

June 3, 1958

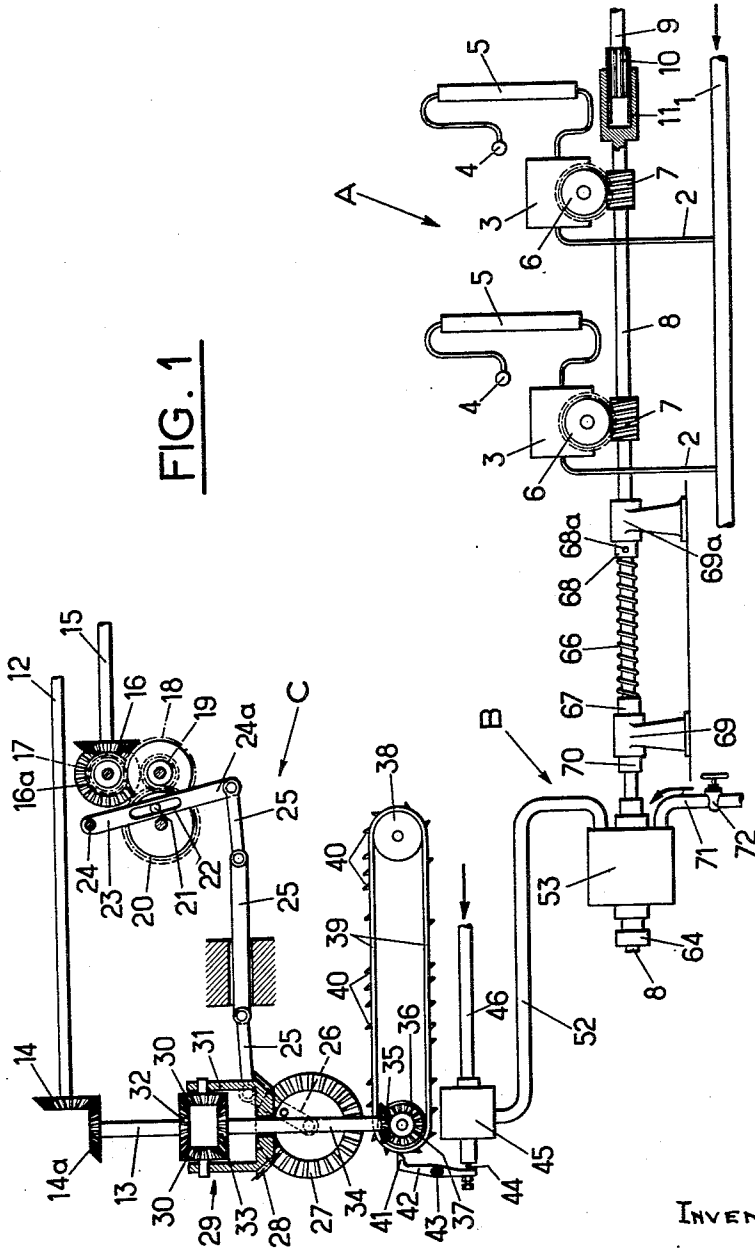
H. J. M. E. E. LINDEMANN
APPARATUS FOR PRODUCTION OF ARTIFICIAL
FILAMENTS OF RANDOMLY VARYING DENIER

