

Jan. 17, 1967

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3,298,401

THREAD CONTROLLER FOR TEXTILE MACHINES

Filed July 17, 1962

6 Sheets-Sheet 1

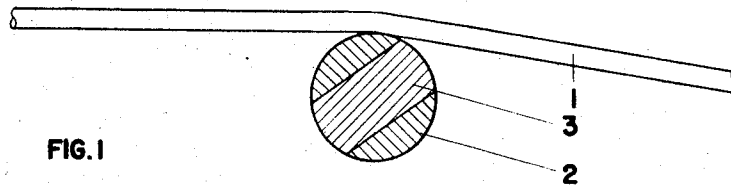


FIG. 1

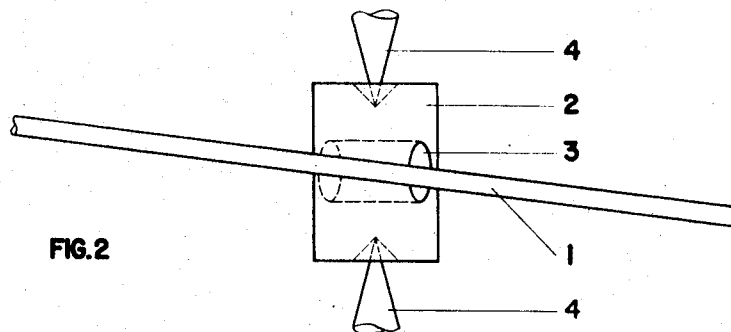


FIG. 2

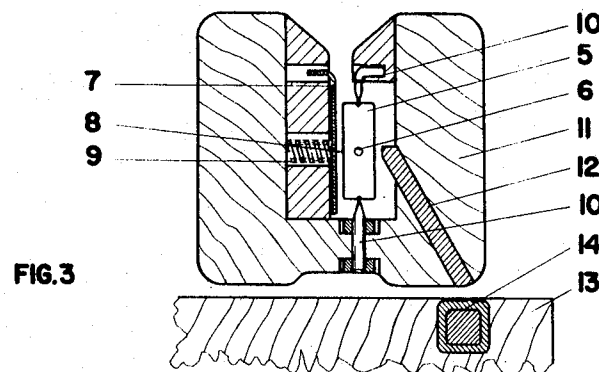


FIG. 3

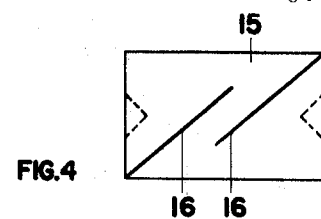


FIG. 4

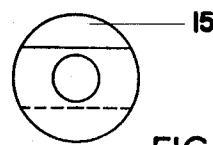


FIG. 4A

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Jan. 17, 1967

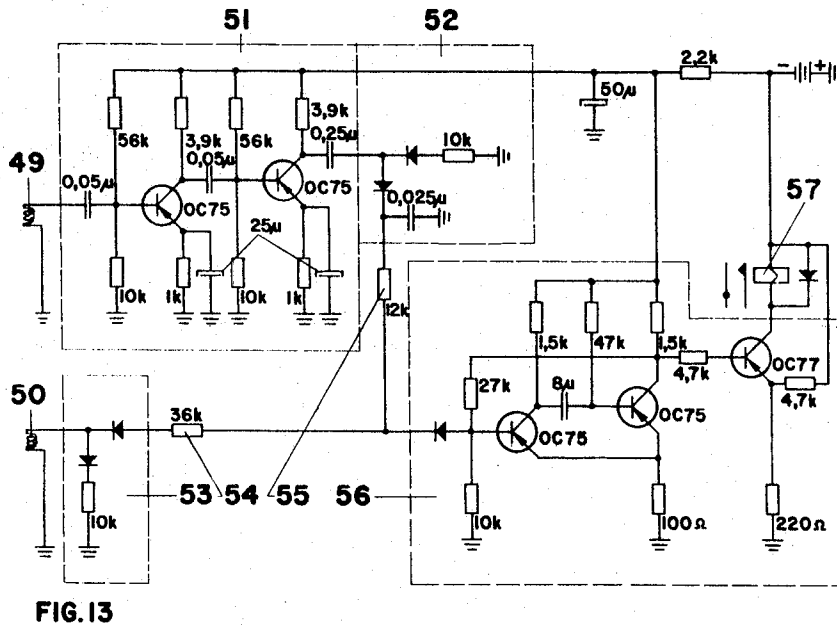
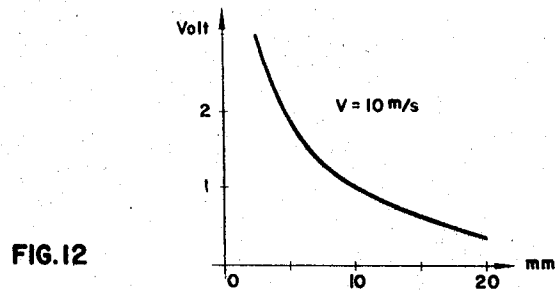
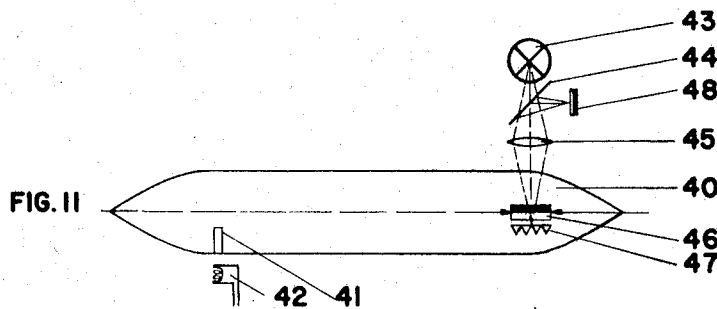
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3,298,401

