in each minute a regular and determinable number of twists, and if I can by the winding give a regular and determined length for each twist, the spinning and winding can go on regularly per minute and per yard. The outfit will therefore be regular and as great as may be desired, and it will be the same with the twist and winding, which will be effected without friction and with tension as low as may be desired.

For the sake of simplifying illustration I have shown in the drawings this present improvement applied to a spinning-machine. I could also apply it to a spindle-machine. For this it would be sufficient either to suppress the drawing-rollers or to work these rollers by organs having a speed of rotation corresponding with that of the flier.

In the accompanying drawings, Figures 1 and 2 are front views of the spinning-machine. Fig. 3 is a side view. Fig. 4 is a view, partly sectional, of the differential gear separate; and Fig. 5 is a cross-sectional view along the line A B of Fig. 4.

The machine is mounted on a suitable frame consisting of four supports 1, provided with bearings and connected by ties. The movement of the motor is transmitted to a shaft 2 by two pairs of pulleys of different diameters, 3 3, each pair comprising a fast and a loose pulley, so that the shaft 2 can be driven at two very different speeds and that the machine can be started and stopped at will. On the shaft 2 is keyed a conical drum 4, which by a belt drives a second conical drum 6 like the first, but arranged in the opposite direction and keyed on the shaft 5. A fork 7, which can be moved at will along a screw worked by a handwheel or otherwise, serves to regulate as desired the transmitted speed.

On the shaft 5 are keyed on the one hand a pulley 10, which drives the flier 8 and on the other hand a conical drum 12, which drives the bobbin 11. The first of these transmissions is effected by a straight belt connecting the pulley 10 to a pulley I of the same diameter keyed on the hollow shaft 56, which carries the flier 8, the second also by a straight belt connecting the conical drum 12 to a second inversely-arranged conical drum 13 of respectively smaller diameters and positively driving the bobbin 11. The shaft 15, which carries the drum 13, is hollow, so as to inclose the shaft 14, which has at its end a spring-bolt 16, arranged to enter a notch on the shaft 15 when the shaft 14 is pushed home—that is to say, when its other end enters the sleeve of the flier, where it can turn subject to light friction. The two shafts 14 and 15 are then positively connected. Besides, on the part of the shaft 14 which receives the bobbin 11 is formed a longitudinal groove, in which slides a key fixed to the bobbin, which can thus slide along the shaft 14, turning with it and the shaft 15. Thus the flier makes always the same number of revolutions per minute as the main shaft 5, and the bobbin makes a smaller number of revolutions.

Differential gear 17, a plan of which on enlarged scale is shown in Fig. 4, is fixed on the frame. It consists, substantially, of a box 17, which can turn on its two hollow axes and contains, first, two equal toothed wheels 18 and 21, keyed on the ends of two shafts 24 and 25, which are in line and have, respectively, at their other ends outside the box, a pulley 23 and a toothed change-wheel 26; second, two special pinions 19 and 20, having the same number of teeth as the pinions 18 and 21, and a balance-roller. The pinions 19 and 20 gear, respectively, with the wheels 18 and 21 and gear together by their inner part. The axes of these two pinions 19 and 20 are journaled in the side walls of the box 17. The pulley 30 is connected by a cross-belt to a pulley 31 of half its diameter, that is keyed on the shaft 15 of the bobbin. The pulley 23 is connected by a like belt to a pulley 22 of the same diameter, keyed on the shaft 5.

Let us examine the action of the actuating-organs of the differential gear, assuming that the flier and the bobbin turn to the left and bearing in mind that the pinions 18, 19, 20, and 21 are formed with the same number of teeth.

A. If we assume the pulley 23 turning alone to the left, the pulley 30 remaining stationary, we have then the case of a pinion 18 actuating another pinion 21 through the medium of two pinions 19 and 20. These four pinions being formed with the same number of teeth, it results that the pinion 21 turns at the same speed as the pinion 18, but in the opposite direction—namely, to the right.

