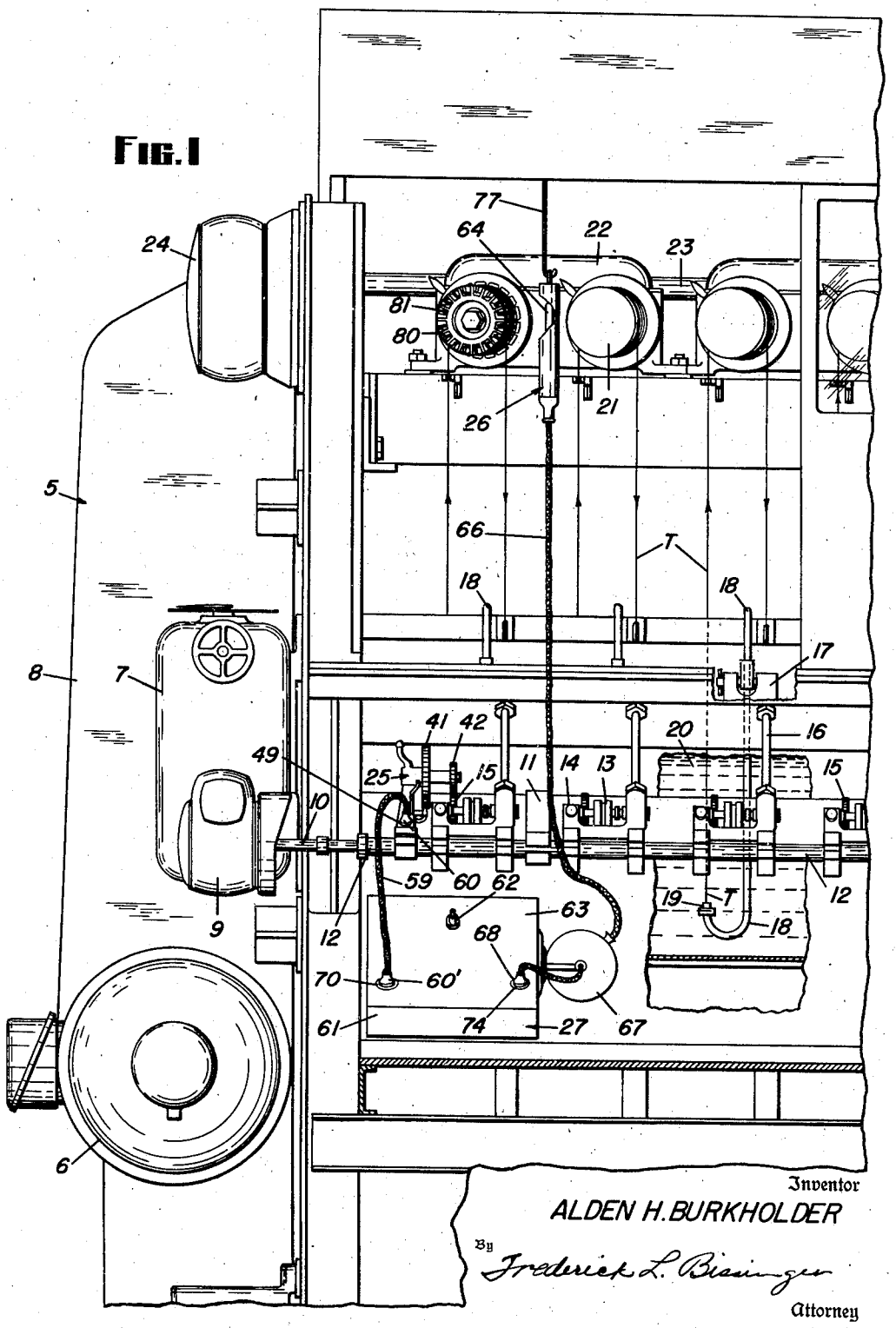
Nov. 23, 1948. A. H. BURKHOLDER 2,454,731

