

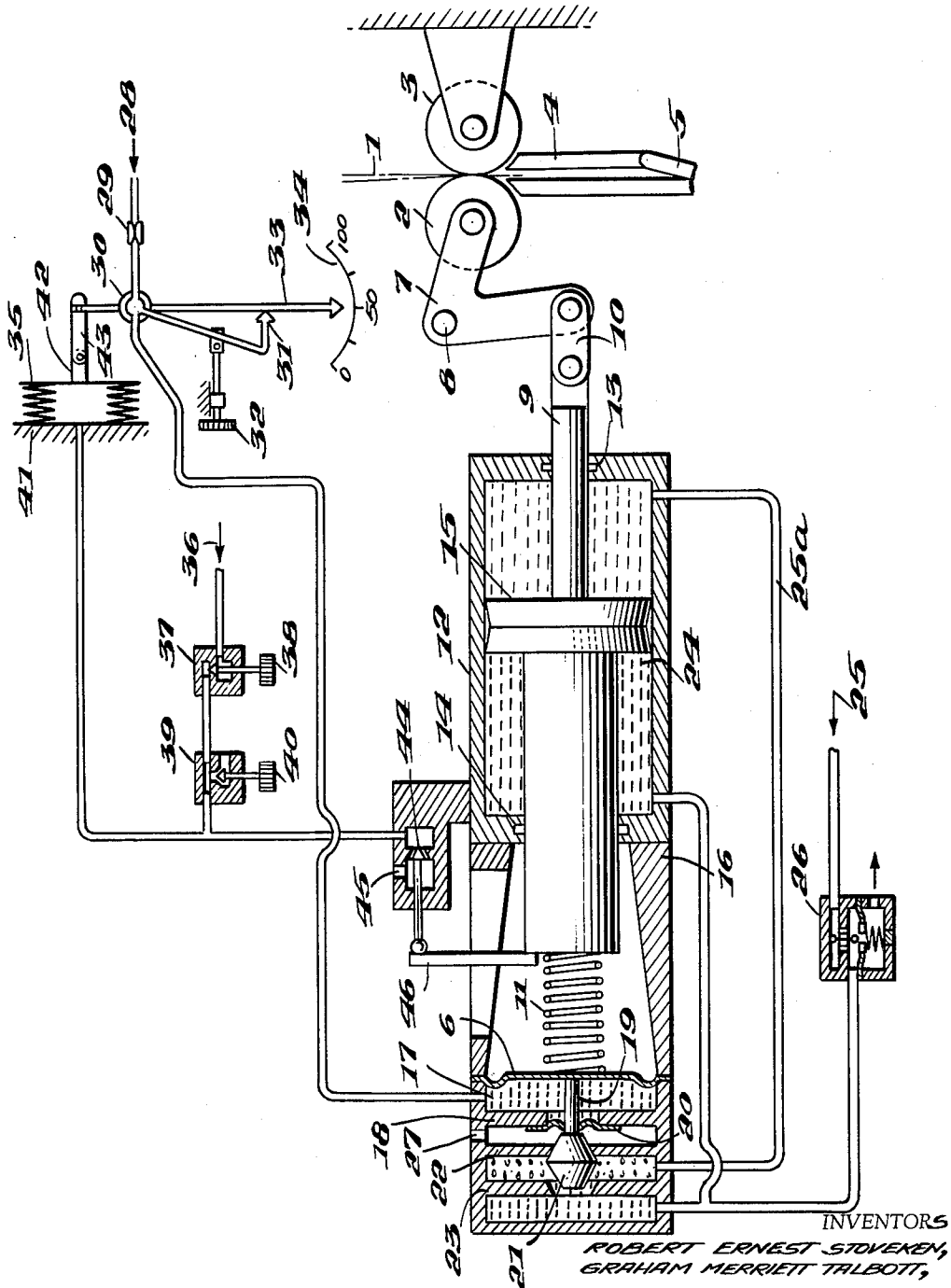
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DEFECT RESPONSIVE APPARATUS

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AGENT

1

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DEFECT RESPONSIVE APPARATUS

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3 Claims. (Cl. 28—1)

This invention is a continuation-in-part of Serial No. 290,801, filed June 26, 1963, now abandoned.

This invention relates to an improved apparatus for crimping of synthetic filamentary tow.