2,836,850

Filed July 13, 1953

5 Sheets-Sheet 1

FIG. 1



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5 Sheets-Sheet 2

FIG. 2

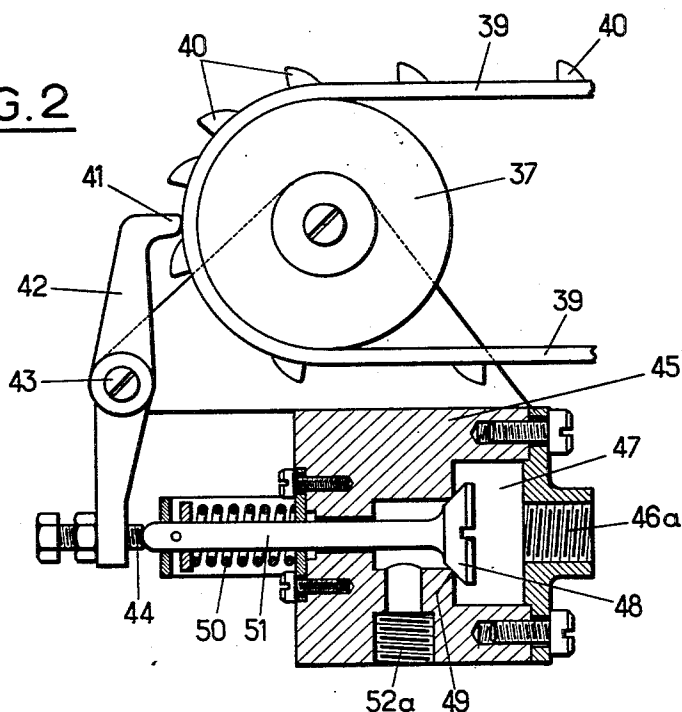
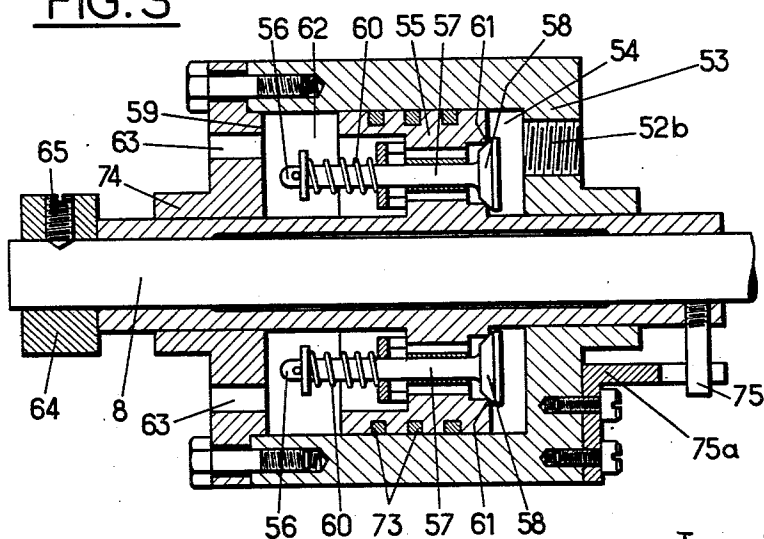


FIG. 3



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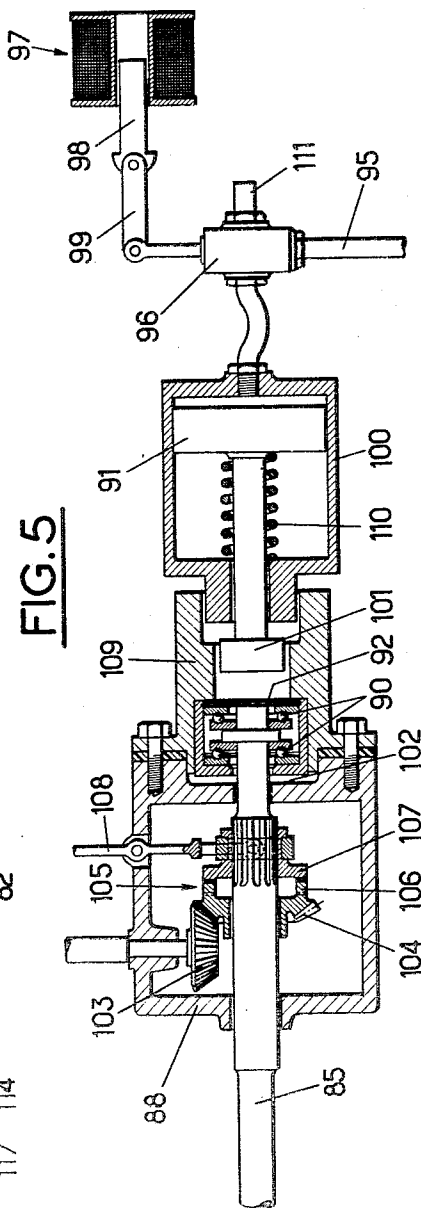
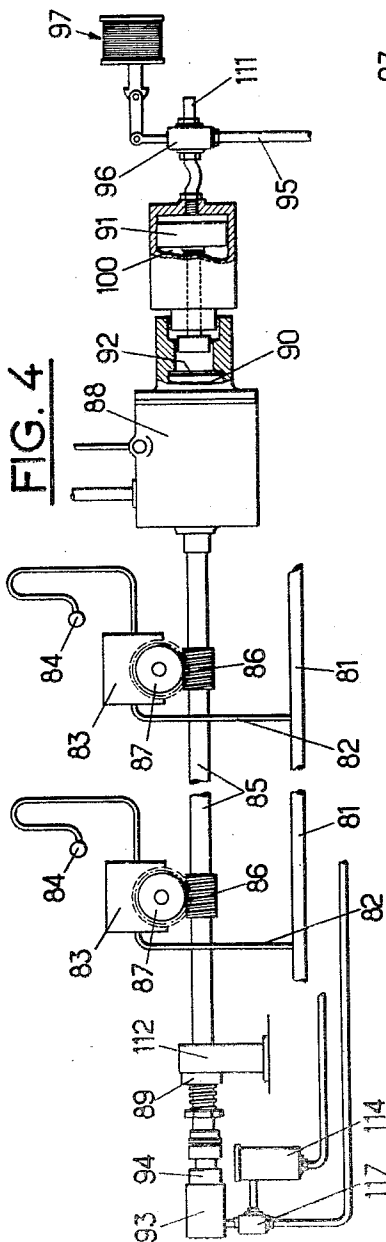
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5 Sheets-Sheet 4