THREAD CONTROLLER FOR TEXTILE MACHINES

Filed July 17, 1962

6 Sheets-Sheet 3



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3,298,401

THREAD CONTROLLER FOR TEXTILE MACHINES

Filed July 17, 1962

6 Sheets-Sheet 4

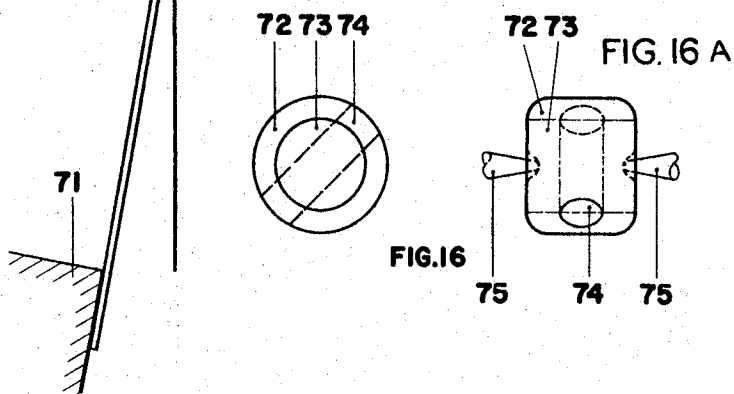
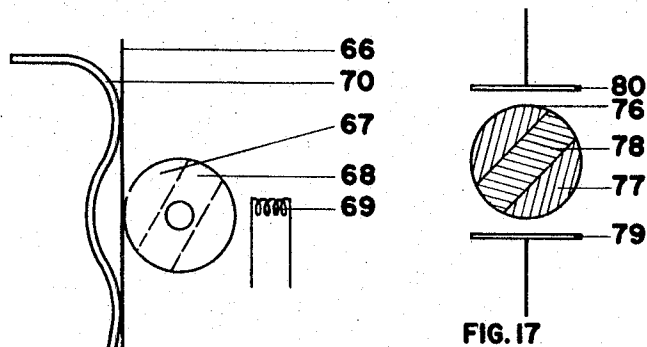
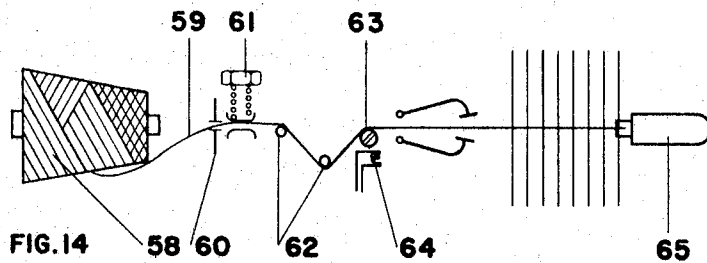