APPARATUS FOR COORDINATING THE OPERATING RATE OF FORMING THREAD WITH THE DRAWING THEREOF

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FIG. 1



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Filed Nov. 21, 1942 2 Sheets-Sheet 2

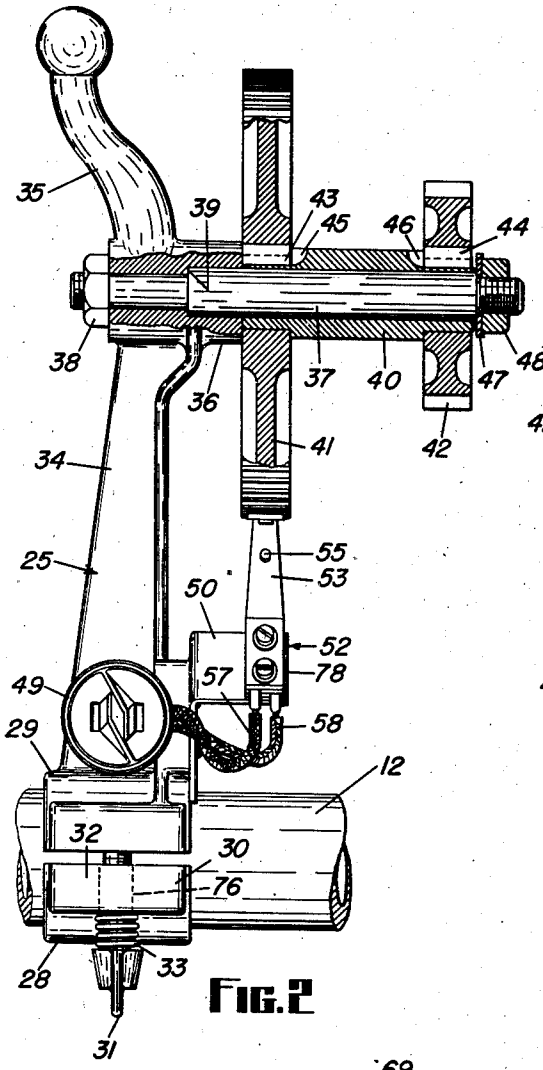


FIG. 2

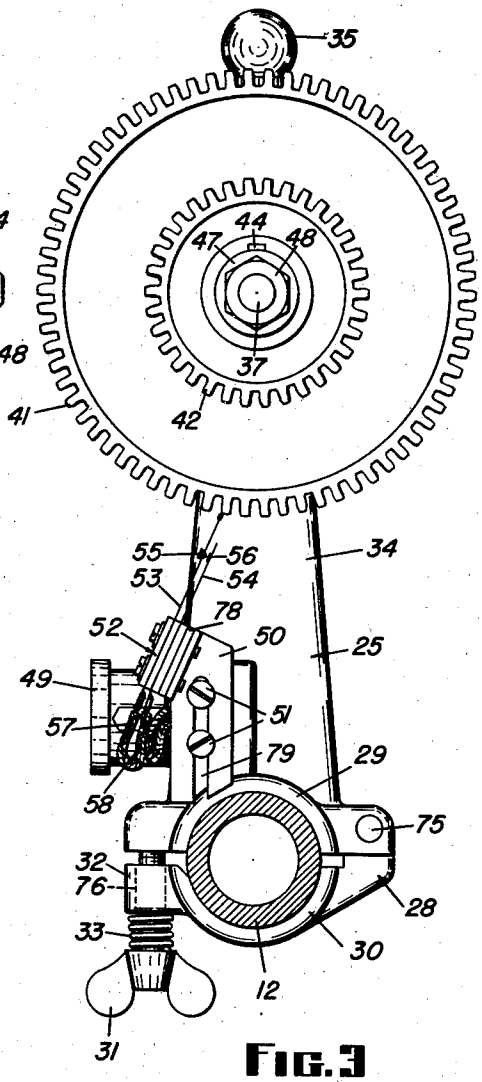


FIG. 3

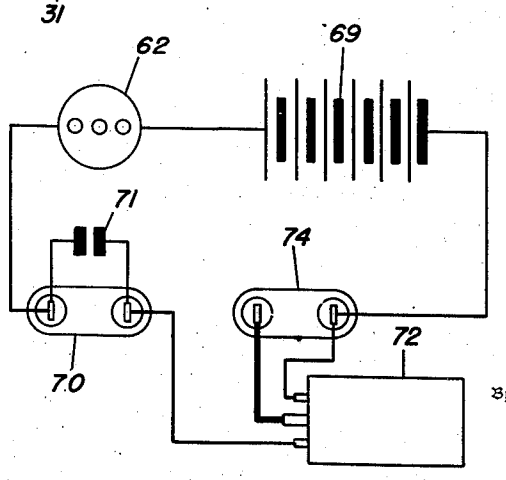


FIG. 4

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2,454,731

APPARATUS FOR COORDINATING THE OPERATING RATE OF FORMING THREAD WITH THE DRAWING THEREOF

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Application November 21, 1942, Serial No. 466,432

7 Claims. (Cl. 18—8)

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The present invention relates to an apparatus for insuring uniformity in the production of thread or the like of synthetic origin. In the production of such materials, the apparatus generally includes means for forming the thread and means for collecting the thread as it is formed. The present invention provides an apparatus for visually comparing the operating rates of the thread-forming and take-up means of such apparatus and facilitates the precise coordination of said thread-forming and take-up means thereby insuring greater uniformity of the product.

In the operation of apparatus for the production of thread of synthetic origin it is necessary to correlate the rate at which the thread is formed with the operating rate of the take-up means to insure the desired uniformity in the thread being produced. The thread-forming means and take-up means are usually maintained in proper operating relation with respect to each other by the employment of positive driving means for actuating both the thread-forming and take-up means. It is, however, advantageous under certain circumstances to introduce variable driving means into the apparatus for actuating either the thread-forming means or the take-up means or both in order to facilitate rapid conversion of the apparatus to permit a change in the character of the thread produced when such change is desired.