FIG. 6

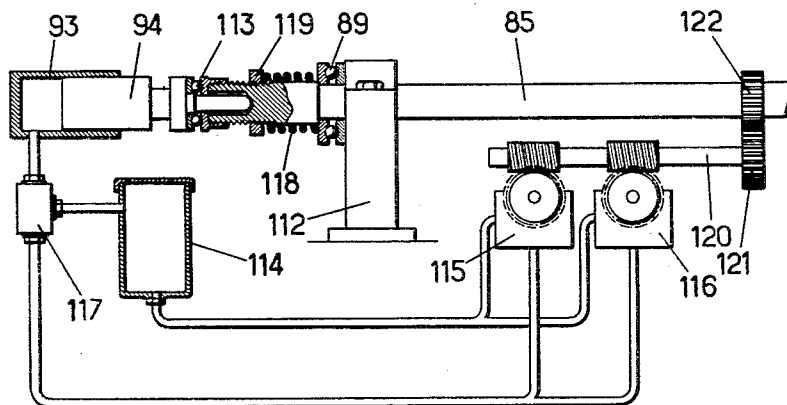


FIG. 9

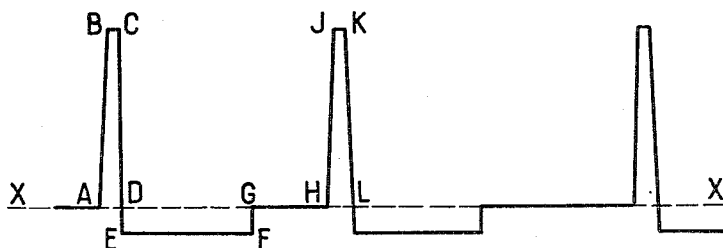
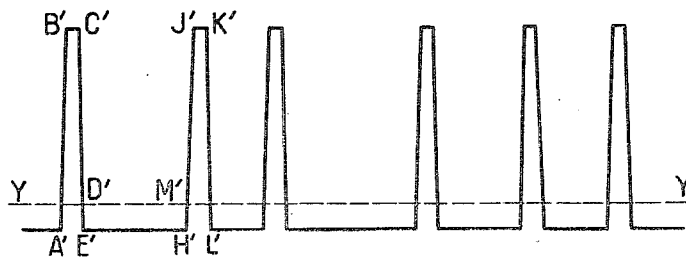


FIG. 10



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5 Sheets-Sheet 5

FIG. 7

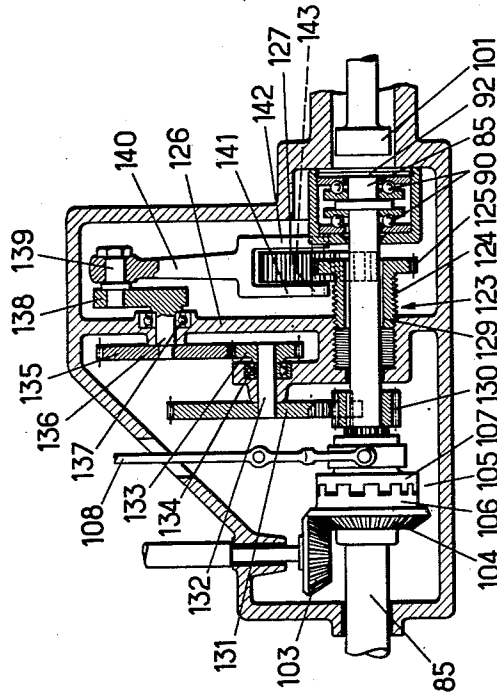
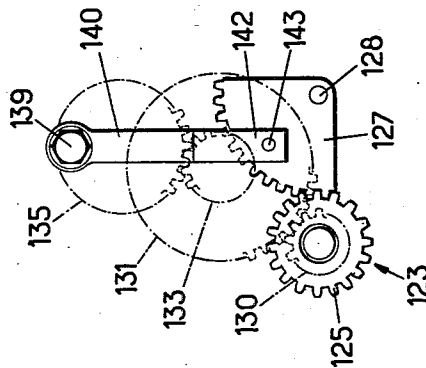


FIG. 8



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APPARATUS FOR PRODUCTION OF ARTIFICIAL FILAMENTS OF RANDOMLY VARYING DENIER

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Claims priority, application France July 17, 1952

17 Claims. (Cl. 18—8)

This invention relates to the production of artificial filaments of varying denier, hereinafter referred to as slub yarn.