FIG. 15

FIG. 16

FIG. 16 A

FIG. 17

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Jan. 17, 1967

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3,298,401

THREAD CONTROLLER FOR TEXTILE MACHINES

Filed July 17, 1962

6 Sheets-Sheet 5

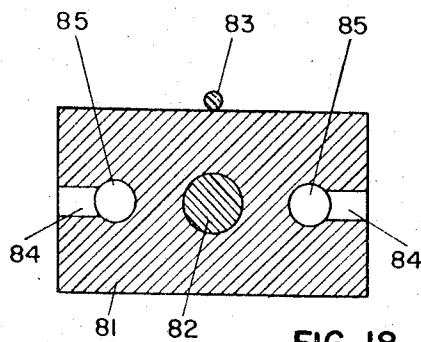


FIG. 18

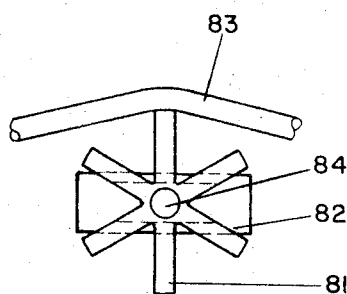


FIG. 18 A

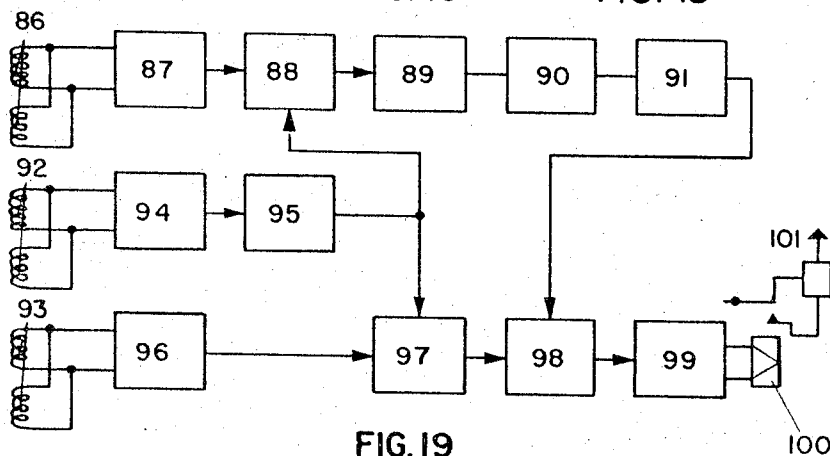


FIG. 19

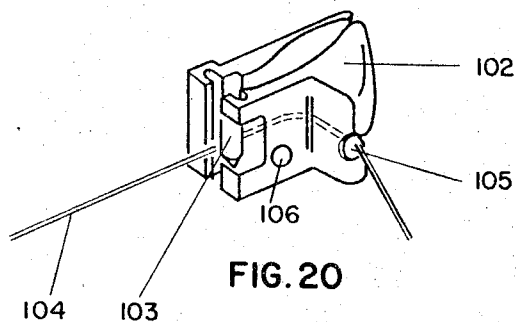


FIG. 20

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3,298,401

THREAD CONTROLLER FOR TEXTILE MACHINES

Filed July 17, 1962

6 Sheets-Sheet 6

Fig. 21

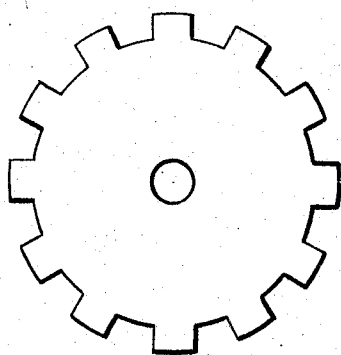


Fig. 23

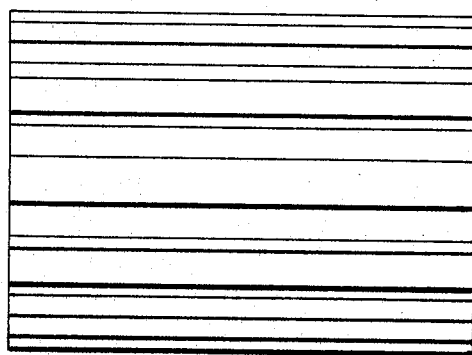
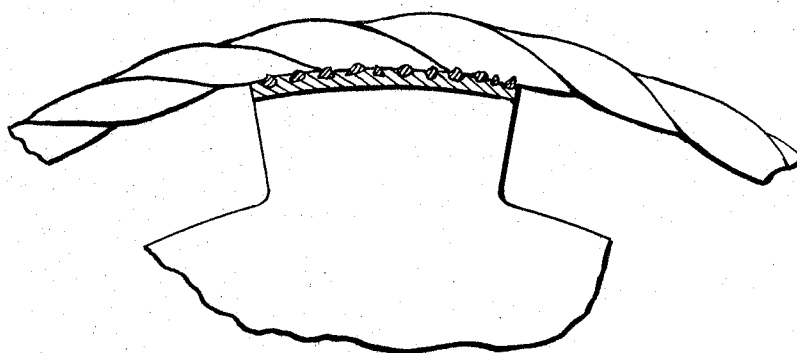


Fig. 22



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1

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THREAD CONTROLLER FOR TEXTILE MACHINES
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Claims priority, application Switzerland, July 20, 1961, 8,554/61

11 Claims. (Cl. 139—371)

This invention relates to a thread controller for textile machines, which examines each individual running thread and which produces a signal when a thread is broken or loose, whereby the signal is used for actuating an indicating or switching device of the textile machine in question.

In looms and weaving machines the weft thread is examined after or at the time of its insertion, and when the thread is broken or loose, or when there is no thread at all, the thread controller supplies a signal which stops the loom. In winding frames, multiple spooling machines, shearing machines and warp machines, each thread is conducted individually over a thread controlling device which actuates an indicating lamp when the thread is broken or loose, and which stops either the entire machine or only the affected spooling section.

In prior art the following control devices were used for looms:

A testing fork was pressed against the weft thread lying upon the warp thread directly after the passage of the shuttle. If there is no weft thread, or if it is broken or loose, the testing fork will drop through the warp thread. On the other hand, if the weft thread is intact, it will prevent the fork from dropping. This construction has the drawback that when there are only a few warp threads, the weft thread can be pushed through them. If, however, the controller is so set that it is extremely sensitive and that it will not push the weft thread through the few warp threads, then the controller will not respond when the weft thread is broken while an end thereof is still located under the fork. Similar difficulties arise when thick and thin weft material is used simultaneously.

Other known devices utilize thread tension to operate a flap built into the shuttle and used to close an electrical contact or to interrupt a light ray. These devices do not operate when the weft thread is broken but when there is still a lengthy piece of thread which is being pulled along, so that there is still a comparatively high thread tension in the shuttle.

Yet another prior art device controls the transverse movement of the thread directly at the edge of the fabric while the shuttle leaves the shed. When the weft thread is intact, it will move at a predetermined distance from the path of the batten in the direction of the edge of the fabric. If the weft thread is broken, however, it will be attracted to the shuttle and will move on the level of the shuttle without being spaced therefrom. This movement of the thread is examined photoelectrically and is used to stop the loom whenever the thread is broken. A device of this type has the drawback that it is not easily possible to supervise the thread within the fabric. This makes it difficult to stop the loom since only very little time is available from the moment the examination takes place to the next shot of the shuttle. Furthermore, two examining heads are necessary, one to the left of the fabric and one to the right of the fabric, and the setting of the device is quite difficult.

Winding frames, multiple spooling machines, shearing machines and warp machines use up to now drop forks which are hung upon horizontally guided threads and which drop down by their own gravity and actuate a switch when a thread is broken or is loose. The main

2

drawback of this arrangement resides in the great inertia of the fork, so that there is an excessive time period between the breakage of the thread and the emission of the signal. Furthermore, it can happen that the thread will break between the fork and the spool upon which it is being wound, and yet will retain sufficient tension so as to prevent the operation of the fork.

A perfectly operating thread controller for looms must comply with the following requirements:

(a) It must control the thread movement as well as the thread tension (including a broken or loose weft thread, or one which has not been inserted), so that the controller must be actuated when there is a lack in thread movement, as well as when there is a lack in thread tension.

(b) It must be able to control at the same time thick and thin weft material.

(c) Examination should be possible at any desired location of the path of the shuttle, particularly also within the fabric.

(d) In automatic looms it should also include the first shot after change of spool (wherein the weft thread does not lie as yet in the final guide direction of the shuttle).

(e) If a part of the controlling device is built directly into the shuttle, a deviation of the movement of the shuttle from its precise path should not detrimentally affect the control.

A thread controller for winding frames, multiple spooling machines, shearing machines and warp machines must comply with the following requirements:

(a) It must control primarily the thread movement, i.e. it must be also effective when the thread does not move but is still under tension.

(b) The actuating time must be as short as possible, so as to cover the shortest possible thread ends.

An object of the present invention is the provision of thread controllers which will comply with all above-mentioned requirements.

Other objects will become apparent in the course of the following specification.

In attaining the objects of the present invention it was found desirable to provide a roller which is rotated by a tensioned and running thread, whereby the rotating roller produces an optical, magnetic or electrical alternating field, which is transformed by a receiver into an alternating current the extent and frequency of which depend upon the speed of rotation of the roller. When a thread is loose or is broken, the roller will not rotate, or will be driven too slowly, so that there is no alternating field, or the frequency is too low, and consequently, the receiver does not produce an alternating voltage, or produces too low a frequency or too low a voltage; this difference in the receiver signal releases a switching impulse.

