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Goldfarb et al.

[11] **3,793,883**

[45] **Feb. 26, 1974**

[54] **YARN ENTANGLEMENT TESTER**

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[73] Assignee: **Rohm and Haas Company,** Philadelphia, Pa.

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[21] Appl. No.: **245,340**

[52] **U.S. Cl.** **73/160**

[51] **Int. Cl.** **G01n 33/36**

[58] **Field of Search** 73/160, 159

[56] **References Cited**

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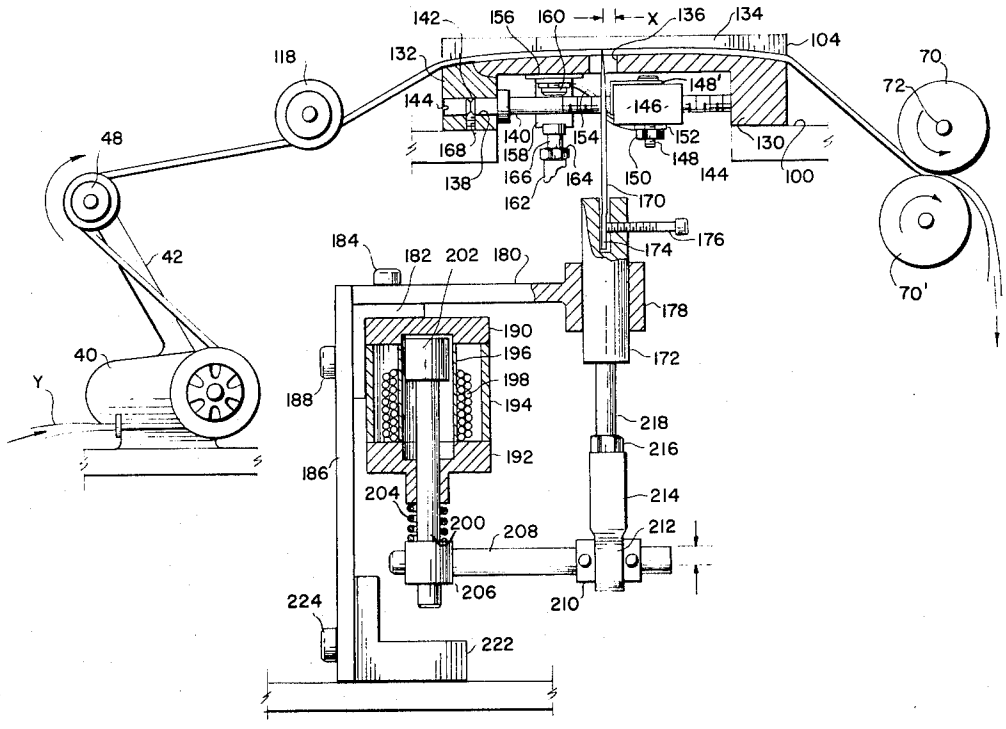
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Primary Examiner—Richard C. Queisser
Assistant Examiner—Denis E. Corr

[57] **ABSTRACT**

A yarn entanglement tester using a needle placed in intermingling obstruction of a traveling yarn. The intermingling of the filaments in the yarn is detected by the needle point penetrating the yarn and as the needle is deflected through engagement of an entanglement, it makes a contact closure completing a resistive circuit which in turn activates a solenoid coil to retract its core, which carries the needle, thus removing the needle from the yarn. Simultaneously, a count is made on a totalizing counter and once the circuit is opened by the needle being fully retracted, a spring action reinserts the needle into the fiber. The operational cycle of the detector is on the order of milliseconds. The tester is composed of two main units; a control display and testing assembly and a control unit assembly containing counting circuit control relays.

