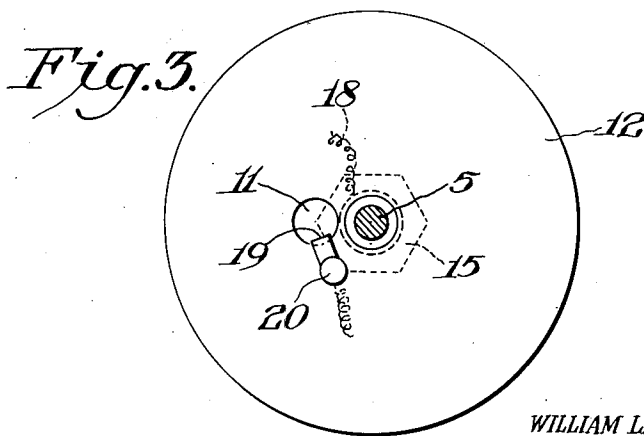
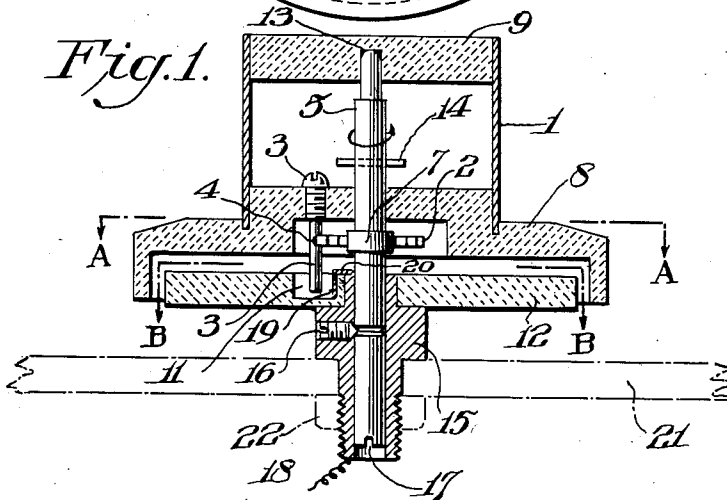
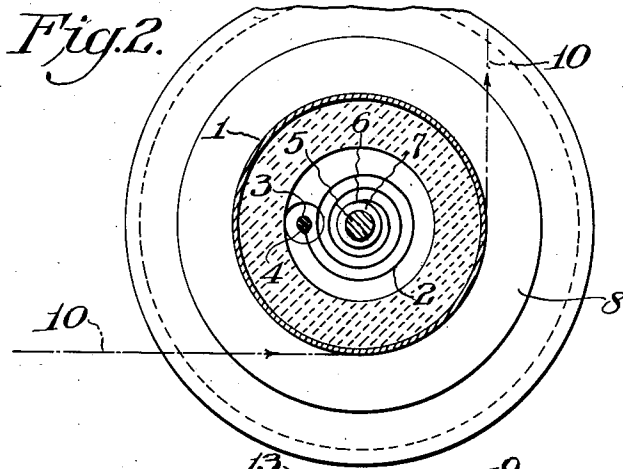


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KINETIC STOP MOTION DEVICE

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KINETIC STOP MOTION DEVICE

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1

This invention relates to stop motions for apparatus handling filaments, yarns, threads and like funicular structures, and particularly to an improved stop motion for causing machine stoppage when abnormal passage filamentous structures occurs.

By "filamentous structures" is meant monofilaments, yarns, threads, strands, cords, ropes, fibers, wires and the like.

A wide variety of mechanisms has been employed previously for effecting stoppage of textile machinery upon filament or yarn failure. By filament or yarn failure is meant either actual breakage, the exhaustion of the filament or yarn supply, or the failure of the filamentous structure, such as yarn, to feed normally due to a defect in the mechanism to which or from which the structure is being fed. Failure may, in fact, be due to any operation which results in improper maintenance of tensions or paths of travel. All of the conventional stop motion devices depend particularly on a changing tension on the filamentous structure, that is, on reduced tension or "slack" in the broken structure. Development of slack allows a dropped wire or fall-back mechanism to operate. The absence of any appreciable slack in a system involving a number of guides frequently results in failure of the conventional stop motion to function.