In apparatus employing a variable driving means for actuating one or both of the thread-forming and take-up means, it is difficult to satisfactorily correlate the operating rates of the two means so that a uniform product will be produced. As a result of introducing the variable driving means, the problem arises of maintaining the operating rates of the thread-forming and takeup means in proper relationship. In the operation of such apparatus, even after the proper relationship has been determined, deviations frequently occur by reason of unavoidable mechanical difficulties such as change of adjustment, wear of the driving means, and the like. Such variations occurring in the course of the spinning operation may cause irregularities in the thread.

These irregularities arising in the thread, whether they be found in a single thread or between two or more threads, may become particularly troublesome after the thread is woven or

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knitted into fabrics. The present invention provides a novel apparatus not only to assist in determining that the proper ratio exists between the operating rates of the thread-forming and take-up means for each individual machine but also to detect deviations in the functioning of the machines, thereby preventing the occurrence of irregularities in the product.

In accordance with the invention, a predetermined ratio between the operating rate of the take-up means and the rate at which the thread or the like is extruded from the thread-forming means, is selected the operating rate of one of the means is visually compared with that of the other and the operation of one of the means is adjusted to the extent necessary to coordinate its operating rate with that of the other of said means as determined by visual comparison whereby the previously selected predetermined ratio between the operating rates of the two means is established. The invention also provides novel apparatus which comprises a stroboscopic viewing means and control means for producing an intermittent operation of said viewing means, said control means being associated with and actuated by one of the means which is being checked.

Although the invention is described herein as being applied to apparatus for the production of thread, it is equally well adapted to use in connection with apparatus for the production of other thread-like articles such, for example, as tapes, bands, ropes, filaments, or the like.