5 Claims, 5 Drawing Figures



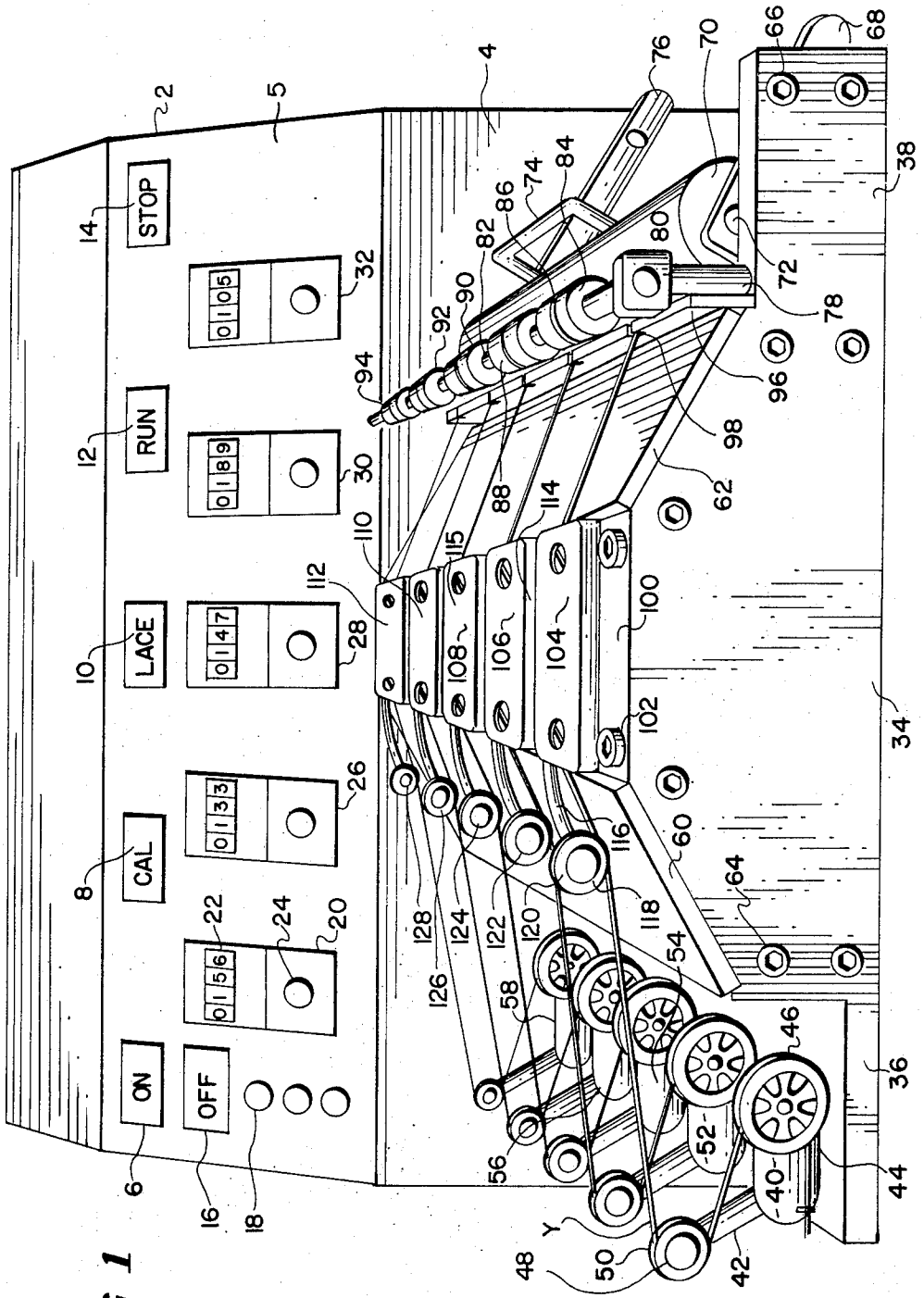

STOP
RUN
LACE
CAL
ON
OFF
0 1 0 5
0 1 8 9
0 1 4 7
0 1 3 3
0 1 5 6
2
4
5
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
66
68
70
72
74
76
78
80
82
84
86
88
90
92
94
96
98
100
102
104
106
108
110
112
114
115
116
118
120
122
124
126
128
Y

FIG 1

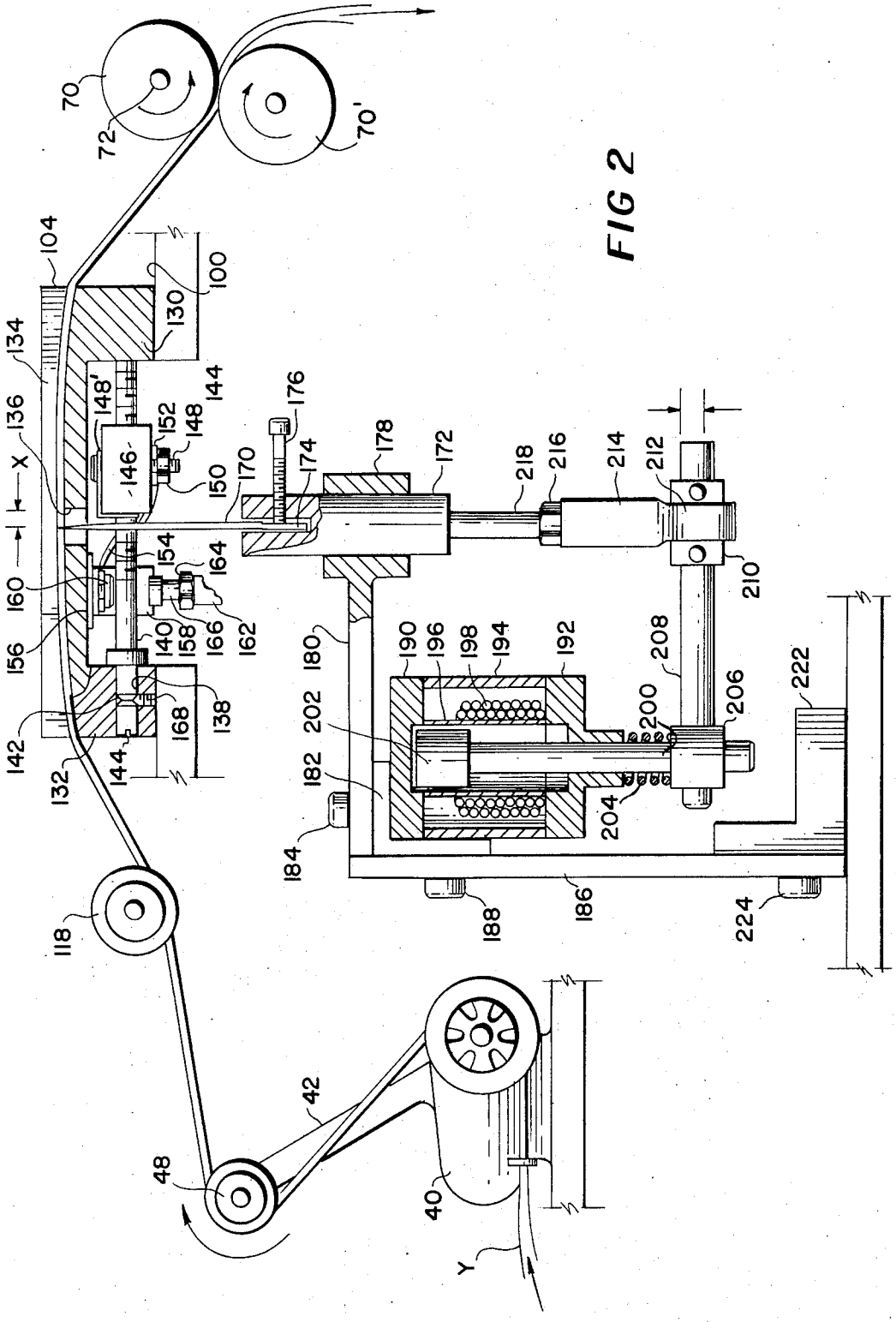

70
72
70'
104
100
130
134
148'
144
136
X
152
148
146
150
170
176
174
178
172
218
216
214
212
210
154
164
160
156
140
158
166
162
180
190
196
198
194
192
208
222
202
200
206
182
204
184
188
186
224
142
132
144
168
138
118
42
48
40
Y