In the production of artificial filaments many proposals have been made for manufacturing slub yarn which involve substantial changes to the spinning machine; for example a spinning machine may have, for each main pump, one or more additional pumps to give a periodic increase in the volume of spinning solution supplied to the jet, or the newly formed thread may be withdrawn from the bath at varying tension.

The object of the present invention is to simplify the production of slub yarn.

According to the present invention, a spinning machine for the production of artificial filaments of varying denier comprises a spinning pump for delivering spinning solution to each spinning position, in which the pumps are driven with a right angle drive from a common driving shaft at constant speed wherein means is provided for periodically moving the driving shaft lengthwise to vary the flow of spinning solution.

Preferably the shaft is moved at irregular intervals to give a random irregular spacing between the slubs.

It is also preferred that the movement of the shaft should be rapid for the initiation of the slub and should be gradual for the return stroke so that the reduction of the denier below that of the main part of the yarn is kept to a minimum. In addition the time between slubs may be controlled so that the maximum time between slubs is less than the time of the return stroke so that the reduced denier becomes the denier of the main part of the yarn.

The movement of the shaft may be effected by any suitable means, for example, a piston operated by compressed air, and the piston may be either integral with the shaft or separated from it.

When a random spacing of slubs is required the mechanism for moving the shaft may be actuated by any suitable unit giving random impulses, for example an electronic unit operated by cosmic rays such as that described in United Kingdom Patent No. 703,697 or a suitable mechanical device may be used.

A further embodiment of the invention is a spinning machine for producing slub yarn with random variations in the spacing and in the length of slubs.

The invention includes a process for the production of artificial filaments of varying denier on spinning machines comprising spinning pumps with a right angle drive from a common driving shaft wherein the flow of spinning solution is varied by periodically moving the driving shaft lengthwise.

The invention includes slub yarn when produced on a spinning machine according to the present invention.

The spinning machine of the present invention has many advantages for the production of slub yarn. A standard spinning machine such as a box spinning machine can be easily adapted without alteration of the individual pump drives, the pumps, the jets, the coagulating bath or

2

the take up and collecting devices. The use of supplementary pumps is avoided. The variation in flow of spinning solution to each spinning position is governed by the movement of the common driving shaft so that each spinning position will be similarly affected and all the yarns will show similar variations. If it is desired to produce yarn of constant denier on a machine according to the present invention this can be readily done without dismantling the slubbing mechanism.

It is generally preferred to produce slub yarn with irregularly spaced slubs since slub yarn having a constant spacing between slubs tends to give an undesirable regular pattern effect when made into a fabric. In one embodiment of the invention means are provided for moving the driving shaft to produce a slub yarn with random spacing of slubs and also random variations in the length of slub.

The invention is illustrated by the accompanying drawings in which:

Figure 1 shows one example of a spinning machine according to the present invention,

Figure 2 shows on an enlarged scale a mechanism for delivering irregular impulses of compressed air,

Figure 3 shows on an enlarged scale a mechanism for moving the common driving shaft,

Figure 4 shows another example of a spinning machine according to the present invention,

Figure 5 shows on a larger scale a further mechanism for moving the common driving shaft,

Figure 6 shows on a larger scale a hydraulic device for regulating the return stroke of the common driving shaft,

Figures 7 and 8 show side and end elevations of a mechanism for producing variations in slub length, and

Figures 9 and 10 are graphs showing the relationship between the denier of the yarn and time, in which the lengths of slubs are much exaggerated.

Referring to Figure 1, the spinning assembly is shown generally at A; the mechanism for moving the pump shaft at B, and the mechanism for delivering random impulses of compressed air at C. In the spinning assembly A, viscose or other spinning solution is led from a main support line 1 through pipes 2 to pumps 3 which feed the viscose to jets 4 by way of non-expandable tubes 5. In normal spinning operations filter candles are placed in a similar position to the tubes 5, but in the process according to the present invention such candles would tend to even out the variations in supply from the pumps and reduce the differences between the slubs and the main part of the yarn. The jets 4 dip into a coagulating bath (not shown) and the thread is formed and collected in any suitable known manner.

The pumps 3 are driven by gears 6 driven in turn by worms 7 on a common driving shaft 8 which is rotated at a constant speed by a shaft 9 driven by a motor (not shown). The drive is transferred from shaft 9 to shaft 8 by splines 10 on shaft 9 co-operating with grooves 11 on a hollow extension of shaft 8. In this way the lengthwise movement imparted to shaft 8 is not transmitted to shaft 9 and the motor.