Oftimes it is of value for the stop motion to become operative before an actual filament break occurs, as upon the reduction of tension below a certain predetermined level. In fact, this minor reduction in tension may create slack insufficient to permit operation of the stop motion. Moreover, in certain textile operations it is advantageous to utilize stop motion devices which are not dependent for proper functioning on actual displacement of broken or slack filaments from the normal line of travel. No simple stop motion device of high sensitivity has heretofore been proposed to operate without actual slack in the filament line and/or without displacement of the filament. Such a mechanism has long been sought in the textile field.

This invention has as an object the provision of a more efficient and a more sensitive mechanism for automatically detecting filament failures by causing stoppage of the operating machine or by giving warning of said failure by suitable signal. Another object is to provide in a machine handling filamentous structures a simple, effective stop motion which is quick in action, highly sensitive and yet not dependent on actual slackness. A further object is the

2

provision of improved means for automatically detecting filament or yarn failure immediately upon their occurrence. A still further object of the invention is to provide a novel stop motion which will be self-contained and operable independent of any rotating part of the textile machine. Another object is to reduce labor cost incident to operation of warp beaming machines. Other objects of this invention, together with certain details of construction and combination of parts, will appear from the subsequent detailed description.

The objects of this invention are accomplished by a novel stop motion device, which operates without any displacement of the filament or yarn from its normal path of travel. The stop motion of this invention for detecting filament failure comprises a rotatable member pivoted on a shaft in such a manner that when a filament is running over its surface at normal winding speeds the member is rotated through a small arc sufficient to keep open an electrical circuit and when the filament motion decreases or actually ceases due to filament failure, the torque is immediately reduced and the member is returned to its original position. The electrical contact is closed thereby and this in turn either stops the machine or gives a signal.

In order that the invention may be more easily understood a stop motion device constructed in accordance with the invention is illustrated by way of example in the accompanying drawings. It is, of course, within this invention to use any equivalents for such parts of the apparatus as the stop pin, retaining clip, coil spring and the like. In so illustrating the invention it has not been deemed necessary to show application of the same to any particular machine, nor to detail any such machine except to point out that the preferred embodiment of the invention is particularly applicable to warpers fed from creels. Referring to the drawings, like characters of reference denote like parts.

In the drawings, which are in no way limitative:

Figure 1 is a sectional elevation of the entire stop motion assembly.

Figure 2 is a horizontal sectional view taken along the line A—A in Figure 1 and shows the coil spring arrangement, the upper bearing disc, and the cylindrical surface over which the filamentous structure, such as a yarn, passes.

Figure 3 is a horizontal sectional view taken along the line B—B in Figure 1 and shows the

base disc together with some details of the electrical circuit.

Referring to the figures, the preferred form of the stop motion device, the dimensions of which can be varied widely, comprises a cylinder 1 to accommodate the particular filamentous structure being processed. This cylinder may be of thin walled, chromium plated, seamless steel about 1" in diameter and $\frac{3}{4}$ " long containing an internal coil spring 2, the outer end of which is soldered or otherwise fastened to the stop pin 3 at 4 and the inner end is fastened to shaft 5 at place 6, by means of collet 7. The restoring force may be supplied by means other than by a coil spring, as, for example, a magnetic or a gravitational force. The lower and upper ends of cylinder 1 are solidly fastened, respectively, to the lower bearing disc 8 fitting tightly around the shaft 5, and upper bearing disc 9 fitted also on shaft 5. The cylinder 1 is so pivoted on shaft 5 that when a filament 10 is running over the cylindrical surface at normal winding speeds, the rotating member, consisting of cylinder 1, lower and upper bearing discs, 8 and 9, respectively or their equivalent and stop pin 3, is rotated through an arc of about 15°-20°. The size of the hole 11 in the stationary member, that is, the base disc 12, shown in Figures 1 and 3, preferably about $\frac{3}{16}$ " in diameter, limits the motion of the stop pin 3. While the cylinder is kept in this rotated position due to the torsional force applied by the running filament 10, an electrical contact is kept open. The invention is not limited to cylinders; other curved surfaces may be used, providing, of course, provision is made for the proper pivoting and rotating of the surface. Generally, a cylinder is preferred as most economical, since standard tubing can be used.