The small roller has preferably the shape of a cylinder, a hollow cylinder, a cage or the like and is driven directly at its circumferential surface by the running thread. Thus the roller does not constitute a part of a composite roller system wherein, for example, the thread would move a separate drive wheel which would be mounted upon a common axle with the roller producing the alternating field.

The magnetic control of the rotation of the roller can be carried out, in accordance with the present invention, by one or more permanent magnets mounted in the roller, which induce during rotation of the roller an alternating current in an adjacent receiving coil. The frequency of the alternating current induced in the receiving coil is the measure for the speed of rotation of the roller. An amplifier amplifies the induced alternating current and transmits it to a rectifier. The amount of the direct current which is thus produced is the factor in determining whether the thread is or is not broken. The direct current operates

through suitable circuits the indicating, stopping or cutting devices of the machine.

In accordance with the present invention, an optical control can be effected by a roller provided with means which modulate the intensity of a bundle of light rays extending between a lamp and a light-electrical cell. The amount of the amplified and rectified signal at the outlet of the light-electrical cell is the factor determining whether the thread is intact, or is broken or loose. The outgoing signal of the controller operates the machine in the same manner as in the case of a magnetic control.

In accordance with a further embodiment of the present invention, one or more inserts having a very different dielectrical constant as compared with the basic material of the roller, are introduced into the roller, so that when the roller is rotated, there is a change in capacity in an electrical condenser field. Alternating voltage produced in the condenser by the varying capacity, is again amplified and rectified and the outgoing signal is used to operate indicating or switching-off devices in the machine.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawings showing by way of example, preferred embodiments of the inventive idea.

In the drawings:

FIGURE 1 is a sectional view of the thread-driven roller of the present invention on an enlarged scale.

FIGURE 2 is a top view of the device shown in FIG. 1.

FIGURE 3 is a section through a shuttle containing this roller.

FIGURE 4 is a side view of a roller which is examined optically.

FIGURE 4a is an end view of the roller shown in FIG. 4.

FIGURE 5 is a side view of a different optically examined roller.

FIGURE 5a is an end view of the roller shown in FIG. 5.

FIGURE 6 illustrates another thread-driven roller.

FIGURE 6a is an end view of the roller shown in FIG. 6.

FIGURE 7 is a diagram illustrating the arrangement of the trigger magnet, trigger coil, control roller and control coil of a weft controller for looms.

FIGURE 8 shows the curve of a trigger impulse of the device shown in FIG. 7.

FIGURE 9 shows the curve of alternating voltage produced in a receiver by the rotating roller.

FIGURE 10 is a simplified box diagram of a magnetic control device.

FIGURE 11 is a diagram illustrating the arrangement of an optical control device for the roller.

FIGURE 12 is a curve illustrating the amplitude of the trigger impulse as a function of the distance between the control spool and the trigger magnet illustrated in FIG. 7.

FIGURE 13 is a circuit diagram of a magnetic control device.

FIGURE 14 illustrates diagrammatically the arrangement of a magnetic control coil and roller in a loom.

FIGURE 15 illustrates a roller which is subjected to a braking action as soon as the thread tension becomes too small.

FIGURE 16 is a plan view of a roller having a specifically strengthened outer surface.

FIGURE 16a is a side view of the roller shown in FIG. 16.

FIGURE 17 illustrates a roller located in the electrical field of a condenser.

FIGURE 18 is a section through a roller used for magnetic inspection which is provided with transverse bore holes for the pneumatic automatic cleaning of the pivot bearing and with means for reducing the weight and increasing the drive friction.

FIGURE 18a is an end view of the roller shown in FIG. 18.

FIGURE 19 is a simplified box diagram of a weft control device located on opposite sides of the path of the shuttle and having switching means which are responsive to the direction of the shuttle movement.

FIGURE 20 is a perspective view of a shuttle consisting of a threader and a roller.

FIGURE 21 is an end view of a signalling roller having longitudinal sharp-edged rills.

FIGURE 22 is a partial enlarged side view of a signalling roller having very small projecting sharp-edged inserts.

FIGURE 23 is a side view of a signalling roller having longitudinal sharp-edged rills.

FIGURES 1 and 2 show in sectional view and top view, respectively, a rotary signalling member, namely, a roller provided with a magnet and a thread running over the roller. The thread 1 is guided over the roller 2 and drives the roller by frictional engagement during the forward movement of the thread. A small magnet 3 is inserted into the roller 2; it rotates along with the roller and thus produces a rotary magnetic field. The roller 2 is supported between pointed pivots 4 so as to have as little friction as possible at the bearing locations.

The diameter of the roller should be made as small as possible, so that in the case of a sudden acceleration of the movement of the thread 1, the roller can be equally quickly accelerated without subjecting the thread to an excessive tensile stress (for example, when the loom shuttle is ejected). In experiments which were actually carried out, the diameter of the roller was 4 mm. It is necessary that the roller should stop as quickly as possible when the thread breaks. This too can be attained by the use of a small roller which should be as light as possible.

To reduce weight the roller may be provided with recesses, so that it may have the shape of a cage, or the like.

Furthermore, if necessary, quick stoppage can be attained by a brake acting upon the roller. In that case, a little brake plate is used to press the thread against the roller. As soon as the thread breaks, the roller is immediately braked by the action of the plate. FIGURE 3 illustrates the manner in which such a roller with a brake plate may be built into a shuttle. The roller 5 contains a magnet 6 and is located between pointed pivots 10. The thread 8 moves past the roller and is pressed against the roller by a small brake plate 7. The spring 9 presses the plate 7 with constant pressure against the thread. The shuttle 11 which carries the roller 5, runs in the loom along the race 13. A control coil 14 is located in the race 13; the coil 14 receives the rotary magnetic field produced by the magnet 6 of the roller 5 and transmits an alternating current.