If shaft 8 is driven at a constant speed, pumps 3 are also driven at a constant speed and yarn of uniform denier is spun. In order to vary the denier an irregularly periodic lengthwise movement is given to shaft 8, so that the spinning pumps are momentarily accelerated and on the return stroke decelerated. This lengthwise movement is given by the mechanism shown generally at B and in Figure 3 and an irregular periodicity is ensured by mechanism shown generally at C and in Figure 2.

Referring to C, a shaft 12 is driven at a constant speed by a motor (not shown) and this drive is transmitted to shaft 13 by bevel gears 14 and 14a. A second shaft 15

also driven at a constant speed drives a gear train. A gear 16 on shaft 15 drives gears 16a and 17 mounted on another shaft, and in turn gears 18 and 19 mounted on a further shaft drive a gear wheel 20. Gear wheel 20 has a stud 21, eccentrically mounted on it, which slides in a slot 22 of an arm 23 fixed at one end 24. The constant rotational speed of shaft 15 imparts a uniform oscillatory movement to the free end 24a of arm 23. This movement is transmitted by link rods 25 to an arm 26 fixed eccentrically to a gear wheel 27, meshing with a gear 28, which is the crown wheel of a differential 29. The differential 29 comprises in known manner, the crown wheel 28, two satellites 30 fixed to extensions 31 of wheel 28, and two planet wheels 32 and 33. Wheel 32 is driven by shaft 13 on to which it is fixed, whilst wheel 33 drives shaft 34. The combination of the constant rotational speed of wheel 32 and the oscillatory movement of crown wheel 28 and its satellites 30, gives to shaft 34 a continuously varying rotational speed which can be expressed as a sine wave.

The varying speed of shaft 34 is transmitted by bevel gears 35 and 36 to a wheel 37 which is fixed on the same shaft as gear 36 and which drives an endless belt 39 running around wheel 37 and a non-driven wheel 38. Belt 39 has irregularly spaced teeth projecting from it which strike the end 41 of a lever 42 pivoted at 43 as they pass it. To give a random spacing of slubs it is necessary that the teeth 40 strike the lever at irregular intervals or at least at intervals the pattern of which repeats only after several complete cycles of the endless belt. For this to happen, the period of oscillation of arm 23 and hence gear wheel 28 must be a prime number with respect to the length of time or one complete cycle of the endless belt. This can be ensured by choosing suitable relative speeds of rotation of shafts 12 and 15. Each time a tooth 40 passes the end 41 of lever 42 it rocks the lever and screw 44 on the other end of lever 42 actuates a valve for a compressed air system shown on a larger scale in Figure 2.

Referring to Figure 2, compressed air from a supply line 46 (Figure 1) enters a chamber 47 through an inlet 46a which receives pipe 46. A valve 48 is normally held on its seating 49 by a spring 50 surrounding a valve stem 51 and the compressed air cannot escape from the chamber 47. When a tooth 40 rocks the lever 42 a screw 44 bearing on the end of the valve stem 51 lifts the valve 48 from its seating 49 and compressed air is free to pass through an outlet 52a along the pipe 52 (Figure 1) which fits into inlet 52b to the cylinder 53 which is shown on a larger scale in Figure 3. A seal prevents escape of air around the valve stem to the atmosphere. When a tooth 40 has passed the end 41 of lever 42, the action of the spring 50 around valve stem 51 returns the valve 48 on to its seating 49.

Referring to Figure 3 a fixed cylinder 53 has a piston 55 within it making a close but sliding fit and sealed with sealing rings 73. The piston surrounds shaft 8 of the spinning machine but does not rotate with it and has valves 58 which are normally held against their seatings 61 by springs 60 around the valve stems 57.

An inlet 52b receiving the pipe 52 (Figure 1) allows compressed air into the annular space 54 while the annular space 62 is open to the atmosphere by way of holes 63 in the cylinder head 74. In operation an impulse of compressed air enters the chamber 54 by the inlet 52b forcing the piston 55 to the left in the drawing until the ends 56 of valve stems 57 strike the fixed cylinder head 74. This lifts the valves 58 from their seatings 61 and allows the compressed air to escape to the atmosphere by way of chamber 62 and holes 63. The movement of piston 55 is transmitted to shaft 8 by means of a collar 64 fixed by a screw 65 to shaft 8. The shaft 8 and piston 55 are returned (to the right in the drawing) by the resistance of the pumps acting on the worms 7 of the shaft 8. A stop 75 screwed into the piston 55 and sliding

in an angle bracket 75a screwed to the cylinder body 53 prevents any rotation of the piston. The movement of shaft 8 may be further controlled and limited by a spring 66 (Figure 1) between the bearings 69 and 69a for shaft 8. A shoulder 67 is fixed to the bearing housing and a stop 68 is fixed to shaft 8. The spring 66 is fixed to stop 68 by a pin 68a. The shaft is moved to the left by the piston 55. This movement is resisted by the pumps which tend to return the shaft to its original position, the strength of the pump being partly balanced by the spring 66. A stop 70 to the left of bearing 69a on shaft 8 may also be used to limit the return stroke.