The invention will be further described by reference to the accompanying drawings in which Figure 1 represents an elevation with parts broken away of one form of machine with which the method and apparatus of the invention are particularly well adapted to be employed; Figure 2 is a front elevation with parts broken away of one form of device which applies the inventive concept; Figure 3 is a side elevation of the device of Figure 2; and Figure 4 illustrates diagrammatically a wiring circuit for the power unit associated with the device of Figures 2 and 3.

The apparatus shown in Figure 1 embodies the thread-forming elements and take-up means of a continuous processing apparatus of the type shown and described in Knebusch et al. Patent

2,225,642 for the continuous manufacture of artificial silk thread or the like.

In Figure 1 of the accompanying drawings, a drive panel 5 which advantageously takes the form of that shown and described in Torrence et al. Patent No. 2,323,879, is located at one end of the apparatus as a whole. Motor 6 comprising part of drive panel 5 actuates a variable driving means such, for example, as speed-changing mechanism 7 mounted on housing 8 of drive panel 5 through a suitable driving means such, for example, as a conventional chain and sprocket drive (not shown) enclosed within housing 8. A conventional worm and gear type speed reducer 9 is operated from the speed-changing mechanism 7 and serves to reduce the speed of motor 6 to the proper operating range for driving longitudinally extending shaft 10 which is supported by a plurality of bearing brackets 11 from the machine frame.

A conduit 12 extends lengthwise of the machine directly in front of shaft 10 as seen in Figure 1 and is supported by bearing brackets 11. Conduit 12 serves to supply pumps 13 mounted upon said conduit 12 by means of yokes 14 with a spinning solution from which threads of synthetic origin are formed. Pumps 13 are actuated from shaft 10 by means of suitable gearing 15. The spinning solution supplied by conduit 12 is forced by means of pumps 13 through tubes 16 to apron blocks 17. The spinning solution passes into mass tubes 18 supported by said apron blocks 17 and emerges from spinnerets 19 which are secured to the lowermost end of mass tubes 18 and are adapted to be immersed in a suitable coagulating medium such, for example, as spin bath 20 for the formation by an extrusion process of thread of synthetic origin.

Thread T is withdrawn from the coagulating medium in which it is formed and passed to a suitable take-up or collecting device, in this instance a cantilever thread-advancing reel 21. Reel 21 illustrated in Figure 1 comprises two intermeshing sets of bar members 30, 31 forming its thread-bearing periphery and advantageously takes the form of the device shown and described in Knebusch Patent 2,210,914. By the operation of reel 21, thread T is continuously but temporarily stored in the form of a helix comprising a plurality of closely spaced turns and thereafter discharged from a point on the periphery of reel 21 to be passed to another part of the apparatus where further processing operations are performed.

A plurality of reels 21 are mounted on a suitable transmission 22 a number of which are preferably arranged side by side and operated by a single longitudinally extending shaft 23. Shaft 23, like shaft 10 which actuates pumps 13, is driven by motor 6 through the medium of the aforementioned chain and sprocket drive enclosed in housing 8 of drive panel 5 and speed reducer 24, which is also mounted on housing 8 of drive panel 5. Shaft 23 is, therefore, positively driven through gears and sprockets. Its speed may, if desired, be varied by changing the sprockets in the drive means enclosed in housing 8.

As hereinbefore explained, it is desirable that there be a definite ratio positively maintained between the rotational speed of reels 21 and the operation of pumps 13 for the purpose of maintaining the uniformity of the thread produced in the spinning operations. One embodiment of the invention as shown in the drawings which comprises interrupter unit 25, a stroboscopic viewing means which may advantageously take the form of light source 26, and power unit 27 is intended to facilitate the accomplishment of this purpose.

Interrupter 25 is adapted to be demountably secured by clamping means 28 to conduit 12 adjacent one of the pumps 13. Clamping means 28 is made up of a semi-circular portion 29 corresponding in diameter to that of conduit 12 and hinged portion 30 which is similar in shape to said semi-circular portion 29 and is hingedly mounted thereon by means of pin 75. Clamping means 28 is fitted about conduit 12 and hinged portion 30 is then adjusted with respect to said semi-circular portion 29 by a wing bolt 31 which extends through an oversized hole 76 in lip 32 of hinged portion 30 and is threaded into semi-circular portion 29.