B. If we suppose the pulley 23 stationary, the pulley 30 turning alone to the left, what will be the operation of the differential gear? If the pinion 20 be fixed to the box 17, the same teeth of both pinions 20 and 21 should remain engaged, and the pinion 21 should make one turn to the left with the pinion 20 and with the box 17 for each revolution of the pulley 30 to the left; but instead of being fixed the pinion 20 turns in the opposite direction as the box 17 and causes the speed of the pinion 21 to be accordingly increased. In fact, the immobility of the pinion 18 causes the pinion 19 to turn at the same speed and direction as the box 17. This pinion 19 actuates the pinion 20, and consequently the pinion 21, this latter making one turn for each revolution of the pinion 19 or of the pulley 30 at the same speed and direction as the box 17—namely, to the left.

To sum up, the wheel 21 turns in the direction of the box 17, making one revolution, due to its engagement with the pinion 20, and a supplemental revolution, due to that of the pinion 19. These points being established, if we represent by n the number of turns made by the bobbin within the time there is a winding made on the bobbin the number of turns of the flier made within the same time must obviously be $(n-1)$. The number of turns made by the pulleys 30 and 23 during the same time are consequently $\frac{n}{2}$ and $(n-1,)$ respectively, on account of the ratio of the diameters of the pulleys 31 30 and 22 23. These quantities being given, if we suppose the pulley 30 to make $\frac{n}{2}$ turns to the left, the pinion 21 will make $2\left(\frac{n}{1}\right)$ turns to the left. During the same time the pulley 23 makes $(n-1)$ turns to the left and causes the pinion 21 to make $(n-1)$ turns to the right. Consequently the combination of both movements upon the pinion 21 will be $2\left(n\right)-(n-1)$ equals one turn to the left. n being any number whatever, it results that whatever may be the relative speeds of the flier and of the bobbin the pinion 21 will make one turn every time there is a winding made on the bobbin. The shaft 25 has a gear 26, which drives the gear 27, and consequently the shaft 28, a part 29 of which is screwed with crossing-threads, so as to cause the sleeve 32, which surrounds it, to move to and fro, which movement is conveyed to the rod 37 by the lever 35, pivoted at 39 and to the bobbin 11 by the fork 40. The lever 35 has at its upper end a slot 36, receiving a pin 38 on the rod 37, which imparts its motion to the bobbin 11 by means of the fork 40, which embraces a grooved pulley fixed on the bobbin. The length of the threaded part 29 is such as to give the upper end of the lever 35 a motion equivalent to the available length of the bobbin. A pin 33, fixed on the sleeve 32, enters a hole 34 of the lever 35. This pin can be varied in height on the sleeve, so as to modify the stroke of the lever 35 to suit the thickness of the thread. The shaft 28 has also at its end a small pinion 45, which gears with a free wheel 46. The ratio of 46 to 45 is the number of the threads of 29, so that the wheel 46 makes one revolution every time the sleeve 32, and consequently the bobbin 11, makes a complete traverse. On the wheel 46 is a pin 47, which, as it passes, lifts the head of the lever 49 by bearing on its tail and the position of which is adjusted, so that it escapes the lever 49 at the moment when the bobbin completes its traverse. The lever 49, with the aid of its counterweight 52 and a pawl 51, actuates a toothed wheel 50, fixed on its axis 48, through a fraction of a revolution determined by the extent of its fall. This fall is adjusted and limited by a cam 59, against which strikes the pin 53, fixed on the lever 49. This cam should differ for every kind of thread. It is turned by the fall of the lever 49 by means of a sprocket-wheel 66, fixed on the shaft 48, which the lever turns as it falls and which actuates by a chain 60, the free ends of which are strained and balanced by the weights 61 62, a second sprocket-wheel 67, keyed on the axis of the cam 59. If the cam 59 has in the first instance been carefully set, so that the first fall of the lever 49 is the longest possible, then at each fresh fall of the lever the cam presents a greater and greater radius, which progressively lessens the extent of fall, and on the extent of the fall depends the advance of the nut-fork 42 on the curved part 41 of the shaft 48, and consequently the shift of the band guided by the fork 42 and the retardation of the bobbin 11. The cam 59 therefore exactly regulates the retardation of the bobbin after each layer of thread wound on it. The two weights 61 62 serve to give a certain tension to the chain and also to allow the return of the cam 59 and the nut-fork 42 to their initial position when the operation is completed. It is sufficient to raise the weight 61 after having first reversed the pawl 51. Actuated by the other weight 62, the chain moves back over the course which it had passed and brings back the cam 59 and the belt of the drums 12 and 13 to their primary position. In order to regulate this return, care is taken on beginning to spin to bring back a stop-ring against the nut-fork 42 and fix it on the screw 41, so that the nut shall be stopped by it on its return, the result being that the chain 60 and the cam 59 shall also be stopped at their initial point.