Both the lower bearing disc 8 and the upper bearing disc 9 at each end of the steel tube, as well as the stationary member 12, are preferably constructed of an insulating material, such as Lucite, polymethyl methacrylate. The lower and upper bearing discs 8 and 9 need not be separate pieces but this upper part of the stop motion may be a single molding, for example, of Lucite. Upper bearing disc 9 rests on shaft 5 and is freely rotatable thereon at 13. Other equivalent constructions may be used. The bearing discs allow free rotation of the cylinder 1 to the extent allowed by the stop pin 3 and the sides of the hole 11 in the base disc 12, into which the stop pin 3 extends. The lower bearing disc 8 is shaped like a cover plate to protect the coil spring 2 and the electrical contact. In order to prevent the lifting of the rotating member off shaft 5, a retaining clip 14 is attached thereto. This supporting shaft 5 is held by a base nut 15 with a conical point set screw 16, which limits axial movement but allows rotation for adjusting the tension on coil spring 2. Base nut 15 also holds the base disc 12 in position and prevents this from rotating. The screw slot 17 in the bottom of the shaft 5 is used to assist in turning the shaft into a position which gives the proper spring tension. After the spring tension is adjusted, the shaft 5 is locked to the nut 15 by means of the set screw 16.

The adjustment of the spiral spring is such that the cylindrical tube will move to the open position at about half of full filament speed, and close quickly at a filament break. Good operation, as for example in the winding of cellulose acetate yarn of 75 denier at 300 Y. P. M.

over a satin finished, chrome plated, cylindrical surface, can be obtained with less than 2 grams tangential pull at the surface of the tube to reach the open position. With a final tension of about 8 grams and an angle of contact of about 90°, more than a 2 gram drag of the filament on the tube (i. e., the part of the 8 grams due to friction between the filament and the tube) is available and the spiral tension spring is set for about 3 grams. With other tensions, speeds, deniers and surfaces, this figure will be different. Likewise, the values will vary with the filamentous structure being processed.

When a failure occurs, that is, when there is a reduction in tension and/or filament speed, the torque is immediately reduced and the rotating member is returned to its original position, thereby closing the electrical contact. The electrical circuit can best be traced from Figures 1 and 3. Starting with the lead-in wire 18, one electrical lead can be traced through the base nut 15, the shaft 5 and the spiral spring 2 to the stop pin 3. Provided there is a reduction in speed and/or tension of the filament traversing the cylinder 1, the stop pin 3 makes contact at 19 with the other electrical lead which consists of a nickel-silver contact strip 20 which is solidly fixed on base disc 12 as shown in Figure 3. The closing of the electrical contact permits the stoppage of machinery, the flashing of signals, etc. If desired, the electrical circuit may be constructed so that when the rotatable member is rotated the circuit is closed and when the member is returned to its original position, the circuit is opened. The device may be supported in any suitable manner such as on frame 21 by means of a locking nut 22 fastening on the threaded portion of base nut 15.

The stop motion of this invention is preferably located on a creel or other similar machinery between the filament supply means and the beamer or other filament collecting mechanism and may be incorporated when initially designing a machine or be constructed as an attachment for the machine where it is desired to supply an efficient means for detecting filament or yarn failure.

The electrical circuit is so arranged that it can readily be made inoperable during the commencement or recommencement of the winding operation. It is obvious that the running filament must obtain a certain speed before the torsional force is sufficient to overcome the force of the coil spring which force is preventing the rotation of the cylinder and hence the opening of the electrical circuit and proper functioning of the stop motion. Provision, therefore, is made for making the stop motion device inoperable at the start-up. Any of the usual switches and the like may be used to accomplish this.

The arc of contact of the filamentous structure 10 with cylinder 1 is not critical and will vary considerably, depending upon the nature of the structure, the tension on it, the coil spring tension, etc. Of course, sufficient contact is needed to cause rotation against the coil spring setting. As an example, an arc of contact of 80° has been found suitable in most instances, particularly when the spiral spring is set for a torque of approximately 2 gram-centimeters. Generally, the tension on the running filamentous structure is adjusted by any of the well-known tension devices so that a light, uniform tension is exerted on the filament. The minimum of

5

this tension will depend on the coil spring adjustment. For example, if the spring is set for a torque of 2 gram-centimeters, the tension on the filamentous structure as it leaves the stop motion would be above 2 grams when using a tube approximately 1 centimeter in radius. For this spring setting, a tension on the structure as it leaves the stop motion of about 4 to 7 grams is normally used. The arc of contact, spring tensions and tensions on the filaments and the like are adjusted to fit the particular operation.