In accordance with the present invention, a magnetic conductor 12 is located between the roller and the control spool so that the largest possible number of lines of force from the magnet 6 should be received by the spool 14, and so that the alternating current induced in the control spool 14 should be as great as possible.

The operation is as follows:

When the shuttle 11 runs over the race 13 and the thread is pulled out of the shuttle, it will move over the roller 5 and will rotate the roller, thereby producing an alternating magnetic field through the magnet 6, in front of the magnetic conductor 12. The latter will transmit the alternating field to the coil 14, so that an alternating current will be induced in the coil 14 while the shuttle moves past it.

In order to direct the magnetic lines of forces toward the coil 14, a part of the magnetic conductor 12 may be also located in the race 13.

When the thread is broken, the roller 5 will not turn and the immovable magnet 6 will induce a single impulse in the coil 14 instead of an alternating current.

5

FIGURES 4 and 4a show another manner in which the rotary movement of the roller can be examined. Two narrow slits 16 are cut in the roller 15 and are filled with a dark material while the roller 15 in general consists of a glass-clear material.

When a ray of light is directed upon this roller, it will be periodically interrupted during the rotation of the roller. This periodically interrupted ray of light can be received in a photo-cell (not shown) and be transformed into an alternating current.

FIGURES 5 and 5a show another construction of an optically controlled roller of this type. A transparent roller 17 is coated with dark strips 18 which also periodically interrupt a ray of light when the latter passes through the roller and the roller is rotated.

The roller 17 of this construction has, as compared to roller 15 (FIG. 4), the advantage that during one rotation of the roller 17 the ray of light is interrupted not twice but eight times. Thus when the roller 17 is used as a weft controller the stretch during which the roller is exposed to the ray of light does not have to be as long as is the case with the roller 15, since by means of the roller 17 it is possible to determine in a much shorter time whether or not the roller is rotated.

FIGURES 6 and 6a show a magnetic roller which serves the same purpose. The roller 19 contains four magnets 20, 21, 22 and 23. All these magnets are inserted into the roller at different angles. Therefore, during one revolution of the roller 19, an alternating current is produced which has a four times greater frequency than that produced by the roller 2 in FIG. 1. Thus the stretch necessary to determine whether the roller rotates, is considerably shortened.

Since in the case of a weft controller, alternating current is induced in the control coil for only a very short time while the shuttle flies by, namely, only when the roller with the magnet is located in the direct proximity of the coil, the device which transforms this alternating current must be also supplied with an impulse which would indicate at which moment the alternating voltage is to appear when the thread is intact. In accordance with the present invention a trigger impulse is induced for that purpose by a permanent magnet built into the shuttle in a coil located in the raceway, whereby the trigger impulse determines the moment in which the rotating roller is to be controlled.

The deeper reason for the necessity of such a device is that a signal must be produced when the weft thread is broken or is not there, but that no signal can be permitted when the thread is intact. Since a thread which is not there can not produce a signal, a signal inversion must be carried out by means of a trigger device in the following manner:

The trigger device produces a "clock" impulse which "inquires" at the receiving device at predetermined time intervals. In principle, this clock impulse could be obtained from a controlling lever operating in synchronism with the shot movement; practical experimentation has shown, however, that this is impractical, since the shuttle from the movement of its ejection moves forward as an independent kinematic system and is not coupled any more with the space-bound loom system. The time measures given by this space-bound system are, therefore, not necessarily applicable to the movable shuttle system. This produces setting difficulties which are of paramount importance in actual practice, since the manner of movement of the shuttle system can not be imitated merely by a slow-up.

FIGURE 7 illustrates a shuttle 24 which is in flight over its race during the weaving. The interior of the shuttle contains a weft spool 25 from which the thread 26 is discharged. This thread as it is being pulled out, passes over a roller 27 containing a small magnet. A permanent magnet 28 is firmly mounted at the opposite end of the shuttle 24. A trigger coil 29 and a control coil

6

30 are mounted in the raceway at the same distance from each other as the distance between the permanent magnet 28 and the roller 27.

While the shuttle 24 flies by, a trigger impulse produced by the magnet 28 is induced in the trigger coil 29. At the same time an alternating voltage is induced in the control coil 30, said voltage being produced by the rotating rollers 27 and the magnet therein. Thus in the case of a broken thread there will be only a trigger impulse in the coil 29 but no alternating voltage in the coil 30.

In order to concentrate the magnetic lines of forces it is advisable to provide magnetic conductors of the type shown in FIG. 3 between the coils 29 and 30 on the one hand, and the permanent magnet 28 and the magnet of the roller 27, on the other hand. Furthermore, such conductors may be provided partly in the shuttle and partly in the race.

FIGURE 8 illustrates the curve of the voltage produced by the trigger impulse which is induced in the coil 29 while the shuttle 24 is flying by.

FIGURE 9 shows the curve of the alternating voltage produced in the coil 30 while the shuttle 24 flies by, provided that the thread is not broken.

FIGURE 10 illustrates diagrammatically a device used for transforming the trigger impulse of FIG. 8 and the alternating voltage of FIG. 9. The alternating voltage of FIG. 9 is transmitted to the point 31 and is amplified by the amplifier 33. Rectification and curve-smoothing also take place in the amplifier 33 and the rectified positive current is transmitted to the resistance 34. The trigger impulse of FIG. 8 is transmitted to the point 32 and only the negative part of the trigger impulse is transmitted by the rectifier 36 to the resistance 35. The two resistances 34 and 35 are interconnected, so that the positive current from the amplifier 33 is added to the negative current from the rectifier 36, and they are transmitted to the flip-flop 37. When the trigger impulse appears at the point 31 while simultaneously alternating voltage appears at the point 32, the two currents will annul each other at the connection of the resistances 34 and 35. Then the flip-flop 37 will not be influenced. When, however, there is no alternating voltage at the point 31, the trigger impulse at the point 32 will be the only one effective and will transmit a negative voltage to the flip-flop 37 through the resistance 35. The flip-flop 37 will become unstable and will attract the relay 38. By way of example, the attraction may continue for 0.3 sec. The relay 38 will close the contact 39 which will actuate the switching-off magnet of the loom, so that the loom will stop.