Figures 4 to 6 show another example of a spinning machine according to the present invention differing from the previous examples in that the shaft is moved by a piston striking the driving end of the shaft and that the return stroke is controlled by a hydraulic cylinder.

Referring to Figure 4, viscose from a main supply line 81 is led by branch lines 82 to gear pumps 83 from which it is fed by way of rounder ends without filter candles to jets 84. The jets 84 dip into a coagulating bath (not shown) from which the freshly formed threads are withdrawn and collected in any suitable known manner. A common driving shaft 85 drives the pumps at a constant speed by means of worms 86 on the shaft and gears 87 on the pumps. The drive for the main shaft is contained in a housing 88 and the shaft is supported by bearings 89 and 90 at either end. Movement of the shaft 85 is effected by a compressed air operated piston 91 which after a short period of free travel strikes the end 92 and bearings 90 of shaft 85 moving them to the left in the drawing and momentarily accelerating the gear pumps 83. The shaft is moved against the action of a hydraulic cylinder 93 and piston 94 which controls the return stroke giving a gradual assisted return.

Figure 5 shows in greater detail the compressed air operated piston and unit for moving the common driving shaft 85. Compressed air is led by a line 95 to a single acting valve 96 of standard construction controlled by a solenoid 97, which receives random electrical impulses from a randomising unit operated by cosmic rays or a radio-active source. This unit is not shown but it may be a unit such as is described in United Kingdom Patent No. 703,697. On receiving an impulse the solenoid 97 operates, by means of links 98 and 99, the valve 96 admitting compressed air into the cylinder 100. The piston 91 is moved to the left in the drawing and a head 101 on the piston after a period of free travel strikes the end 92 and bearings 90 of shaft 85 moving shaft and bearings together until they come up against a stop formed by the main wall 102 of the shaft drive housing 88. The shaft 85 is rotated by an electric motor (not shown) through gears 103 and 104 and a clutch 105 in the drive housing 88. Gear 104 and the driving clutch member 106 are not fixed to the drive shaft 85, and the drive is transmitted by way of the driven clutch member 107 which is splined to the shaft 85. A hand operated lever 108 is used to bring the clutch into and out of engagement with the driving motor. The longitudinal movement of the shaft 85 is therefore also transmitted to the clutch 105 but it has been found that in a normal type of box spinning machine there is sufficient play in the clutch dogs to prevent damage to the driving motor. The distance of travel of the shaft 85 can be adjusted by varying the distance between the bearings 92 and the stop on the wall 102 of the drive housing 88 and the distance of free travel of the piston 91 can be adjusted by sliding the cylinder 100 in its support 109 which is bolted to the drive housing 88. The object of having a period of free travel for the piston 91 is to build up the speed and inertia of the piston before it strikes the shaft 85 thereby giving a sudden acceleration to the pump and a sudden increase in the flow of spinning solution. The piston 91 is returned by means of a spring 110 and the compressed air is allowed to go to

atmosphere through the valve 96 and pipe 111. This is the normal position of the valve from which it is only momentarily moved by the action of the solenoid 97.

The return of the pump shaft 85 is controlled by a hydraulic cylinder shown in detail in Figure 6. The pump shaft 85 is rotatably mounted in a support 112 and bearing 89. A non-rotating piston 94 sliding in a cylinder 93 fits into the end of shaft 85 through a bearing 113 and imparts a longitudinal pressure on shaft 85 without rotating with it. Oil from a reservoir 114 is pumped by two 6 cc. spinning pumps 115 and 116 to the cylinder 93 through a relief valve 117 so that a constant predetermined pressure is maintained on the piston 94. The shaft 85 is moved by piston 91 against the hydraulic pressure of the cylinder 93 and its return is controlled and assisted by this pressure. An adjustable spring 118 between bearing 89 and a nut 119 exerts a force to the left in the drawing and ensures that contact is maintained between the shaft 85 and piston 94. In addition, if it is desired to run the machine to produce yarn of constant denier and the hydraulic cylinder is not in operation the spring 118 keeps the shaft 85 to the left in the drawing giving a maximum rate of flow of spinning solution.

Any suitable pump or pumps may be used for the hydraulic cylinder unit. Thus it may be a pump driven independently of the spinning machine, or as shown in Figure 6 two pumps 115 and 116 from unused spinning ends may be employed. In this case the pumps 115 and 116 are disconnected from the main shaft 85 and driven by worm gearing on a separate shaft 120, which is driven by gears 121 and 122 from the main shaft 85. Pumps 115 and 116 are thus driven at a speed proportional to the speed of shaft 85 and the main spinning pumps 83 but are not affected by the movement of the shaft 85.