The machine operates as follows: Pressing the spring 16 the shaft 14 is drawn outward until it does not extend beyond the hollow shaft 15. A bobbin 11 is placed in the fork 40, and the shaft 14 is pushed through the bobbin. A thread end is then led through the hollow shaft 56 and over the rollers 57 and fixed to the bobbin. The stop-ring 43 for the fork-nut is fixed, and the belt is brought back by the fork as far as the stop permits.

The machine is started by pressing the lever 63, which by means of the rod 64 and fork 65 causes the belt to slide from the loose to the fast pulley 3. The belts which work the bobbin and the flier not being crossed, both these turn in the same direction and the thread is twisted. As the bobbin turns faster than the flier, thread is wound on the bobbin. The length of twist of the thread or its pitch is equal to the length of thread wound per turn of the flier, and this length depends on the diameter of the convolution and on the place occupied by the belt on the drums 12 and 13. For the first layer on the bobbin the length of twist is therefore settled by the place occupied by the belt on the said drums 12 and 13. Now the number of twists being the number of revolutions of the flier, and consequently depending on the position of the belt on the drums 4 and 6, on the other hand, the length of twist being given by the place occupied by the belt on the drums 12 and 13, the result will be that for the first layer of thread on the bobbin the number of twists per minute and per yard is fixed. To obtain regular spinning, it is only necessary to maintain for succeeding layers the same extent of thread wound per turn of flier. If the bobbin did not vary in diameter, the belt might be kept on the drums 12 and 13 in the position suited to the desired length of twist; but for every layer of thread received by the bobbin it increases in diameter by twice the thickness of the thread. Therefore to maintain regularity of twist immediately on each layer being completed and only then must the speed of the bobbin be suddenly reduced by a suitable amount, still maintaining regularity of layer. This reduction of speed is obtained at the end of each traverse of the bobbin by means of the shifting of the nut-fork 42, which makes the belt slide along the drums 12 13 toward the larger end of 13 by a different amount for each layer as determined by different radii of the cam 59, (calculated for this,) which limits the fall of the lever 49, and consequently the shift of the belt on the drums 12 13. In order to maintain the regularity of the layer, the traverse of the bobbin must vary according to the thickness of the thread, or the thread would not be uniformly distributed on the available length of the bobbin. Moreover, the pitch of the winding must remain uniform for all layers and must be approximately equal to the thickness of the threads. The first condition is attained by the possibility of shifting the pin 33, which moves the lever 35, and thus modifying the stroke of the lever and the longitudinal stroke of the bobbin. The fork 40 may also be shifted along the rod 37 to allow of symmetrical distribution over the two halves of the bobbin. The second condition—namely, regularity of the pitch of the winding—is attained by the differential gear and the parts worked by it. The shaft 25 making one revolution every timet he bobbin makes one turn more than the flier—that is to say, for every convolution on the bobbin—the threaded sleeve 32 moves whatever be the size of the bobbin and for every convolution on the bobbin to a constant extent, depending on the pitch of the screw 29 and on the ratio of the gears 26 and 27. The movement of the sleeve for each convolution may, therefore according to the gearing employed, be as small as desired and so proportioned as to give the bobbin for every convolution a traverse equal to the thickness of the thread, which movement will remain the same however the bobbin increases. The winding is therefore regular, capable of regulation, and mathematically constant. The layer of winding being uniformly distributed in convolutions with a pitch equal to the diameter of the thread will have uniform diameter over all the layer. On the other hand, as the belt of pulleys 12 and 13 allows of retarding the bobbin in such manner that the quantity wound on is the same for each layer per turn of the flier the twist of the spinning will be uniform. It can therefore be regulated as desired and remains constant for a given time in number and length of twists. In respect of tension it can be as desired, since it has no influence on the operating parts. Threads of either right or left pitch can be produced, according to the direction in which the driving-belt and the belts of the differential gear move.