It is also possible to supervise the rotation of the roller optically, instead of magnetically. FIGURE 11 shows such an optical control of the rotation of a roller, serving as a weft controller for looms. The shuttle contains a trigger magnet 41 similar to that already described which produces a trigger impulse in the coil 42 while the shuttle is flying by. At the same time a lamp 43 illuminates the roller 46 through a semi-transparent mirror 44 and a lens 45. The roller 46 may be constructed in the same manner as the roller 15 of FIG. 4 or the roller 17 of FIG. 5. The light passing through the roller 46 falls upon a katadioptric reflector 47 which reflects the incoming light in the same direction. This light passes through the lens 45 and strikes the semi-transparent mirror 44, whereby a part of the light reaches the photo-cell 48. In this photo-cell an alternating voltage is produced the form of which is similar to that shown in FIG. 9. This alternating voltage is again subjected to an amplifying device in the manner illustrated in FIG. 10.

Since in a loom the distance between the shuttle and the race and, consequently, the distance between the shuttle and the control coils, can vary, it is of utmost importance that the voltages induced in the coils should

be adequate for the greatest possible distances. FIGURE 12 shows the induced voltage as a function of this distance, the speed of the shuttle being 10 m./s. It is apparent that when, for example, the distance of the shuttle is increased from 5 mm. to 10 mm., the voltage induced in the spool will vary between 1 and 2 volts. This variation is still within a size range which can be absorbed without any difficulty by the amplifying device.

FIGURE 13 illustrates, by way of example, the entire electrical circuitry used for a weft controller in looms. The controlling coil 49 receives alternating voltage from the magnet rotating with the roller. The current is amplified in the amplifier 51 and is changed into a positive direct current in the rectifier 52. The trigger impulse is induced in the trigger coil 50 and is changed into a negative voltage impulse in the rectifier 53. This impulse is transmitted to a resistance 54 which supplies it to the flip-flop 56. At the same time the positive current delivered by the rectifier 52 is also transmitted to the inlet of the flip-flop 56 through the resistance 55. When this positive direct current flowing through the resistance 55 is not there, the flip-flop assumes its unstable position and actuates the relay 57 for about 0.3 sec. The contacts of the relay 57 can then actuate a switch-off magnet so as to stop the loom. In accordance with the present invention, the active switching elements, which are illustrated in detail in FIG. 13, are all without exception semi-conductors which have an unlimited life span.

In weaving machines, the control device should not be built inside shuttles, since it is easily possible to observe the thread outside of the fabric. FIGURE 14 shows, by way of example, the manner in which this can be attained. The thread 59 is pulled by a shuttle 65 from a spool 58 and it passes through a thread guide 60, a thread brake 61 and guide rollers 62. Then the thread moves over a control roller 63 containing a small magnet inducing an alternating voltage in the control coil 64. When the thread breaks before the shuttle 65 has left the fabric, the roller 63 will stand still and no alternating voltage will be induced in the coil 64. This alternating voltage and a trigger impulse may be also transmitted to the apparatus shown in FIG. 13 so as to produce stoppage of the machine. In addition, the roller 63 can be subjected to a braking action in case of thread breakage, by means of a thread brake of the type shown in FIG. 3.

When the thread breaks, the roller (which may be of the type shown in FIGS. 1, 3, 4, 5 and 6) should be stopped as quickly as possible. The time required to stop the roller, depends upon the brake force exerted thereon and its mass inertia. Since the mass inertia increases with the fourth power of the diameter of the roller, the required braking force also increases very rapidly as a function of the diameter. This provides the possibility of using rollers of small diameters to provide very small braking periods. Furthermore, in accordance with the present invention, the frequency procedure of the amplifier 51 of FIG. 13 can be so arranged, that the frequency which corresponds to the greatest speed of the roller will be greatly preferred, while the lower frequencies will not be amplified at all. This will result in that the outlet voltage of the amplifier will drop greatly even when the speed of rotation of the roller drops slightly, so that the flip-flop will be actuated when the trigger impulse arrives. The result is that it is possible to detect a thread break when it takes place shortly before the moment of control arrival; this feature also makes it possible to influence to a greater extent the controller by insufficient thread tension, so that the controller will be actuated in the case of loose threads as well.

When threads are thin, there is the possibility that the thread 8 (FIG. 3) will pass between the roller 5 and the little brake plate 7 (FIG. 3) without rotating the roller; this can happen when the brake plate 7 or the

roller 5 have a little recess at their line of contact, so that at that location the thread is not clamped. FIGURE 15 shows how this can be avoided. In accordance with the present invention, the brake acting upon the thread, is raised from the roller by the thread when the thread tension and the speed are correct. FIG. 15 shows a roller 67 having a magnet 68 and a thread 66 passing over this roller. 69 is the control coil, while 70 is a leaf spring having the same width as the roller 67. A support 71 carries a leaf spring 70. The spring 70 presses the thread 66 against the roller 67. As soon as there is a drop in the tension of the thread 66, the spring 70 moves against the roller and serves as its brake by contact. On the other hand, if the tension of the thread 66 is sufficiently high, the spring 70 is raised from the roller 67, so that the latter will be safely rotated as soon as the thread 66 is moved.

The device shown in FIG. 15 is particularly useful for multiple spooling machines. However, it can be also built into weaving shuttles using thin threads so as to supervise effectively the thread tension as well as the thread movement.