FIG 2

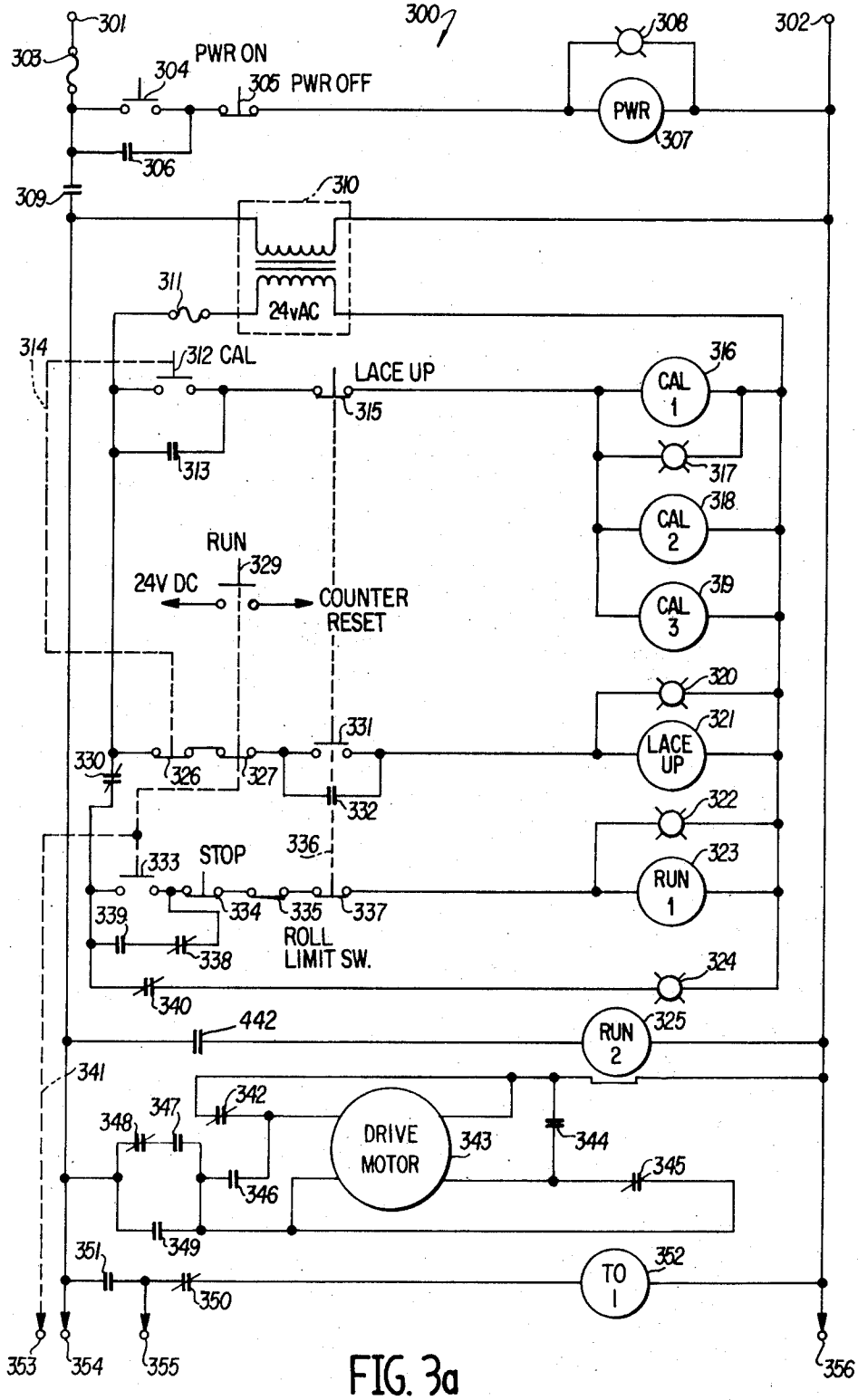

300
301
302
303
304
PWR ON
305
PWR OFF
306
307
PWR
308
309
310
24vAC
311
312 CAL
313
314
315
LACE UP
316
CAL 1
317
318
CAL 2
319
CAL 3
RUN
329
24V DC
COUNTER RESET
320
321
LACE UP
330
326
327
331
332
322
323
RUN 1
333
STOP
336
334
335
337
339
338
ROLL LIMIT SW.
340
324
442
RUN 2
325
341
342
347
348
DRIVE MOTOR
343
344
345
346
349
351
350
TO 1
352
353
354
355
356