In order to permit the position of interrupter 25 to be adjusted manually about the axis of conduit 12, clamping means 28 is provided with a compression spring 33 which is inserted between the head of wing bolt 31 and lip 32 of hinged portion 30. By virtue of this construction, the fit of clamping means 28 on conduit 12 is rendered just sufficiently tight to enable interrupter 25 to remain in whatever position it is placed with respect to conduit 12. The position of interrupter 25 may thus be readily adjusted so as to cause it to be either in or out of operating engagement with gearing 15 which actuates pump 13 from shaft 12.

Upwardly extending arm 34, secured to semi-circular portion 29 of clamping means 28 and advantageously being unitary therewith, is provided with handle 35 and horizontally extending hub portion 36. Mounted in hub portion 36 of arm 34 is a spindle 37 held in place by means of nut 38 threaded on one end thereof and shoulder 39 in hub portion 36. Mounted upon spindle 37 is cylindrical bushing 40 to which interrupter gear 41 and drive gear 42 are secured by means of keys 43 and 44 which register with keyways 45 and 46, respectively, cut into said bushing 40. Bushing 40 is positioned axially with respect to spindle 37 by means of washer 47 and nut 48 threaded on the end of spindle 37.

At the base of arm 34, plug-in receptacle 49 is provided together with angle bracket 50. Angle bracket 50 is so constructed that it is capable of being adjusted in a direction parallel to the vertical axis of arm 34 by set screws 51 which engage the sides of slot 79 in said bracket. Secured to angle bracket 50 is a make and break device which advantageously takes the form of breaker means 52 comprising two spaced, flexible strip elements 53 and 54 which are preferably made of some material characterized by a good electrical conductivity and mounted in insulating member 78. Elements 53 and 54 are provided on their adjacent surfaces with contact points 55 and 56. Wires 57 and 58 connect each of the terminals of the plug-in receptacle 49 with elements 53 and 54, respectively. An electric cable 59 on the ends of which are mounted plugs 60, 60', one of which is inserted in plug-in receptacle 49, serves to connect interrupter 25 with power unit 27.

Element 53 is slightly longer than element 54 of breaker means 52 and extends upwardly so as to contact the toothed periphery of interrupter gear 41. As interrupter gear 41 is rotated, element 53, being flexible, is moved up and down, thus intermittently making and breaking contact between contact points 55 and 56 of elements 53 and 54, respectively.

Power unit 27 comprises case 61 in which are

enclosed a suitable electric storage battery which may advantageously be of the dry cell variety, a coil, a condenser, and receptacles to which the several units of the device of the invention may be connected. The operation of the unit is controlled by a toggle switch 62 mounted on the panel 63 of said case 61. The electrical current from power unit 27 is supplied to a suitable lamp 64 in light source 26 by means of cable 66 which for ease in handling may advantageously be coiled in a wire reel 67 mounted on case 61 of power unit 27 and connected thereto by means of plug 68.

The electrical circuit employed in power unit 27 is illustrated diagrammatically in Figure 4 of the drawings. One terminal of battery 69 is connected through toggle switch 62, interrupter receptacle 70, to which cable 59 is connected, condenser 71 and coil 72 to one of the terminals of the receptable 74 for lamp 64. The other terminal of the battery 69 is connected through the other of the terminals of the receptacle 74 for lamp 64 to coil 72, thereby closing the circuit when toggle switch 62 is snapped into closed position.

Power unit 27 is shown as being secured to the machine structure at a point adjacent drive panel 5. Hook 77 adjacent reels 21 is provided to support lamp 64 while the necessary adjustments are being made in the drive mechanism for the apparatus. In ordinary use, lamp 64 is customarily held by the operator during the testing operation directly in front of the unsupported end of one of the reels 21 which is desired to be checked.