In Figures 4 and 5 the travel of shaft 85 is limited by a fixed stop formed by the wall 102 of the drive housing 88. Figures 7 and 8 show a method of continuously changing the position of the stop to give variations in the length of slub. Figure 7 shows a side elevation, partly in section, of the mechanism and Figure 8 shows an end elevation of the gear train. In these figures parts already described are given the same numbers as in previous figures.

The shaft 85 is driven by an electric motor (not shown) through bevel gears 103 and 104 and clutch 105. The end 92 of shaft 85 is supported in bearings 90 and movement of the shaft is effected by the head 101 of the piston (not shown) striking the end 92 and bearings 90 of shaft 85. A stop 123 limits the travel of shaft 85 and consists of a threaded portion 124 and a geared portion 125. The threaded portion 124 screws into the wall 126 of the drive housing and the toothed portion engages with a quadrant gear 127 pivoted at 128 and driven by a gear train and crank from shaft 85. The shaft 85 passes through a bore 129 in the stop 123 without contact. The quadrant gear 127 is driven as follows:

A gear 130 fixed to shaft 85 drives a gear 131 fixed into the same shaft 132 as gear 133. The shaft 132 rotates in bearings 134 fixed to the drive housing. Gear 133 drives in turn gear 135 fixed to a shaft 136 rotated in bearings 137 also fixed to the drive housing. At the other end of shaft 136 is a crank 138 and pin 139 carrying a forked lever 140. The quadrant gear 127 pivoted at 128 is mounted between the forks 141 and 142 of the lever 140 by a pin 143.

In operation shaft 85 drives the gear train 130, 131, 133, 135 and crank 138 so that the lever 140 reciprocates and rotates the quadrant gear 127 backwards and forwards about its pivot 128 through approximately 90°. This oscillatory rotation is transmitted to stop 123 which rotates alternately clockwise and anticlockwise. Since stop 123 is screwed into the wall 126 of the drive housing the stop will also move into and out of its socket with a horizontal reciprocating motion thereby continuously changing its position with respect to the shaft 85 and

bearings 90 and continuously altering the limit of travel of the shaft 85. If the shaft 85 moves at random intervals, the distance of travel of the shaft 85 and the length of slub, which is proportional to the distance of travel of the shaft 85 will also vary randomly.

Figures 9 and 10 are graphs showing the relationship between the denier of the yarn and time. In Figure 9 the line X—X represents the denier of the main part of the yarn, the distance AD the time taken for the slub stroke, DG the time for the return stroke and GH the time when the drive shaft is not moving lengthwise. The area ABCD must equal area DEFG hence it is clear that the longer the time of the return stroke and the shorter the slub stroke, the less will be the reduction of denier on the return stroke. Suitable times on a yarn of main denier 200 are for example 0.05 seconds for the slub stroke and 0.8 seconds for the return stroke.

There are thus three principal yarn deniers, the main denier, the slub denier and the reduced denier of the return stroke. Figure 10 shows a graph of a yarn having only 2 principal deniers. From Figure 9 it can be seen that if slub stroke HL is initiated before point G, the yarn will not be restored to its main denier and this denier will be eliminated leaving only the slub denier and the reduced denier. To enable yarn of this type to be spun it is necessary that the maximum time between slubs be controlled so that it is less than the time of the return stroke. This can be effected by suitable modifications to the randomising unit. For example with a return stroke of 0.8 seconds the maximum time between slubs may be 0.5 seconds. Figure 10 shows a graph of such a yarn in which Y—Y is the theoretical main denier which is never attained, A'B'C'D' represents the slub stroke and D'E'H'M' is the incomplete return stroke. In this yarn the size of the slubs will vary slightly from slub to slub, but the difference will not be appreciable.

What I claim is:

1. A spinning machine for the production of artificial filaments of varying denier from a spinning solution, said machine comprising at least one spinneret, an individual spinning pump for delivering spinning solution to each spinneret, a toothed wheel for driving each pump, a single common drive shaft, worm gearing mounted on said shaft for driving each toothed wheel, and means for randomly reciprocating said drive shaft and worm gearing axially lengthwise, thereby varying the speed at which said drive shaft drives the pump and consequently the rate of flow of the spinning solution and the diameter of the filament spun.

2. A spinning machine as claimed in claim 1 in which said means for randomly moving said shaft and worm gearing lengthwise comprises differential gearing constituted by coaxial driving and driven bevel gears and an idler gear transmitting the motion of the former to the latter, means for periodically varying the angular position of said idler with respect to the axis of said driving and driven gears and thereby varying the speed at which said driven gear is rotated, an endless belt driven from said driven gear, said belt being provided with irregularly spaced projections, and hydraulic means for axially shifting said shaft, in which said hydraulic means is controlled by actuating means positioned adjacent the path of travel of said endless belt, said actuating means being engaged by said projections successively as they pass thereby, and the time required for said belt to complete a single cycle is a prime number with respect to the period of said driven gear.