FIG. 3a

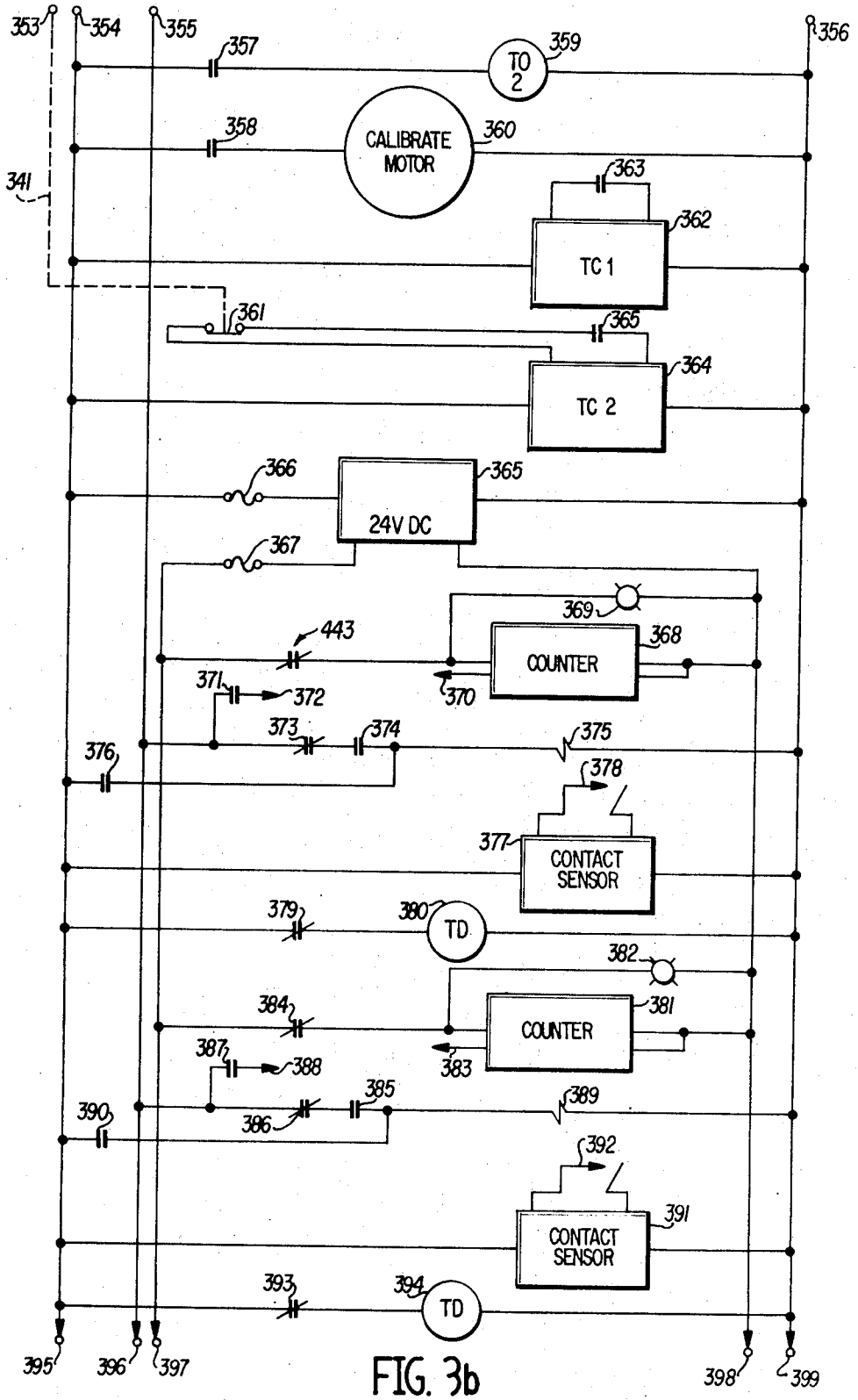

353
354
355
356
357
TO 2
359
358
CALIBRATE MOTOR
360
341
363
362
TC 1
361
365
364
TC 2
366
24V DC
365
367
369
443
COUNTER
368
371
372
370
373
374
375
376
378
377
CONTACT SENSOR
379
380
TD
382
384
COUNTER
381
387
388
383
385
389
390
386
392
391
CONTACT SENSOR
393
394
TD
395
396
397
398
399

FIG. 3b

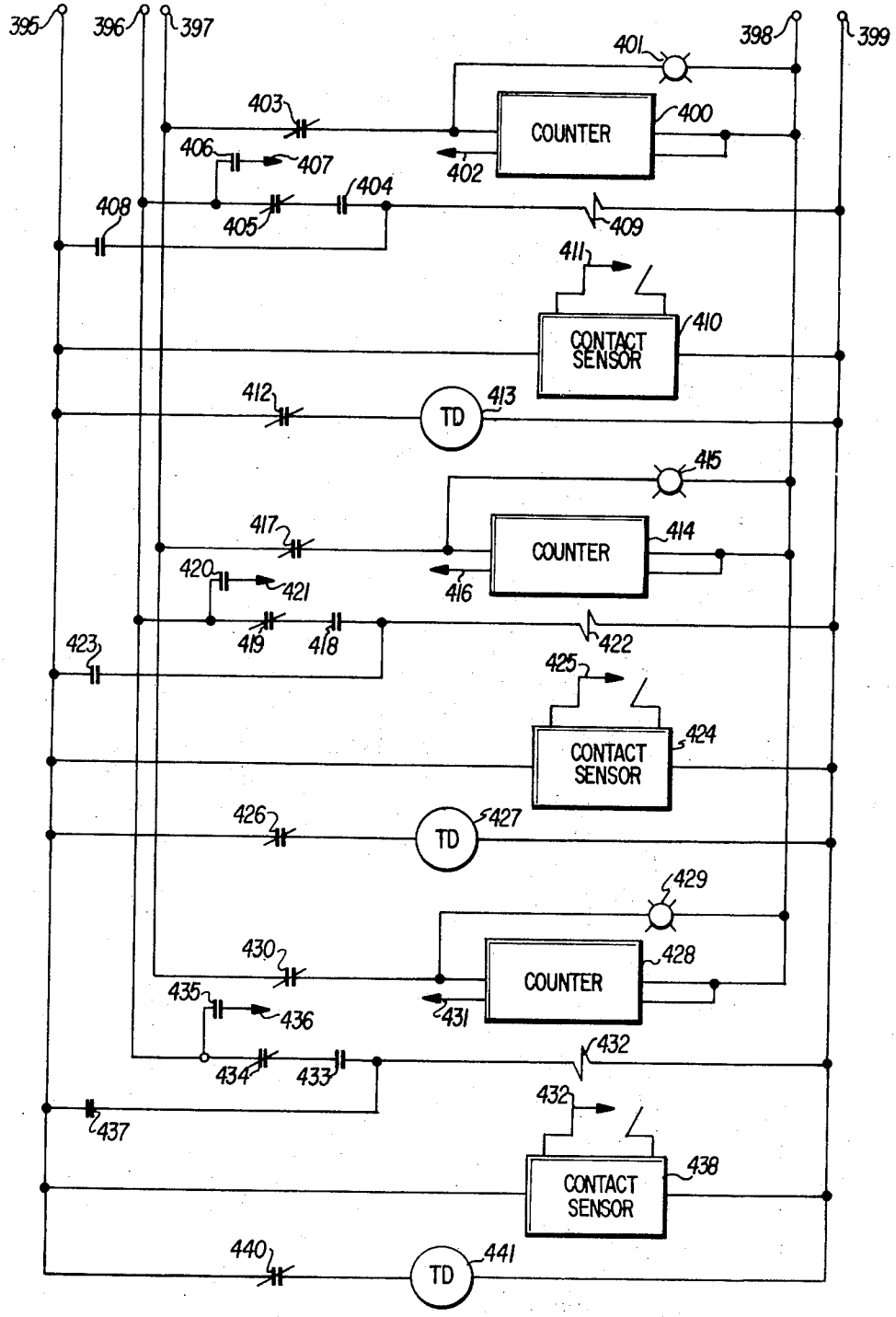

395
396
397
398
399
401
403
COUNTER
400
406
407
402
404
408
405
409
411
CONTACT SENSOR
410
412
TD
413
415
417
COUNTER
414
420
421
416
419
418
422
423
425
CONTACT SENSOR
424
426
TD
427
429
430
COUNTER
428
435
436
431
434
433
432
437
432
CONTACT SENSOR
438
440
TD
441

FIG. 3c

YARN ENTANGLEMENT TESTER

This invention relates to a yarn entanglement tester. Entangled yarn is where individual filaments and groups of filaments are randomly intermigled with adjacent filaments along the length of the yarn.