When it is desired to coordinate the operation of the thread-forming and take-up means for a given machine, interrupter 25 is attached to conduit 12 of the machine by clamping means 26 in such a position that drive gear 42 will engage gearing 15 which operates pump 13 when interrupter 25 is swung down into position. Toggle switch 62 is snapped into closed position so that the electrical circuit is complete. The operator grasps handle 35 on arm 34 of interrupter 25 and swings the unit about the longitudinal axis of conduit 12 until drive gear 42 meshes with gearing 15 of pump 13.

Drive gear 42 actuated by gearing 15 of pump 13 rotates bushing 40 and interrupter gear 41 since both gears are operatively connected to said bushing in the manner previously described. Contact point 55 of element 53 which, as previously explained, contacts the serrated periphery of interrupter gear 41 intermittently makes and breaks contact with contact point 56 of element 54 as said interrupter gear 41 is rotated. This recurring make and break between contact points 55 and 56 of elements 53 and 54, respectively, creates an intermittent flow of current from power unit 27 to lamp 64, causing it to flash on and off at specifically timed intervals which will be determined by the number of teeth in gears 41 and 42 as hereinafter explained.

Lamp 64 during the testing operation is positioned near the unsupported end of one of the reels 21 and due to its flashing interval produces a stroboscopic effect. The reel 21 employed in the test need not necessarily be the one which operates to withdraw the thread T being formed from the spinning solution which is forced through the pump 13 with which drive gear 42 of interrupter 25 is enmeshed. All of the reels 21 will be operating at a predetermined uniform angular velocity in accordance with the positive

operation of the drive means enclosed in housing 8 and speed reducer 24 to which shaft 23 actuating the several transmissions 22 is connected.

By virtue of the structure of reel 21 it is necessary only to check one of the sets of bar members 80 or 81. For the purpose of simplifying the explanation, it will be assumed that the set including bar members 80 is employed.

If the bars 80 in one of the sets of bar members of reel 21 in the course of the test appear to be standing still in the flashing light of lamp 64, the operating rate of shaft 10 driving pumps 13 is exactly coordinated with the operating rate of reel 21 in accordance with the standard determined by the proper choice of gears 41 and 42 of interruptor 25. If, on the other hand, bars 80 of reel 21 appear to be rotating either to the left or to the right as viewed in the light of lamp 64, certain adjustments must be effected in the operation of speed-changing mechanism 7 which drives shaft 10 operating pumps 13 in order to bring shaft 10 into phase with reel 21. The operator can readily determine by noting in which direction bars 80 of reel 21 appear to be rotating, what adjustment should be made in speed-changing mechanism 7 to coordinate the operating rate of shaft 10 with that of reel 21.

As previously indicated, the angular velocity of reel 21 may be positively determined and the reel caused to operate at a given rate of speed. Since the operation of pumps 13 is variable, it is usually desirable to adjust the speed of operation of shaft 10 to bring it into proper relation with the operating speed of reel 21 after the required angular velocity of reel 21 has been provided by the proper choice of sprockets in housing 8 for the character of thread to be manufactured. The adjustment of the angular velocity of shaft 10 driving pumps 13 is accomplished by varying the output of speed-changing mechanism 7 which actuates shaft 10 through speed reducer 9.

In order to employ the device of the invention in coordinating the operation of shaft 10 with that of reels 21, it is necessary to determine in advance certain specifications for gears 41 and 42 which will insure the desired results. The specification for gear 41 and 42 depends upon a number of factors including the nature of the thread to be produced with respect to its denier (the number corresponding to the weight in grams of 9000 meters of the thread), the kind of mass used in forming the thread, and other physical characteristics. Also involved are the speed of operation of reel 21, the number of bar members in each set comprising said reel, as well as the percentage of stretch, if any, required in the thread. All of these factors are employed in determining the number of teeth on the periphery of each of gears 41 and 42 so as to translate the driving force of gearing 15 for pump 13 into a flashing rate for the lamp 64 which will determine the proper ratio between the angular velocity of shaft 10 and reel 21 for the desired set of conditions.