Satisfactory processing of synthetic staple to yarns, employing conventional textile equipment, is sensitively dependent on the proper level of and the uniformity of staple crimp. Too little crimp leads to poor web and sliver cohesion and to processing discontinuities, while too much crimp leads to excessive fiber entanglements and to non-uniform yarns.

It is even more important to maintain good control of crimp quality in production of tow, which is intended to be processed on textile equipment without prior cutting to staple. In this case, a uniform level of crimp serves to implement the interfilament cohesion which assures lateral contiguity, without which it would be impossible to adjust tow width and distribution of filaments to good uniformity along its width. The cutting or breaking equipment employed in the trade, such as the Turbo-stapler and the Pacific Converter, will yield a sliver of reproducible cut fiber length distribution and good overall quality only if the tow fed to the breaking zone has good filament distribution uniformity across its width.

Crimpers of the type described in U.S. Patent 2,747,233 wherein feed rolls force yarn into a stuffer box have enjoyed extensive commercial success in the production of crimped synthetic filaments. As pointed out in this patent, it is very important to maintain the clearance between rolls within quite narrow limits as defined by, among other things, the size of the tow being processed to prevent formation of unregulated, random crimp. Tow containing such irregular crimp fails to meet the trade requirements referred to above. The patent referred to offers improved control of this critical clearance in the form of an adjustable stop which implements selection of the minimum clearance compatible with any given tow.

With demands for higher productivity leading to larger tows and to higher speeds of processing, it has been found that the improvement offered by the aforementioned patent falls short of requirements. In high speed operation, fluctuations in rope thickness, due to momentary non-uniformity in distribution of filaments in the bundle cross section or passage of knots required for tying in of new ends of uncrimped tow, will jolt the feed rolls apart with such force that control of the rope is momentarily lost. Such loss of control is frequently sufficient to cause complete break-out of the tow and wraps on the rolls of preceding equipment. Such discontinuities lead to serious loss of machine productivity and of product.

It has also been found that clearance requirements for a given tow will be different during low-speed start-up operation from those employed in continuous, equilibrium operation. Prevention of irregular crimp is particularly difficult during start up, requiring constant attention of a skilled operator to control.

It is an object of the present invention to provide a yarn feed roll assembly for a yarn crimping device, at least one of the rolls of which is recoilable upon passage of a yarn defect, the said recoilable roll having a fast recoil in response to a defect and a fast retraction to its normal operational position after recoil. These and other

2

objects will become apparent in the course of the following specification and claims.

In accordance with the present invention an apparatus is provided wherein one of a pair of feed rolls in a yarn forwarding device is recoilably mounted to bear against a flexible diaphragm through shaft means; a pressure retaining cylinder, in fixed relationship to the said flexible diaphragm, through the longitudinal axis of which the said shaft means is slideably mounted; a piston in the said cylinder fixed to the said shaft; a pressure means for the said cylinder; a pressure retaining chamber behind the said diaphragm and of which the said diaphragm forms one wall; a second pressure means for the said chamber; a valve stem attached normal to the said diaphragm within the said chamber and mounted to protrude sealably through the wall of the said chamber opposite to the said diaphragm; valve means, for the first said pressure means, attached to the said valve stem, to provide in the said cylinder at one position, equal pressure to opposite faces of the said piston and at another position differential pressure to opposite faces of the said piston; an expandable pressure element fixed at one point and movable on pressure change at another point; a third pressure means for the said pressure element; valve means for the said second pressure means fixed to the movable point of the said pressure element to provide a fixed pressure in the said chamber in one position and a different pressure in said chamber in a second position; valve means for the third said pressure means to provide one pressure to the said pressure element when the feed rolls are at a set clearance and a different pressure when the feed rolls are at a greater clearance.

The invention will be more readily understood by reference to the drawing which is a schematic representation, partly in side elevation. The apparatus is shown in the position wherein the feed rolls are at a preset clearance for normal operation.

With reference to the drawing, tow 1 is fed into the nip of feed rolls 2 and 3, driven by means not shown, which force it into stuffing box 4. Clapper 5, urged shut by regulated means not shown, restricts egress of the crimped tow so as to maintain a uniform back-pressure in the stuffing box. Crimped tow emerging from the stuffing box is forwarded by means not shown to subsequent processing steps, including cutting to staple, drying, and baling or drying without cutting and packaging as finished tow. Shaft means between recoilably mounted feed roll 2 and flexible diaphragm 6 is provided by lever 7, pivoted at pivot point 8, shaft 9 attached to lever 7 through mechanical linkage 10, and spring 11. Thus recoil of feed roll 2 is transmitted by this shafting means and produces flexing of diaphragm 6. Shaft 9 is slideably mounted along the longitudinal axis of pressure cylinder 12, passing through pressure seals 13 and 14. A piston 15 movable in cylinder 12 is fixed to shaft 9. Cylinder 12 is held in fixed relationship to diaphragm 6 by means of housing 16.