Due to a continuous acceleration and braking of the roller, particularly in the case of weft controllers, such as the roller 67 in FIG. 15, there is the danger that the outer surface of the roller will be used up quickly. In accordance with the present invention, this is avoided by providing the roller with a hard outer surface, as shown in FIGURES 16 and 16a. The roller has an outer cover 72 consisting, for example, of an aluminum alloy which is oxidized, so that it has a glass-hard outer surface. This will diminish the wear. The core 73 of the roller consists, according to the present invention, of a material, such as nylon, which has good dry run qualities. The pointed pivots 75 are preferably made of steel; they are rounded at the points and polished, so that there is the smallest possible bearing friction. To prevent any dust from settling upon the bearing locations, the present invention provides that the bore recesses in the nylon body 73, which receive the pivots, should be short and as flat as possible. The magnet 74 consists of a material having the greatest possible coercive force, such as oxide ceramics.

The hard outer surface of the roller body is preferably roughened. This secures a positive drive of the roller by the thread. The surface roughening can be provided, by way of example, through sharply edged rills, as shown in FIGS. 21 and 23, extending parallel to the longitudinal direction of the roller, and the outer covering can contain sharply edged inserts, as shown in FIG. 22, such as the tiniest glass splinters which may be embedded therein.

FIGURE 17 shows a roller 76 located in an electrical field. The base 77 of the roller consists of a material, such as nylon, which has a very different dielectrical constant from the insert 78, which may be made of barium titanate, for example. The roller rotates in the field of a condenser provided by the two plates 79 and 80, and the field is deformed in rhythm with the rotation frequency. The capacity of the condenser is charged in the same rhythm and so does the voltage at the plates when, for example, the charge is constant. This alternating voltage is further treated in a manner analogous to the above-described magnetical and optical controllers.

FIGURES 18 and 18a show a specially shaped roller provided with pivotal bearings. To increase the life of the bearing of the roller 81, round pivots inserted into the bore holes 84 are used, which exert considerably less bearing pressure than pointed pivots. However, there is the danger that thread fibers will be collected in the bearings 84 and will exert such a strong braking action upon the roller 81, that the driving force of the thread 83 will be insufficient to rotate the roller. In accordance with the present invention, such collection of dirt in

the bearings 84 can be prevented by venting bores 85; a suction effect will be exerted upon the bearings 84 through the bore holes 85 due to the high circumferential speed of the roller 81, so that the bearings 84 will always remain clean due to this suction. The driving force of the thread 83 can be also increased by the rib-shaping of the roller 81. The edges which are then produced upon the outer surface, provide a greater frictional effect between the thread 83 and the roller 81. Furthermore, the roller 81 will be lighter, thereby diminishing the load of the bearings and lowering the torque, so that an effective braking of the roller 81 can take place in case of thread breakage. In this construction, the permanent magnet 82 can be easily built into the roller 81 in the illustrated manner.

FIGURE 19 illustrates schematically a circuit arrangement for a controlling device located on both sides of the race of a loom, wherein the circuits respond to the flight direction. In looms the weft thread must be controlled up to the outer edge of the fabric. Therefore, it is necessary to provide controlling devices at both ends of the race. Since, however, the thread inside the shuttle does not run as yet when the shuttle enters the shed, it is necessary to alternately make that controlling device unresponsive which is located at the entry side of the shed. As shown in FIG. 19, alternating voltage is induced in the control coils 86 by the rotary roller. These coils are located to the right and left at the end of the race. The induced voltage is amplified in the amplifier 87 and the current is transmitted to the gate 88. When the gate is open, the amplified alternating current flows to the rectifier 89. The rectified alternating current is integrated in the integrating counter 90 and operates the discriminator 91. This discriminator delivers a voltage as soon as the voltage integrated by the device 90 exceeds a predetermined value, whereupon this voltage operates the gate 98. The trigger spools 92 and 93 are located close to the control coils 86, namely, there is one coil 92 as well as one coil 93 to the right of the race as well as to the left of the race. The shuttle when leaving the shed always moves firstly past a trigger coil 92 and then past the coil 93; when the shuttle enters the shed it moves, on the other hand, first past the coil 93 and then past the coil 92. The trigger impulses are amplified in the impulse formers 94 and 96 and changed into rectangularly shaped impulses. The impulse former 94 supplies the impulse extender 95 which for example, can be constructed as a flip-flop and which extends the impulses to, say, 20 ms. The extended impulse actuates the gates 88 and 97. Thus the gate 88 frees the alternating voltage of the amplifier 87 from the moment during which the shuttle flies over the spool 92. Thereupon the integrator 90 is charged, for example during 20 ms., and thereafter it is slowly discharged. After the shuttle has flown past the spool 92 it will reach, for example, after 10 ms., the spool 93 and will induce the second trigger impulse therein. This is transmitted to the gate 97. This gate is open during 20 ms. Thus the impulse now reaches the gate 98. When the integrator 90 is charged the gate 98 is closed. On the other hand, when the integrator is not charged, i.e. when the thread is broken, the gate 98 is open. The impulse proceeds to the impulse extending element 99, is there extended to about 300 ms. and attracts the relay 100. When the shuttle flies in, the trigger impulse appears first in the spool 93 but it can not pass through the gate 97 since it is still closed. Consequently, the relay 100 is actuated only during the outer movement of the shuttle, namely, only when the thread is broken. This relay supplies a powerful electromechanical transformer 101 such as an electromagnet, which actuates the coupling and the brake of the loom and thus stops the loom.

FIGURE 20 illustrates a construction wherein the threader and the roller are combined into a single unit comprising the threader block 102 and the roller 103. The thread 104 leaving the shuttle spool enters the

threader 102 from the back, is guided over the roller 103 and leaves the threader through the guide 105. The entire aggregate is screwed into the shuttle by means of the bore hole 106.

It is apparent that the apparatus of the present invention, set forth in the above-described embodiments, eliminates the difficulties experienced with prior art thread controllers. A particular feature of the present invention is that it utilizes a continuous rotation to represent the actual movement of the thread, and not, as in prior art constructions, merely the thread tension. The period of response of the control to thread breakage amounts only to a few milliseconds, so that the dragged thread end, even in the case of the highest possible thread speeds of 20 m./s. can be only a few centimeters long.