Prior evaluation procedures have been complicated and failed to give an accurate indication of the entanglement factor of a given yarn. A commonly used concept in the past has been to take 100 cm. length of yarn and vertically tension it with 100 gms., assuming that the total yarn denier is greater than 500. A hook weighing 10 gms. is usually inserted into the yarn and descends at the rate of 1 to 2 centimeters per second until the hook is supported by the yarn. The hook traverse is measured and recorded. Approximately one hundred determinations are made for each yarn sample. The highest and lowest twenty percent of the data is discarded and the remainder are averaged. The average hook drop distance is divided into hundredths to yield a "coherency" factor, the absolute value of which is the index of the degree of entanglement. In some cases, it has been preferable to simply report the hook drop distance which is in inverse proportion to the degree of entanglement.

Existing instruments adaptable to this procedure use a crosshead which provides a convenient vehicle to lower a hook at 1 to 2 centimeters per second. This instrument usually can accommodate approximately 10 yarns per crosshead descent.

The problems of the existing manual and machine procedures are many. Initially they require a considerable amount of operator time and also involve considerable judgement in making determinations. In other words, they have to make an estimation up to one millimeter of a meter stick. Furthermore, the prior procedures required considerable replication and involved considerable operator variation.

The instant yarn tester obviates all of the foregoing disadvantages and problems. It measures a minimum of 10 times the number of entanglements previously measured, thereby vastly improving accuracy and also reducing analysis costs since the measurement is made in one-tenth of the time.

The intermingling of the filaments in the yarn is detected by a needlepoint penetrating the yarn in the instant invention. As the needle is deflected through engagement of an intermingling obstruction, it makes a contact closure completing a resistive circuit. This momentarily deactivates a solenoid which in turn permits a spring to retract the core carrying the needle point, thus removing the needle point from the fiber. Simultaneously, a count is made on a totalizing counter. once the circuit is opened by the needle being fully retracted, the solenoid is activated to reinsert the needle into the fiber. The operational cycle of the detector is in the order of milliseconds. This frequency is capable of detecting the entanglements on samples of yarn representing the highest level of filament intermingling. The needle is designed to be calibrated to make contact when the force of the obstruction is ten grams or if it is desired, some lesser or greater value.

A timing circuit automatically controls the duration of the test period and also controls the drive and counting systems. The yarn is designed to move past the needle at a constant velocity of 1 centimeter per second with a regulated tension on the yarn of 100 grams.

The instant system tests five strands of yarn simultaneously. The tester can be loaded from a cart containing a number of bobbins and fed past a detector and through nib rolls into a receiving container. The fiber is constrained in a groove while passing the detector area and the nib rolls pull the fiber at a constant rate.

Activation of the system starts the movement of the fiber and the delay timer. Once the delay time has passed, the test timer commences and the count accumulates. At the conclusion of the times test period, which is adjustable, the system is stopped and the needle locked in a position free from the path of fiber travel. The operator then records the number of entanglements recorded from each strand of yarn, cuts the strand and prepares for the next series of tests.

Accordingly, it is an object of this invention to provide a yarn entanglement tester which overcomes all of the above described disadvantages and operates in a highly efficient and fast manner. It is a further object of this invention to provide a yarn entanglement tester whereby a solenoid actuated needle point is inserted into traveling yarn for a given period of time. A further object of this invention is to provide a yarn entanglement tester using counter circuits and relay circuits to insert a needle into a traveling length of yarn and to retract it for a given time period upon it encountering an obstruction within the yarn.

It is a further object of this invention to provide an automatic yarn entanglement tester which enables an operator to test approximately ten times the present capacity of the above manual and automatic methods.

A still further object of this invention is to provide a yarn entanglement tester which can handle from 800 denier yarns to 4,000 denier yarns.

These and other objects of the invention will become apparent in the accompanying specification when taken with relation to the accompanying drawings in which:

FIG. 1 is a perspective view of the overall machines showing the control display panel and the detection apparatus;

FIG. 2 is a diagrammatic view of the yarn attesting groove, the adjustment mechanism, and the needle insertion retraction assembly;

FIGS. 3*a*, 3*b* and 3*c* comprise an electrical schematic of the various relays and operative components of the control system.

Referring now to FIG. 1, the apparatus is shown generally designated as 2. It consists of a front vertical panel 4 and a display panel 5. Display panel 5 is a series of operational buttons, namely the "ON" button 6, the calibration or "CAL" button 8, the "LACE" button 10, the "RUN" button 12, the "STOP" button 14, and the "OFF" button 16. A series of counters are located on the display panel and are indicated as 20, 26, 28, 30 and 32. Each counter has an indicator light such as 24 and a mechanical counter such as 22. Located under the "OFF" button are a series of fuses such as 18.

A main base portion 34 extends from panel 4 outwardly therefrom and has a bracket 38 on one side and a planar surface member 36 on the other side thereof. A series of pretensioners such as 40, 52, 54, 56 and 58 are located on planar portion 36. The pretensioners control tension discs, such as 46 and have a tension arm such as 42 thereon supporting tension arm pulleys such as 48. Tension arm pulley 48 has a groove 50 therein

and tension disc **44** has a groove **46** therein through which the yarn may be fed. A disc tensioner eyelet is provided as at **44'** through which the yarn is initially fed. The yarn is designated generally as Y and after being fed around disc **44** and pulley **48**, is fed around idler pulley **118** having groove **120** therein and supported by arm **116**. Each strand of yarn (there are five shown in FIG. 1) is fed through detector heads such as **104, 106, 108, 110** and **112** located atop a flat portion **100** of member **34**. Machine screws such as **102** secure the detector heads to portion **34**. Each detector head has a groove such as **114** located therein which is generally called the yarn groove. A guide member **96** is provided atop section **38** and has a series of notches such as **98** therein through which each individual yarn is fed. A post **78** supports a journal **80** which, in turn, supports one end of a calibration shaft **82** having a series of calibration collars such as **84, 88, 90, 92** and **94** thereon. Each collar has a groove such as **86** located on collar **84**.

A pair of nip rolls such as **70** are provided adjacent the calibration shaft. The other roller is not shown in FIG. **1**. Roller **70** is downwardly biased by a spring (not shown) acting on level arms **68** and **76**. A handle **74** is attached to a portion of the frame (not shown) and enables the user or operator to pull nip roll **70** of a similar underlying roll with which it is in contact. Machine screws such as **66** secure the arms **68** and **76** to the general framework of the apparatus.