The position of the cylinder 1 is not critical as either a horizontal or vertical mounting may be employed. The vertical position is the preferred one, however. As regards the surface of the cylinder, a dull or satin finish chrome plate is recommended but not essential. Moreover, the size or length of the cylinder may vary within wide limits. For a convenient size utilizing available torque an outside diameter of 1" is advocated. Furthermore, it is not absolutely essential that the surface over which the filament passes be cylindrical. Any curved structure might be employed, particularly a curved surface not requiring filament slack for successful operation of the stop motion mechanism.

While the angular motion of the cylinder is not critical, it is obvious that it must be at least sufficient to keep the electrical circuit open and free from sparking. An arc of rotation of 15°-20° has been cited in the preferred embodiment of the invention because it gives a satisfactory time lag. Cylinders of different diameters require different arcs of rotation for satisfactory performance.

In the above description of the lower, upper, and base discs, 8, 9, and 12, it was pointed out that a transparent, insulating plastic material, such as Lucite, was the preferred material from which to make said discs. It is obvious to anyone skilled in the art that by proper insulating bushings, all of the discs may actually be constructed of any suitable conducting or non-conducting material, transparent or otherwise; however, simplicity of construction is lost in so doing. Moreover, the type of contact 19 employed need not necessarily be one of a nickel-silver alloy, but can be any of the materials usually used in this respect.

The principle of operation of this novel stop motion device is unique, in comparison to conventional, heretofore known devices, in that the torque to operate the mechanism is a function of the speed of the filament and not of the total tension on the filament leaving the device. The basic operating principle involves the torque developed by a filamentous structure running over a cylindrical surface, and the difference in value of this torque at normal winding speeds and at reduced speeds. The amount of torque available to turn the stop motion against the resistance of the spiral spring is equal to the frictional drag of a filament on the cylindrical tube multiplied by the radius of the tube. The frictional drag of the filament on the cylindrical tube or the tension added to that in the filament by contact with the tube can be expressed as the difference of tension in the filament as it leaves the device and as it approaches the device. It is this difference of tension multiplied by the radius of the tube that determines the torque acting on the tube rather than the absolute value of the final tension.

As pointed out above, some initial tension in the filament ahead of the stop motion is necessary.

6

Selecting an initial tension T_0 to give a satisfactory final tension T_1 for winding, the ratio of the final tension to the initial tension

$$\frac{T_1}{T_0}$$

can be calculated from the equation $T_1/T_0 = e^{F\alpha}$, where e is the base of natural logarithms, F is the coefficient of friction of the filament against the metal tube, and α is the angle of contact of the filament with the tube expressed in radians. From this equation the difference between the initial and final tension can be calculated, which is the force to be multiplied by the radius of the stop motion tube to obtain the torque acting on the stop motion. It will be noted from the equation that the ratio of the final tension to the initial tension is a function of the coefficient of friction of the filament on the tube and the angle of contact. Since the angle of contact may be kept constant, the ratio varies exponentially as the coefficient of friction. It has been determined experimentally that the coefficient of friction of the filament on the cylindrical tube varies with the speed of the filament motion. For cellulose acetate the value of the coefficient drops rapidly as the filament speed drops below 100 yards per minute and very rapidly as the speed drops below 10 yards per minute. Typical values for common filament size, filament lubricant, and metal surface are 0.45 at 300 yards per minute, 0.25 at 5 yards per minute, and less than 0.2 at 1 yard per minute. These differences are adequate to operate the stop motion on a change of speeds even if the initial tension were automatically raised to maintain the same final tension. In a practical operating set-up, the initial tension will also drop with the filament speed and the reduced ratio of final to initial tension will be applied to this smaller initial tension providing a larger differential from high speed to low speed to operate the stop motion. When a break occurs, the motion of the filament stops; the tendency of the filament to turn the tube ceases; the tension in the filament drops to nearly zero and the drag of the filament to prevent the spiral spring from returning the cylindrical tube to its closed position is negligible. This last situation is distinctly different from that existing when a break occurs with a conventional lever or drop type stop motion, especially when there are a number of guides on either side of the stop motion. Although the tension becomes nearly zero when the break occurs, considerable weight in the lever or drop is required to pull the filament through the guide and develop sufficient slack to permit the drop making an electrical contact. The said heavy weight is objectionable in regular operations in that false stops frequently occur and excessive drag is put on the filament.