By way of explanation, it will be assumed that it is desired to manufacture undelustered, 150 denier, 40 filament viscose artificial silk thread to which a 10% stretch is to be imparted. The required operating rate for the reel and the pump to produce such thread has been determined empirically in the usual manner known to the art. For purposes of illustration, it will be assumed that it has been determined in this manner that a reel of 5 inch diameter having 14 bars in each set must be operated at 200 R. P. M.

and the pump shaft speed must be 20 R. P. M. It will also be assumed that the pump is provided with a gear having 40 teeth.

Using this information, the ratio of bars per minute to pump teeth per minute passing a given point or

$$\frac{\text{R. P. M. of the reel} \times \text{number of bars}}{\text{R. P. M. of the pump} \times \text{number of teeth in the pump gear}}$$

is calculated. From the above data, the ratio becomes

$$\frac{200 \times 14}{20 \times 40} = \frac{2800}{800}.$$

This ratio represents the relation of the number of teeth required in interrupter gear 41 to the number of teeth in drive gear 42. Thus, with a drive gear 42 having 20 teeth, the interrupter gear 41 must have 70 teeth.

With the aforementioned gearing relation, the lamp 64 will have a flashing frequency such that each successive bar 80 of the one set of bar members of reel 21 will be illuminated as it passes a given point. If it is desired, for the sake of convenience, to employ two gears of more comparable size, it is possible to operate the apparatus efficiently by viewing only every other bar 80 of reel 21. In this way, a gear 41 of approximately half the size of that calculated may be used such, for example, as one having 35 teeth instead of 70 teeth.

The proper drive gear 42 and interrupter gear 41 now having been selected are then mounted on bushing 40 and the device assembled in the manner previously described. Interrupter 25 is thereafter ready to be attached to conduit 12 for the purpose of testing the operation of shaft 10 and detecting any discrepancy in its angular velocity with respect to that of reels 21.

In the foregoing description, reference has been made to the use of thread-advancing reels serving as the take-up means. Any of several suitable forms of collecting devices may be employed provided that the type selected has suitable markings perceptible to the operator to be viewed stroboscopically. Such collecting devices may include a spin spool, godet wheel, skeining swift or the like. If either the spin spool or godet wheel is employed, a plurality of equally spaced markings should be applied to the outermost periphery where they will be seen by the operator. Such markings will serve adequately as visible guides after the fashion of bars 80, 81 of reel 21 or the thread-supporting arms of a skeining swift. By reason of the limitations of visual perception, however, the number of the marks or the rotational speed of the take-up means should, in general, be such as to produce a frequency of not less than ten markings or segments passing a given point during each one second interval.

After the device of the invention has been employed in coordinating the operation of shaft 10 and reels 21, it may be used to particular advantage in the inspection of reels 21 to determine whether any operating or structural irregularities are present. When the apparatus is once checked and pump shaft 10 is properly coordinated with reels 21, all of the reels should upon inspection with lamp 64 appear to stand still. If for any reason any one or more of the reels do not meet this test, it indicates that such reels may be defective and should be removed for inspection or repair.

Certain modifications may be made in the apparatus hereinbefore described without departing from the spirit or scope of the invention. For instance, power unit 27 may be made portable in order that interrupter 25 may be attached to any part of the machine for the purpose of inspecting any given pump 13 or reel 21. Interrupter gear 41 may also take the form of a disk or other suitable annular member having a serrated periphery for actuating element 53 of breaker means 52. Similarly, wire reel 67 may be employed in coiling cable 59 extending between interrupter 25 and power unit 27 instead of cable 66 as illustrated. Other changes of like character will readily suggest themselves to one skilled in the art.