Having thus described the nature of this invention and the best means I know of carrying the same into practical effect, I claim—

1. In spinning and like machines, the combination of a driving-shaft 2, conical drums 4 and 6, an adjustable belt-fork 7, a main shaft 5 connected first with the flier 8 by means of equal belt-pulleys 9 and 10, and secondly with the bobbin 11 by means of conical belt-pulleys 12 and 13 inversely arranged, in order to regulate at will both the peculiar and the relative speed of the flier and bobbin and consequently the length of twists, substantially as described.

2. In spinning and like machines, the combination of a driving-shaft 2, conical drums 4 and 6, an adjustable belt-fork 7, a main shaft 5 connected with the flier 8 and with the bobbin 11, with suitable belt-pulleys 22, 23, 30, and 31, a differential gear 17 controlled thereby, the free axle of which makes one turn for each winding on the bobbin, substantially as described.

3. In spinning and like machines, the combination of a driving-shaft 2, conical drums 4 and 6, an adjustable belt-fork 7, a main shaft 5 connected with the flier and with the bobbin 11, and a differential gear 17, with a shaft 28 having a cross-threaded portion 29, a sleeve 32, an adjustable pin 33 on this sleeve entering a hole 34 of the lever 35, an oscillating lever 35, a movable rod 37, and a fork 40 engaging the bobbin for controlling the traverse of the same, substantially as described.

4. In spinning and like machines, the combination of a driving-shaft 2, conical drums 4 and 6, an adjustable belt-fork 7, a main shaft 5, conical belt-pulleys 12 and 13, the flier 8, the bobbin 11, and a differential gear 17, with change-wheels 26 and 27, a shaft 28 having a cross-threaded portion 29, a sleeve 32, an adjustable pin 33 on this sleeve entering a hole 34 of the lever 35, an oscillating lever 35, a movable rod 37 and a fork 40 for controlling the traverse of the bobbin and for regulating the pitch of winding according to the thickness of the thread, substantially as described.

5. In spinning and like machines, the combination of a driving-shaft 2, conical drums 4 and 6, an adjustable belt-fork 7, a main shaft 5, the flier 8 and the bobbin 11, a differential gear 17, a shaft 28 having a cross-threaded portion 29, a sleeve 32, an adjustable pin 33 on this sleeve engaging a hole 34 of a lever 35, an oscillating lever 35, a movable rod 37, a fork 40 engaging the bobbin, with a pinion 45 keyed on the shaft 28 engaging a pinion 46, a pin 47, a lever 49, a counterweight 52, a pawl 51 engaging a toothed wheel 50, a shaft with a threaded portion 41 engaging a nut-fork 42, for shifting the band along the pulleys 12 and 13 and consequently regulating the retardation of the bobbin, after each layer of thread wound on it, substantially as described.

6. In spinning and like machines, the combination of a driving-shaft 2, conical drums 4 and 6, an adjustable belt-fork 7, a main shaft 5, the flier 8 and the bobbin 11, a differential gear 17, a shaft 28 having a cross-threaded portion 29, a sleeve 32, an adjustable pin 33 on this sleeve engaging a hole 34 of a lever 35, an oscillating lever 35, a movable rod 37, a fork 40 engaging the bobbin, a pinion 45 keyed on the shaft 28 engaging a pinion 46, a pin 47, a lever 49, a counterweight 52, a pawl 51 engaging a toothed wheel 50, a shaft 48 with a threaded portion 41 engaging a nut-fork 42, a mutable cam 59, chain-wheels 66 and 67, a chain 60 with counterweights 61 and 62, for theoretically shifting the band along the pulleys 12 and 13, and consequently regulating the retardation of the bobbin according to the thickness of the thread, after each layer of thread wound on the bobbin, substantially as described.

In witness whereof I have hereunto set my hand in presence of two witnesses.

LEON DUGAUQUIER.

Witnesses:
ED. VHIRIONES,
GREGORY PHELAN.