Referring now to FIG. **2**, there is shown a schematic diagram of the needle guide assembly, the solenoid assembly, and the adjustment assembly. The yarn, designated as Y, is fed over disc **40**, over pulley **48**, and pulley **118** into the yarn groove **114**. Yarn groove **114** has a side wall **134** and it has a generally convex configuration. Detector head **104** has depending portions **130,132** which rest atop portion **100** of member **34**. A slot **136** is located on the upper convex surface of yarn groove **114**. In FIG. **2**, the second nip roll is shown as **70'**, the first nip roll is shown supported by a shaft **72**. Portion **138** has a bore therein which receives the end of an adjustment shaft **140** having a threaded portion **144** and a reduced diameter portion **142**. A pointed adjustment screw **168** is mounted in portion **132** and locks into reduced diameter portion **142** to maintain shaft **140** in one longitudinal position. Provision is made for turning the shaft, as by slot **144**, in the end thereof.

A plastic block **146** is mounted for transverse movement on threaded portion **144** of shaft **140**. Block **146** is plastic and extends inwardly and has another bore receiving a smooth shaft (not shown) which extends between portions **130** and **132** of detector head **104**. A bolt **148** secures an L-shaped contact member **148'** and a lead terminal **152** to block **146**. It should be noted at this time that block **146** is naturally insulated. A wire **154** extends from terminal **152** and is connected by a screw **160** to the plate member **156**. Plate member **156** has a depending flange portion **158** which is biased against the top of adjustment screw **166** held in position by a lock nut **164** on member **162**. Thus, with the use of biased flange **158**, the detector head may be totally removed from the top portion **100** of member **34** without the necessity of unfastening any leads or connections.

Adapted to extend upwardly through slot **36** and head **104** is needle **170** which is held in a needle holder assembly **172** which has a slot **174** in an adjustment screw **176** which securely fastens the needle there within. Assembly **172** is mounted within a guide bushing assembly **178** supported by a bracket member **180**. Assembly **172** is mounted within car **178** for vertical sliding movement.

Bracket **180** is supported on angle bracket **182** by machine screw **184** and is thus connected to support member **186** which in turn is held to angle bracket **182** by machine screw **188**. Bracket **186** is supported on a base member **222** by machine screw **224**. Angle bracket **182** supports a solenoid assembly **190** having a lower base portion **192**, a cylindrical collar wall **192** and an inner collar wall **196**. Located within the cylindrical chamber defined by wall **196** is a solenoid member **202** having a solenoid rod **200**. Member **202** is normally biased downwardly by spring member **204** as shown in FIG. **2**. Activation of solenoid **198** causes member **202** to move upwardly, as shown in FIG. **2**, and rod **200** through coupling **206** moves upwardly as shown in FIG. **2**, and rod **200** through coupling **206** moves perpendicularly to rod **208** upwardly therefrom.

A rod **218** extends down from assembly **172** to a yoke member **214**. An adjustment nut **216** secures the rod in place and the distance between assembly **172** and yoke **214** may be adjusted by loosening nut **216** and adjusting rod **218**. Yoke **214** is secured to cross member **208** by a collar **210** and travels downwardly therewith.

Referring now to FIGS. **3***a*, *b* and *c*, there is shown the electrical schematic of the control system designated generally as **300**. A 115-volt AC source is connected across terminals **301** and **302**. To activate the system, the power "ON" switch **304** is depressed which activates power relay **307** to close power contacts **306** and **309**. Light **308** also is lit to indicate the power is on. To turn the system off, the power "OFF" switch **305** is depressed which will deactivate relay **307** and its associate contacts. The overall system runs on AC power from the initial inputs of **301** and **302** and from the transformer **310**. The counters **368, 381, 400, 414** and **428** are supplied power through a DC rectifier **365**.

To calibrate the system, calibration button **312** is momentarily depressed. This activates calibration relays **316, 318** and **319** and ignites lamp **317**. Calibration relay **316** closes contacts **376, 390** and **408** to activate solenoids **375, 389** and **409** respectively. Calibration relay **318** closes contacts **423** and **437** to solenoids **422** and **432**, respectively. Relay **318** opens normally closed contacts **330** to remove the power from the run relay **323**, and also closes contact **313** to keep the power to the calibration relays after the calibration switch has been released. Calibration relay **319** opens normally closed contact **350** to prevent time-out relay **352** from being activated and also closes contacts **358** to apply power to calibration motor **360**. As will be explained later in the general functioning of the machine, the activated solenoids will insert the needle into the upright position and apply a given weight thereto for proper calibration of the indicating system. As long as the power is on, the contact sensors **377, 391, 410, 424** and **438** are activated as well as counters **368, 381, 400, 414** and **428**. These counters and sensors are used during the calibration process. It should be noted that switch **312** is ganged by **314** to switch **326** in the lace-up relay **321** power line.

After calibration, the lace-up button is depressed which opens ganged contact **315**, closes contact **331** and opens contact **337**. The opening of contact **315** deactivates the calibration relays **316, 318, 319** and extinguishes light **317**. The opening of contact **337** prevents the application of power to run relay **323**. The closing of contact **331** initiates lace-up relay **321** and ignites light **320**. The activation of lace-up relay **321** closes contacts **332** to hold power thereto after the lace button is released.

The next operation is depressing the "RUN" button which closes the ganged contacts **329**, opens contact **327**, closes contact **333** and opens contact **361**. Contact **329** connects the 24-volt DC source with the reset inputs **370, 383, 402, 416** and **431** of counters **368, 381, 400, 414** and **428** respectively. Contact **327** deactivates lace-up relay **321**. Contact **333** applies power to run relay **323** and contact **361** resets timing circuit **364**. Run relay **323** closes contacts **339** to keep power thereto upon the opening of contacts **333**. Run relay **323** opens normally closed switch **340** to ignite stop-light **324** which has been ignited through the calibration and the lace-up. Run relay **325** is activated by the closing of contacts **442** by run relay **323**. The run relays and their contacts will be opened or reset by the depression of stop button **334** or the opening of contacts **335** by the roll limit sensor. Also at the end of a **200** second cycle, timing circuit **365** will open normally closed contacts **338** to stop the run.

Run relay **325** controls the forward direction of nip roller drive motor **343**. Upon activation of run relay **325**, normally closed contacts **342** and **345** are open and contacts **344, 346** and **349** are closed. Thus, current will flow from power terminal **302** through closed contacts **344** to the lower right-hand corner of the drive motor, down through closed contacts **356** and **349** to the other power terminal **301**.