In applying the apparatus of the present invention to thread controllers for looms, the controllers built into shuttles, as herein described, have two vital advantages in comparison to prior art devices mounted in battens:

In the first place, the outgoing thread is precisely fixed in its position within the shuttle by guides, so that it can be easily controlled. This eliminates continuous adjustment. On the other hand, as is well known, the operation of controllers mounted in battens is made very difficult by the fact that the thread during its insertion is not always found in the same position due to deviations during the flight of the shuttle and to the general tolerance prevailing in looms.

In the second place, the controller which moves along with the shuttle can be set precisely to a specific type of yarn, since in looms employing many shuttles a specific shuttle will always carry the same type of yarn to a fabric. Therefore, when setting the controller it is not necessary any more to make a compromise which heretofore made the work of a thread controller actually impossible in many cases.

A thread controller which is built into a shuttle is not bound to a thread loop and thus is also suitable for automatic looms.

The transmission of a signal from a controller carried by a shuttle to the loom takes place without contact or inertia during the flight of the shuttle, thereby eliminating the drawbacks of mechanical or electromechanical transmitting devices.

A controller within a shuttle responds to broken threads as well as to loose threads, i.e., to threads which were inserted with insufficient tension and which can produce a faulty fabric just as much as a broken thread. Thus the controller of the present invention responds not only to thread movement but also to thread tension, whereby the effect of these two values can be adjusted whenever necessary by varying the angle of contact and the pressure of the roller brake.

With the exception of the setting magnet, the controller of the present invention operates without any electromechanical auxiliary means; this simplifies assembly and assures undisturbed operating conditions.

A further feature of the present invention which is of great importance, is that its controlling element is also self-controlled. Should the controller become inoperative, the loom will be stopped, since then it will be impossible for it to continue in operation.

The magnetic control of the present invention has the further advantage that the control can take place at any desired location of the path of the shuttle since the warp thread does not disturb the transmission of the signal. Furthermore, in this magnetic control the height of the signal is influenced by deviations of the actual flight of the shuttle from its prescribed path within limits which can be easily absorbed by the half-conductor elements used in the electronic part of the apparatus.

It is apparent that the examples described above have been given solely by way of illustration and not by way of limitation and that they are subject to many variations and modifications within the scope of the present inven-

tion. All such variations and modifications are to be included within the scope of the present invention.

What is claimed is:

1. In a weaving machine having a thread-carrying shuttle, a thread controller comprising a rotary signalling member carried by the shuttle and adapted to engage and to be rotated by the moving thread emerging from said shuttle, the rotary signalling member comprising means for producing signals shaped depending upon the speed of rotation of said signalling member; signal receiving means including signal sensing means mounted on the weaving machine near the path of said shuttle, said signal sensing means receiving said shaped signals to produce therefrom alternating voltage the amount and frequency of which depend upon the speed of rotation of the rotary sensing member, and signal discriminating means coupled with said signal receiving means and operable to produce a control signal when at least one of the characteristic values of said voltage is below a set amount corresponding to a regular operation of said rotary signalling member.

2. A thread controller as claimed in claim 1, wherein the signal receiving means include an amplifier coupled to said signal sensing means and a rectifier connected with said amplifier, said controller further comprising integrating means connected with said rectifier and discriminating means connected with said integrating means, the discriminating means being adapted to produce a control signal when the output of the integrating means exceeds a predetermined value defined by the setting of the discriminating means.

3. A thread controller as claimed in claim 1, wherein the signal receiving means include an amplifier coupled to said signal sensing means and a rectifier connected with said amplifier, said controller further comprising integrating means connected with said rectifier and discriminating means connected with said integrating means, the discriminating means being adapted to produce a control signal when the output of the integrating means exceeds a predetermined value defined by the setting of the discriminating means, the frequency response of the amplifier being such that the frequency corresponding to the normal speed of rotation of the rotary signalling member is amplified in a higher degree than other frequencies.

4. A thread controller as claimed in claim 1, wherein the signal receiving means include an amplifier coupled to said signal sensing means and a rectifier connected with said amplifier, said controller further comprising integrating means connected with said rectifier, discriminating means connected with said integrating means and adapted to produce a control signal when the output of the integrating means exceeds a predetermined value defined by the setting of the discriminating means and electromechanical actuating means coupled with said discriminating means for actuating the stop mechanism of the weaving machine when energized by a control signal from the discriminating means.

5. A thread controller as claimed in claim 1, wherein said rotary signalling member comprises a roller having a body consisting of a material with good dry run characteristics and an outer covering consisting of a very hard material.

6. A thread controller as claimed in claim 1, wherein said rotary signalling member comprises a roller having a body consisting of nylon and an outer covering consisting of aluminum oxide.

7. A thread controller as claimed in claim 1, wherein said rotary signalling member comprises a roller having longitudinal sharp-edged rills.

8. A thread controller as claimed in claim 1, wherein said rotary signalling member comprises a roller having microscopically small sharp-edged inserts projecting from the outer surface of the roller.

9. A thread controller as claimed in claim 1, wherein said rotary signalling member comprises a roller having a diameter of less than five millimeters.

10. In a weaving machine having a thread-carrying shuttle, a thread controller comprising a rotary signalling member carried by the shuttle and adapted to engage and to be rotated by the moving thread emerging from said shuttle, at least one permanent magnet carried by the rotary signalling member and rotating therewith, said permanent magnet producing a rotary magnetic field during its rotation; signal receiving means including at least one coil mounted on the weaving machine near the path of the shuttle for producing alternating voltage the amount and frequency of which depend upon the speed of rotation of said rotary signalling member, and signal discriminating means connected with said signal receiving means and operable to produce a control signal when at least one of the characteristic values of said voltage is below a set amount corresponding to a regular operation of said rotary signalling member.

11. A thread controller as claimed in claim 1, further comprising triggering means carried by the shuttle and adapted to produce trigger signals when the shuttle moves; an electric trigger device connected with said signal discriminating means and including trigger sensing means mounted on the weaving machine near the path of said shuttle, said trigger sensing means being adapted to receive said trigger signals and to produce therefrom electrical trigger signals.

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