A pressure retaining chamber 17 is formed between flexible diaphragm 6 and partition 18 of housing 16. A valve shaft 19, within chamber 17 and attached normal to diaphragm 6, extends through and is sealed to a second diaphragm 20 which is in turn sealed to partition 18. Two-position valve 21 connects to shaft 19. The valve as shown is seated in an orifice in housing partition 22. Sliding motion of shaft 19 opens the orifice in partition 22 and valve 21, at the opposite end of its travel, seats in the orifice shown in housing partition 23. For clarity of presentation, the distance between the two orifices (and hence the travel of valve 21) is greatly exaggerated.

Pressure means, preferably air under pressure, is provided cylinder 12, at fluid source 25 through regulating

valve 26. With feed rolls 2 and 3 at a preset, normal operational clearance, valve 21 is seated in the orifice in housing partition 22, supplying equal pressures to each face of piston 15. Reaction of the apparatus to an upset such as caused by a fluff ball or knot passing between feed rolls 2 and 3 is to cause a recoil of 2 which is transmitted mechanically to diaphragm 6 which flexes against the pressure in chamber 17, moving valve 21 from its seat in the orifice in partition 22 to its seat in partition 23. By this action pressure is maintained in cylinder space 24 in back of the face of piston 15 which will oppose the recoil motion and is bled from the space in front of piston 15, through line 25a to the orifice in partition 22 and then into the atmosphere through housing orifice 27, thereby causing retraction of the mechanism to the preset condition. The equilibrium pressure, supplied by the pressure means from source 25, is returned to the space in front of piston 15 through line 25a.

A second pressure means, again preferably air under pressure, is provided to chamber 17 at fluid source 28 through limiting orifice 29 and the pivot 30 of a Foxboro "Model 20" controller. The pressure supplied to chamber 17 by this means determines the clearance between feed rolls 2 and 3 and will affect the flexibility of diaphragm 6 and the extent of response upon passage of a knot or the like between the said rolls. Bleed orifice 31 is mechanically set, at knob 32, against indicating needle 33 so that pressure in chamber 17 tends to exhaust when the needle, which is pivoted to suspend over scale 34, moves away from the orifice.

A third pressure means, again preferably air under pressure, is provided to expandable pressure element 35, at fluid source 36 through variable limiting orifice 37 which is mechanically set at knob 38 and pressure regulating valve 39 which may be set mechanically by knob 40. Pressure element 35 has a fixed end 41 and a movable end 42 attached through mechanical linkage 43 to needle 33 thereby providing pivoted motion to the said needle over scale 34 when element 35 expands or contracts. Needle valve 44 of a Moore "V-Matic" pick-up cartridge permits bleed of pressure from element 35 into the atmosphere through orifice 45 when sensing probe 46, attached to shaft 9 permits valve 44 to unseat. Thus when shaft 9 moves, due to a knot or the like forcing increased clearance between feed rolls 2 and 3, probe 46 moves to permit valve 44 to open, thereby deflating element 35, which causes needle 33 to pivot away from bleed orifice 31, which in turn drops pressure suddenly in chamber 17. Resistance of diaphragm 6 to movement by spring 11 is thereby decreased, permitting rapid and exaggerated travel of valve 21. The rapid motion of valve 21 provides a sudden shift in pressure on the opposite faces of piston 15 from balanced to unbalanced, producing rapid retraction to the preset condition whereupon probe 46 closes valve 44 expanding element 35, pivoting needle 33 to close bleed 31 which in turn permits the predetermined pressure in chamber 17 to adjust the clearance between feed rolls 2 and 3 by flexing of diaphragm 6. The system thereby provides an exaggerated and facile response to an upset and equally rapid return to a preset condition.