Run relay **323** also closes contact **363** which initiates timing circuit **362**. This timing circuit allows a **30** second time delay for the machinery to obtain its dynamic equilibrium before starting the sensing process. After 30 seconds, timing circuit **362** closes contact **365** of timing circuit **364** and contacts **351** to apply power down the line defined by points **355** and **396**. It should be noted that **250** milliseconds after the power switch **304** was depressed, time delay relays **380, 394, 413, 427** and **441** close contacts **374, 385, 404, 418** and **433** in solenoid power circuits **375, 389, 409, 422** and **432** respectively. Thus when timing circuit **362** closes contacts **351**, solenoids **375, 389, 409, 422** and **432** are activated. **200** seconds after the closing of contacts **265**, timing circuit **364** opens normally closed contacts **338** to cut the power to run relay **323** which in turn cuts the power to run relay **325**.

Upon deactivation of run relay **323**, contacts **363** are opened and timing circuit **362** is deactivated. This opens contacts **351** which deactivates the solenoids and retracts the needles. While contacts **351** were closed, time-out relay **352** was activated which closed switch **357** to a second time-out relay **359** and opened normally closed contacts **348** in the drive motor **343**'s power circuit. The second time-out relay **359**, when activated, closes contacts **347** also in the drive motor **343**'s power circuit. Two seconds after the opening of contacts **351**, the first time-out relay **352** closes normally closed contacts **348** and opens contacts **357**. This allows nip roll drive motor **343** to reverse for the time of seven seconds which is determined by the second time-out relay **359**. The reverse power circuit can be traced from power terminal **302** through now normally closed contacts **342** to the upper left side of the motor going through motor, coming out through now normally closed contacts **345** on the lower right-hand side and going through the closed circuit of closed contacts **347** and **348** to the other power terminal **301**. The contacts **342, 344, 345** and **346** are in the state shown since run relay **325** is deactivated. In the 7 seconds after the opening of contact **357**, time-out relay **359** is deactivated, opening switch **347** and shutting down the motor.

Of the five sensor circuits shown in FIGS. **3***b* and **3***c*, only one's function will be disclosed. As indicated earlier, after the initial 30 seconds, contact **351** is closed applying power down **355** to normally closed contacts **373** and now closed contacts **374** to solenoid **375**. When the needle detects a snag, contacts **378** are closed to activate contact sensor relay **377**. Contact sensor relay **377** opens switch **373** to deactivate the solenoid and retract the needle and closes contact **371** which sends current through **372** to an event recorder. Relay **377** also opens relay **380**. When time delay relay **380** is deactivated, contacts **443** assume their normally closed position to send a pulse to the counter and contacts **374** are opened to cut off the power to solenoid **375** and thus hold the needle retracted. When the needle is retracted, contacts **378** are opened, thus deactivating contact sensor relay **377**. When contact sensor relay **377** is deactivated, contacts **373** and **397** assume their normally closed position. After **250** milliseconds, time delay relay **380** closes contacts **374** to reactivate solenoid **375** again.

The general operation of the electrical system is commenced by pressing the "ON" button. It lights and the five indicator lights accompanying each counter **20, 22, 28, 30** and **32** will momentarily light. The "STOP" button will also light. It is understood that each of the main control buttons has a light therein but it is not shown for purposes of clarity. The "CAL" button is then pressed and lights. The needle **170** then appears in slot **136** and yarn groove **114** and calibration shaft **192** will commence to rotate. The "LACE" button is then depressed causing the light to go off in the "CAL" button and the needle **170** will retract and shaft **92** will stop rotating. At this point, the nip roll **70** is closed atop nip roll **70'** and the "RUN" button is depressed, causing all the counters to reset to zero. The light will go off in the "LACE" and "STOP" buttons and the driven nip roll will start to rotate. After approximately 30 seconds, the needle points will again appear in the slot **136** through the action of timing circuit **362**.

Depressing the "STOP" button will cause it to light and the light to go off in the "RUN" button and again the needle **170** will retract and the nip rolls **70** and **70'** will stop rotating. Time-out relay **352** causes a two second delay whereupon the rolls **70** and **70'** will rotate in the reverse direction for 7 seconds under the control of relay **359**. Pressing the "RUN" button after the 30 second delay period has passed allows one to open the nip rolls. Needle **170** will retract and the nip rolls **70** and **70'** will stop. At this point, the "OFF" button should be pressed.

Operation of the tester is controlled from the master control display panel **5** by the lighted push buttons **6, 8, 10, 12, 14** and **16** with the sequence operations con-

forming to left to right orientation as viewed in FIG. 1. The counters 20, 26, 28, 30 and 32 display the sum of the number of yarn entanglements while the indicators below, such as 24, light simultaneously as each entanglement is counted. Each counter can be matched by color to a corresponding detector head, for instance, yellow or green, etc.

Yarn is drawn through the detector heads by the constant speed nip rolls 70 and 70' at the rate of 1 centimeter per second. Uniform tension of the yarn is constantly maintained at 100 grams by the pretensioners, such as 40, on the feed side of the machine. An entanglement is counted when it is strong enough to force needle 170 against contact 148' under detector head 104 and to thereby complete an electrically safe, resistive circuit. The force required to make such a contact is set and calibrated at 10 grams by adjusting the gap between needle 170 and the contact 148'. Timing of the length of the test for a 2 meter sample of yarn is maintained by automatically stopping the nip roll 70 and 70' at the completion of a 200 second-period from the beginning of the test period, this being determined by time circuit 364. The proper yarn tension and yarn rate of feed is obtained during the automatically controlled 30 second free test period as determined by time circuit 362. Interactions between entanglements are minimized and controlled by a regulated time delay relay set at 250 milliseconds delay from the time the initial contact is made until the needle is again in position to engage another entanglement, this being accomplished by counter delay 380. Thus, an entanglement will not be counted unless it is more than one twenty-fifth millimeter from the previously counted entanglement. At the conclusion of the controlled test period, the nip rolls 70 and 70' are automatically reversed for seven seconds by relay 358 to remove the tension on the yarn, thus protecting needles 170 and tensioner 40 from accidental damage and/or unobserved shifts in calibration. Nip rolls 70 and 70'' are also constructed with an interlock (not shown) that safely stops the machine and prevents damage to needle 170, the rolls are opened during a test run.