Under certain circumstances, it may be desirable to have reels 21 actuated by variable driving means of a type similar to speed-changing mechanism 7 while pumps 13 are positively driven by motor 6 through a series of gears and sprockets. The coordinating method and apparatus of the present invention is equally well adapted to be applied to the coordination of such apparatus as it is to that hereinbefore described. The operation here differs only in respect of the fact that shaft 10 actuating pumps 13 is operated at a predetermined rate to insure the output required for the character of thread desired to be produced by the proper choice of sprockets in the drive means enclosed in housing 8 and gears associated therewith while the operation of reels 21 is varied by adjustment of the speed-changing mechanism until said reels are in precise coordination with shaft 10 when checked stroboscopically.

It may be desirable, particularly in continuous processing apparatus of the type shown and described in the aforementioned Patent 2,225,642, to operate both shaft 10 and reels 21 through variable driving means so as to provide an even greater variety of operating relationships therebetween. In this event, the operating rate of shaft 10 may be checked against any one of the subsequent manipulating devices which is positively driven at a predetermined rate such, for example, as the next reel in the series which forms part of a continuous processing apparatus and is employed in storing the thread while it is subjected to processing treatment.

The term "stroboscopic viewing means" as employed herein contemplates the use of comparable units in the apparatus which, although they may operate on slightly different principles, are recognized equivalents in the art. A shutter arrangement, a combination of slotted or notched disks and the like could be readily operated so as to produce the same stroboscopic effect in combination with a steadily illuminated object as is accomplished with a flashing light source such as that to which the foregoing description relates. The invention is, therefore, intended to include all comparable structural forms which will operate in accordance with the method herein described.

I claim:

1. In apparatus for the manufacture of thread or the like of synthetic origin by an extrusion process employing thread-forming means and take-up means, a device for directly comparing the operating rate of one of said means with that of the other comprising a stroboscopic light emanating device and control therefor, said control being associated with and actuated by one of said means for producing an intermittent light emission at a predetermined frequency, said stroboscopic light being directed at and illuminating the other of said means.

2. A device of the character described in claim

1 in which the control means comprises a make and break device and actuating means for operating the make and break device, said actuating means being characterized by a serrated periphery predetermining the frequency of light emission.

3. A device of the character described in claim 2 in which the control means comprises a make and break device and actuating means operated by the thread-forming means for operating the make and break device, said actuating means being characterized by a serrated periphery.

4. A device of the character described in claim 1 in which the control means comprises a make and break device, actuating means for operating the make and break device, said actuating means being characterized by a serrated periphery, and driving means for operating the actuating means driven by the thread-forming means.

5. Apparatus for comparing the operating rates of a supply pump for delivering a spinning solution to a thread-forming means and a take-up device adjusted to operate at a predetermined rate comprising, a gear driven supply pump, a source of electrical energy, a lamp directed at said take-up device for emitting light impulses thereon, an interrupter for controlling the frequency of said light impulses, said interrupter being characterized by a make and break device, a toothed annular member for actuating said interrupter, and means for rotating said toothed annular member, said means being actuated by said gear of said supply pump, the supply pump being one of the members the operating rate of which is being coordinated with that of the take-up device.

6. In apparatus for the manufacture of thread or the like of synthetic origin by an extrusion process employing thread-forming means, a take-up means comprising a reel, a supply pump for delivering a spinning solution to said thread-forming means and a drive having a gear for actuating said supply pump, a stroboscopic device for comparing the operating rate of the pump drive with that of the take-up reel comprising, a light source and control means associated with

and actuated by said gear driving said supply pump for producing an intermittent flow of energy to said light source for effecting an emission of light at a rate proportional to the take-up reel rotation, said light being directed at said take-up reel, said control means embodying a make and break device characterized by a plurality of spaced flexible elements each of which is provided with at least one contact point, a rotatably mounted toothed member the periphery of which contacts at least one of the flexible elements of the make and break device and a drive gear which drives said toothed member and which meshes with the gear of a said drive.

7. Apparatus of the character described in claim 6 in which the take-up reel comprises a thread store-thread advancing device having a periphery of a plurality of interdigitating thread-bearing bar members and said stroboscopic light is directed at said bar members.

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