In addition to the advantages discussed above, adjustment of the clearance between feed rolls 2 and 3 can be done by simple manipulation of knob 40 of regulating valve 39. This is important during operation since it has been found advantageous to employ a smaller clearance between rolls 2 and 3 during start up than during operation at high speed. By using conventional equipment to automatically control valve 39 in response to the speed of travel of tow 1, the need for special attention to roll clearance at start up, when machine instability imposes variable loads on the crimper roll, is avoided. This additional feature makes control of this critical setting completely automatic and avoids the frequent ad-

justments necessary during start up, as well as providing for control during continuous equilibrium operation.

The most important advantage of this invention has been seen in freedom from process discontinuity resulting from loss of control as a knot passes between the rolls. With conventional means, involving a constant, preset level of either spring-loading or pneumatic cylinder-loading, the jolt given the rolls as a knot passes through at high speed creates so large an excursion of the movable roll that purchase on the tow by the rolls is lost for a finite period of time. The crimping step generally follows drawing of the fiber to from three to six times its undrawn length, so that tow is in a stressed condition as it enters the crimper. Unless the required pull is maintained constantly, the large forces which tend to bring about fiber shrinkage cause instantaneous reversal of the direction of tow travel at the crimping rolls, withdrawal of crimped tow from the stuffing box and wrapping of the resulting slack on the preceding draw rolls. Substantial amounts of fiber are lost in restarting the machine and re-establishing equilibrium, continuous operation, and machine productivity is reduced. A more subtle, but important, secondary advantage has been seen in a substantial improvement of over-all average tow quality. The extreme precision and speed of the readjustments from excursions in clearance in the apparatus of the present invention leads to improved control even under those circumstances where a minor variation in rope thickness occurs.

With this equipment, it has been found possible to establish empirically an optimum clearance setting for each tow being produced which can be set precisely and conveniently at the beginning of processing of that particular tow. With equipment known to the art this setting has been done by trial and error, resulting in substantial loss of product and machine time.

While the apparatus of the present invention has been described in terms of a yarn forwarding device, it will be obvious to those skilled in the art that it is equally applicable for the forwarding or monitoring of other strand- or sheet-like structures such as wire, fabric or sheet metal. Although the function of the apparatus has been described in terms of valves which are completely open or closed, those skilled in the art will recognize that when employing pneumatic pressure it is often convenient to operate with a constant escape of air, the position of the valves determining the amount of air to be retained for the various conditions of the mechanism.

Many other modifications will be obvious to those skilled in the art from a reading of the above without a departure from the inventive concept.

What is claimed is:

1. A defect responsive device for use with a continuously traveling shaped structure comprising contact means adapted to bear against at least one face of the said structure, the said contact means being recoilably mounted; first pressure means to retract the said contact means upon recoil; a flexible diaphragm responsive to recoil of the said contact means; a second pressure means to vary the flexibility of the said diaphragm; first valve means, responsive to the flex of the said flexible diaphragm, to apply the first pressure means to retract the said contact means upon recoil; a second valve means, responsive to the recoil motion of the said contact means, to vary the second pressure means whereby flexibility of the said diaphragm is increased on recoil of the said contact means.

2. A defect responsive device for use with a traveling shaped structure of substantially uniform cross section comprising a pair of feed rolls, a flexible diaphragm, a shaft means, at least one of said pair of feed rolls being recoilably mounted to bear against said flexible diaphragm through said shaft means; a pressure retaining cylinder, in fixed relationship to the said flexible diaphragm, through the longitudinal axis of which the said shaft means is slide-

5

ably mounted; a piston in the said cylinder fixed to the said shaft; a first pressure means for the said cylinder; a pressure retaining chamber behind the said diaphragm and of which the said diaphragm forms one wall; a second pressure means for the said chamber; a valve stem attached normal to the said diaphragm within the said chamber and mounted to protrude sealably through the wall of the said chamber opposite to the said diaphragm; valve means, for said first pressure means, attached to the said valve stem, to provide in the said cylinder at one position, equal pressure to opposite faces of the said piston and at another position differential pressure to opposite faces of the said piston; an expandable pressure element; a third pressure means for the said pressure element; valve means for said second pressure means fixed to said expandable pressure element to provide a fixed pressure in the said chamber in

6

one position and a different pressure in said chamber in a second position; valve means for said third pressure means to provide one pressure to the said pressure element when the feed rolls are at a set clearance and a different pressure when the feed rolls are at a greater clearance.

3. The structure of claim 2 wherein the said feed rolls are the forwarding rolls of a stuffer box crimper and the said traveling shaped structure is a tow.

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15 DONALD W. PARKER, *Primary Examiner*.