Operation for the yarn test on the machine consists primarily of lacing the yarn through the tester, running the test, recording the data, and preparing the next test. The total testing time for five simultaneous determinations can be less than 10 minutes.

A yarn entanglement is detected when it forces the needle 170 against contact 148' located under detector head 104. The force required to make this contact is set at 10 grams. This calibration is very critical. The contact is adjusted for the correct gap in force by rotating shaft 140, by inserting for example, a screw driver in slot 144. Clockwise adjustment of the screw portion 144' makes contact; counterclockwise adjustment breaks contact. When the adjustment is made, all the indicator lights at each counter position of the control display panel should be off. It they are not, the shaft 140 should be turned counterclockwise until the corresponding light does go off. The screw is then adjusted clockwise until the corresponding light on the control panel 5 for that detector position just turns on The screw direction is reversed just enough to turn the light off. Again the screw is turned clockwise until the corresponding light flickers, thus completing the calibration for that channel. These adjustments are made by placing a string with a weight suspended to the nip roll side into the groove 114, groove 86 of rotating collar 84 opposite the corresponding detector head 104.

The disc tensioners, such as 40, are set and calibrated to maintain 100 grams tension on the yarn as it is pulled by nip rolls 70 and 70'. The position of the tensioning arm pulley 48 can be adjusted by a mechanism not shown.

When a test is to be made, the nip rollers 70 and 70' are opened by pulling up on handle 74 and the "LACE" button should light up when depressed. The yarn from one bobbin, the creel, is then taken and the end lead is pushed through the disc tensioner eyelet 44' and around the tensioning disc 44 and under and over the tension arm pulley 48. The yarn is then placed into the groove of the detector head, which may have a Plexiglas cover thereon and then under the guide pulley immediately before the detector head, such as pulley 118. The yarn is then passed between the open nib rolls 70 and 70' and positioned in the appropriate notch, such as 98. At that point, the nip rolls are closed and the "RUN" button is pressed which causes the counters to reset to zero.

The machine will run for 30 seconds, as determined by relay 352, before the actual testing begins. This is to enable the operator to observe and make sure that all yarns are in the appropriate guides, rollers and grooves of each testing channel. It also insures that there will be no sagging filaments, particularly around the pretensioning areas and that the yarns fall freely off the nip rolls 70 and 70'. At the conclusion of the 30 second period, the test will run for 200 seconds. After a momentary delay at the conclusion of the test, the nip rolls will reverse for approximately seven seconds as determined by relay 358 to remove the tension from the yarn.

At the conclusion of each run the data on the counters is recorded, the "LACE" button is depressed and the nip rolls opened. The yarns in the machine at that time are cut before the tensioner eyelets 44' and the yarn is pulled through the machine until the ends have cleared the nip rolls 70 and 70'.

With the instant machine, 50 bobbins per hour can be evaluated. Based on a texturing output of one doff/hour/texturing machine, this unit has the potential to provide 100 percent bobbin evaluation of 50 texturing machines.

The unit requires only one test operator. Virtually no operator variability can be introduced due to the automatic nature of the instrument. Yarn may be fed to the unit directly from packages mounted on a portable buggy. A small amount of twist introduced by pulling the yarn over the end of the package may be neglected.

The machine determines the rate of entanglement in five samples simultaneously and standardizes these determinations by eliminating from the operator's control all variables that have an effect on the test results. This is accomplished in part by automatic regulation of the rate at which the yarn is fed through the instrument; an automatic pretesting period in which dynamic equilibrium is attained prior to entanglement counting; and an automatically controlled test period to provide accurate and precise lengths of samples.

While only one embodiment of this machine has been shown and described, it will be obvious to those of ordinary skill in the art that many modifications and changes can be made without departing from the scope of the appended claims.

What is claimed is:

1. A yarn entanglement detection apparatus comprising a support means, at least one yarn pretensioning means on said support means, roller means to pull yarn from said yarn pretensioning means, a detection head assembly, said assembly having a groove means through which yarn is adapted to be pulled and a needle means adapted to be selectively placed in said groove and in a retracted position, motor means to turn said roller means, a counter, and electrical circuit means associated with said needle means so as to control the position thereof, and said counter adapted to register each time said needle encounters an intermingling obstruction in a length of yarn being pulled through said apparatus, wherein said circuit means includes a first counter time delay means to retract said needle from said groove for a first small predetermined increment of time after each obstruction is encountered, said delay means cooperating with said circuit means to replace said needle in said groove after said first predetermined increment of time has expired and said circuit means also includes a second time delay relay means to maintain said needle in retracted position for a second predetermined interval of time after said roller means are activated and to then place said needle in said groove for a predetermined third interval of time.

2. An apparatus as in claim 1 wherein said circuit means also includes a third time delay relay means adapted to stop said roller means for a fourth predetermined interval of time after said third interval of time has expired and then to reverse the direction of rotation of said roller means for a fifth predetermined interval of time to allow said yarn to slacken.

3. An apparatus as in claim 2 wherein said first interval of time is about 250 milliseconds, said second interval of time is approximately 30 seconds, said third interval of time is approximately 200 seconds, said fourth interval of time is 2 seconds and said fifth interval of time is 7 seconds.

4. A yarn entanglement detection apparatus comprising a support means, at least one yarn pretensioning means on said support means, roller means to pull yarn from said yarn pretensioning means, a detection head assembly, said assembly having a groove means through which yarn is adapted to be pulled and a needle means adapted to be selectively placed in said groove and in a retracted position, motor means to turn said roller means, a counter, and electrical circuit means associated with said needle means so as to control the position thereof, and said counter adapted to register each time said needle encounters an intermingling obstruction in a length of yarn being pulled through said apparatus, said circuit means includes a laterally adjustable contact member spaced from said needle, said circuit means being operatively associated with said contact member and said needle means so that when said apparatus is activated and an entanglement forces said needle to engage said contact, it will register on said counter and said groove means includes an adjustment screw mounted thereunder, said contact member being mounted for movement toward and away from said needle upon rotation of said screw whereby the amount of force required to force said needle to engage said contact member is selectively adjustable by varying the distance therebetween.

5. An apparatus as in claim 4 and also including a shaft mounted on said support means having at least one collar with a groove therein, means to rotate said shaft whereby the test yarns with weights on one end thereof may be fixed at the opposite end, run through said groove means and over said collar in said groove to calibrate the amount of force needed to push said needle means against said contact member.

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