3. A spinning machine as claimed in claim 2 in which said hydraulic means comprises a source of pressure fluid, a piston connected to said shaft and a valve controlling the application of said pressure fluid to said piston, and in which said shaft and piston are returned after axial shifting to their original positions by the resistance offered by said toothed wheel to the rotation of said worm

7

4. A spinning machine as claimed in claim 1 in which said means for randomly moving said shaft and worm gearing lengthwise comprises a cylinder and a piston mounted therein for longitudinal movement with respect to said shaft, and means for randomly admitting fluid under pressure to said cylinder to actuate said piston, said piston being spaced from said shaft by a distance less than its stroke so as to strike said shaft after a short period of free travel and thereby shift it axially upon admission of pressure fluid to said cylinder.

5. A spinning machine as claimed in claim 4 in which said piston is biased away from said shaft by spring means which serves to return it to its original position after it has struck the shaft.

6. A spinning machine as claimed in claim 1 in which the means for randomly reciprocating said drive shaft comprises a power unit connected to axially translate said drive shaft, an independently driven endless belt provided with irregularly spaced projections, actuating means for controlling said power unit positioned adjacent the path of travel of said belt, said actuating means being engaged by said projections successively as they pass thereby so as to actuate said power unit to axially translate said shaft, and differential gearing connected to drive said belt at a velocity which varies continuously within successive regularly recurring time periods, the time for one complete cycle of the belt being a prime number with respect to the time period of the continuously varying velocity.

7. A spinning machine as claimed in claim 1 in which said means for randomly reciprocating said drive shaft comprises means for varying the lengths of the individual axial movements imparted thereby to said drive shaft, so as to produce slubs of random length.

8. A spinning machine as claimed in claim 1 in which the means for randomly reciprocating said shaft comprises power means connected to reciprocate said drive shaft, actuating means for controlling the operation of said power means, a driven element, means for producing a cyclically irregular motion in said driven element, and means for superimposing on the cyclically irregular motion of said driven element an independently derived cyclical irregularity and for transmitting the resultant motion to said actuating means.

9. A spinning machine as claimed in claim 8 in which said two means for producing cyclical irregularity in the motion transmitted to said actuating means are set to produce motions having different periods which are numerically prime with respect to each other.

10. A spinning machine as claimed in claim 1 comprising a compressed air operated piston abutting one end of said common drive shaft for reciprocating it lengthwise, and a unit controlling the admission of said compressed air to said piston, said unit comprising an endless belt with irregularly spaced projections and differential gearing for driving said belt at a continuously varying velocity so as to give a random spacing of slubs along the filaments.

11. A spinning machine as claimed in claim 10 in said differential gearing is constructed to drive said belt at

8

a velocity which varies continuously over a period of time and the length of said belt is proportioned to complete a cycle of travel over a different period of time, and the ratio between said periods is equal to the ratio between two different prime numbers.

12. A spinning machine as claimed in claim 11 in which said compressed air operated piston is positioned to translate said drive shaft in the direction which will cause the pumps to increase the diameter of the filaments, but in which the said pumps are adapted to exert a back force to move said shaft in the opposite direction, the latter motion of said shaft being slower than the former.

13. A spinning machine as claimed in claim 10 wherein the spacing of said projections and the velocity at which said gearing drives said belt are so fixed that the maximum time interval separating two successive increasing movements is less than the time interval necessary for the backforce exerted by the pumps to cause a complete gradual return stroke, thereby preventing the machine from being restored to the spinning condition in which said machine would deliver a yarn of unmodified diameter.

14. A spinning machine as claimed in claim 1 comprising a compressed air operated piston positioned to move said drive shaft longitudinally, a valve which controls the admission of air to said piston, a unit for producing random electric impulses, and electrically controlled valve operating means which is actuated by impulses from said impulse producing unit and operates said valve.

15. A spinning machine as claimed in claim 14 in which said piston when at rest is spaced from the end of said common drive shaft so that said piston moves said shaft only after a short period of free travel in which said piston has built up its speed so as to produce a sudden movement of the shaft and consequent increase in the diameter of the filament, said machine being provided with hydraulic means for gradually returning said shaft to its initial position and thereby decreasing the diameter of said filament.

16. A spinning machine as claimed in claim 15 in which said piston is biased away from said shaft by spring means which serves to return it to its original position after it has struck the shaft.

17. A spinning machine as claimed in claim 1 comprising a stop which limits the longitudinal movement of said common drive shaft and an alternately rotating toothed sector which positions said stop, so as to vary the length of movement of the shaft and give slubs of random length.

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