Although the preferred embodiment of the invention has dealt with a filament, it is understood by anyone skilled in the art that the stop motion mechanism can be used successfully for a plurality of filaments, provided the sensitivity of the coil spring or its equivalent is properly adjusted so as to compensate for changes in tension when, for example, one filament out of ten breaks.

While this device has proved highly beneficial in winding operations involving cellulose acetate and viscose rayon yarns and filaments, it may be employed to distinct advantage in similar operations involving any textile yarn, or combination thereof. The invention may be employed in connection with such filaments and yarns as cellu-

lose propionate, cellulose butyrate, cellulose acetopropionate, cellulose ethers, nylon, polyacrylonitrile, polystyrene, Vinyon (vinyl chloride-vinyl acetate copolymer), vinylidene chloride, polyethylene, polyvinyl alcohol, polytetrafluoroethylene, polyesters, casein, cotton, silk, wire, coated wire and the like.

It is understood further that while the principles of the invention have been described by way of example as applied to warp beaming machines, the improved method and means of the invention may also be applied to yarn slashers, weaving machines, knitting machines, inspection tables, and in fact to any phase of the textile and related arts where those principles find useful applications.

By the employment of this automatic device, it is possible to keep false stops to a minimum and no large reduction intension (amounting to slack for conventional devices) is required for successful operation. Moreover, there is no excessive drag or displacement put on the filament or yarn. Furthermore, the employment of this unique stop motion device enables a single operator to take care of numerous warping or other textile machines simultaneously, thereby decreasing the cost of operation. The highly sensitive stop motion mechanism herein described acts quickly, enabling the filament failures to be instantly spotted or causing the machine to stop before the broken ends run into the fabric.

Any departure from the above description which conforms to the present invention is intended to be included within the scope of the claims.

We claim:

1. Apparatus for detecting failure in a filament kept running by a feeding mechanism which comprises an electrical switch; a pivoted member rotatable by said filament in the direction of travel of said filament when it is running in frictional contact with the outer surface of said member; and means for rotating said member in the reverse direction upon filament failure to alter said switch, whereby stoppage of the feeding mechanism is effected.

2. Apparatus for detecting failure in a filament kept running by a feeding mechanism which comprises an electrical switch; a pivoted member rotatable by said filament in the direction of travel of said filament when it is running in frictional contact with the outer surface of said member which thereby is held away from a contact contained in said switch; and means for rotating said member in the reverse direction upon filament failure to alter said switch, whereby stoppage of the mechanism feeding said filament is effected.

3. Apparatus for detecting failure in a filament kept running by a feeding mechanism which comprises an electrical switch; a pivoted member rotatable by said filament in the direction of travel of said filament when it is running in frictional contact with the outer surface of said member which thereby is held away from a contact contained in said switch; means contained in said member to limit the degree of rotation

of said member; and means for rotating said member in the reverse direction upon filament failure to alter the said switch, whereby stoppage of the mechanism feeding said filament is effected.

4. Apparatus for detecting failure in a filament kept running by a feeding mechanism which comprises an electrical switch; a pivoted member rotatable by said filament in the direction of travel of said filament when it is running in frictional contact with the outer surface of said member, which thereby is held away from a contact contained in said switch; a stop pin contained in said member to limit the degree of rotation of said member; a coil spring for rotating said member in the reverse direction upon filament failure to alter said switch, whereby stoppage of the mechanism feeding said filament is effected; and means for adjusting the tension on said spring.

5. Apparatus for detecting failure in a filament kept running by a feeding mechanism which comprises an electrical switch; a pivoted member mounted and rotatable on a shaft firmly held by a stationary member, said pivoted member being rotatable in the direction of travel by said filament when it is running in frictional contact with the outer surface of said member; control mechanism for limiting the degree of rotation of said pivoted member; means for rotating said member in the reverse direction upon filament failure altering said switch thereby; means for keeping said pivoted member mounted on said shaft; and means for mounting said apparatus in filament receiving position.

6. Apparatus for detecting failure in a filament kept running by a feeding mechanism which comprises an electrical switch; a pivoted member rotatable by said filament in the direction of travel of said filament when it is running in frictional contact with the outer surface of said member; and means for rotating said member in the reverse direction upon filament failure to close said switch.

7. Apparatus for detecting failure in a filament kept running by a feeding mechanism which comprises an electrical switch; a pivoted member rotatable by said filament in the direction of travel of said filament when it is running in frictional contact with the outer surface of said member; and means for rotating said member in the reverse direction upon filament failure to open said switch.

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