Oct. 29, 1963 E. C. RUST, JR 3,108,353

LOOM NEEDLE PENETRATION COUNTER

Filed May 22, 1961 3 Sheets-Sheet 1

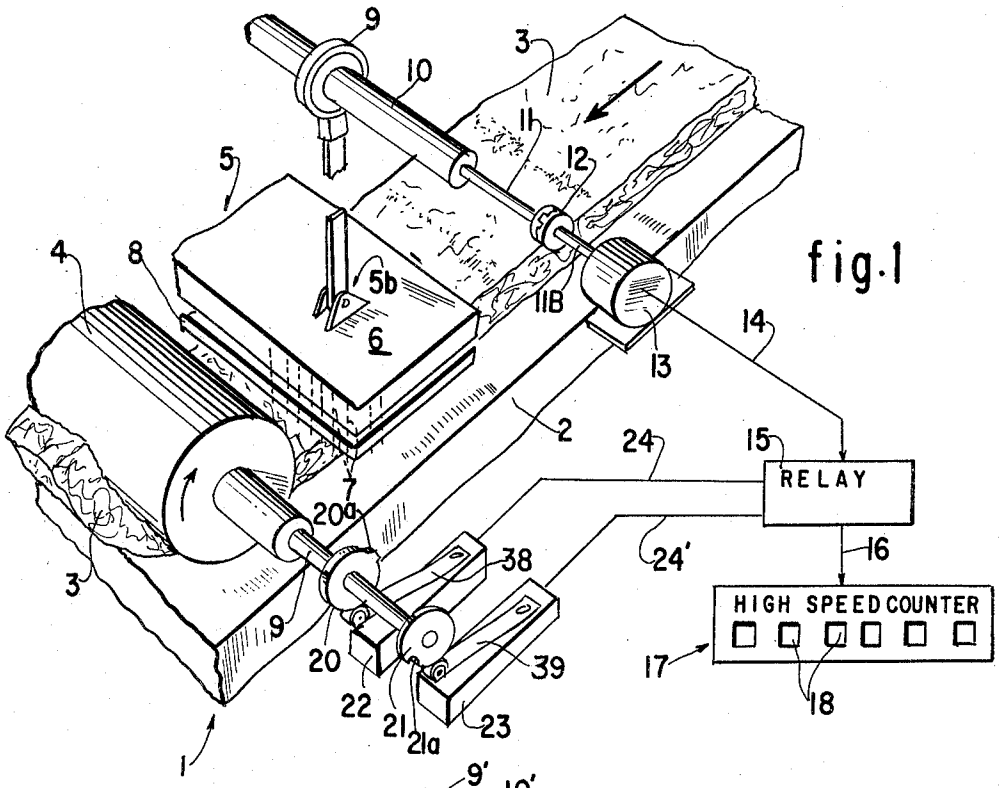


fig.1

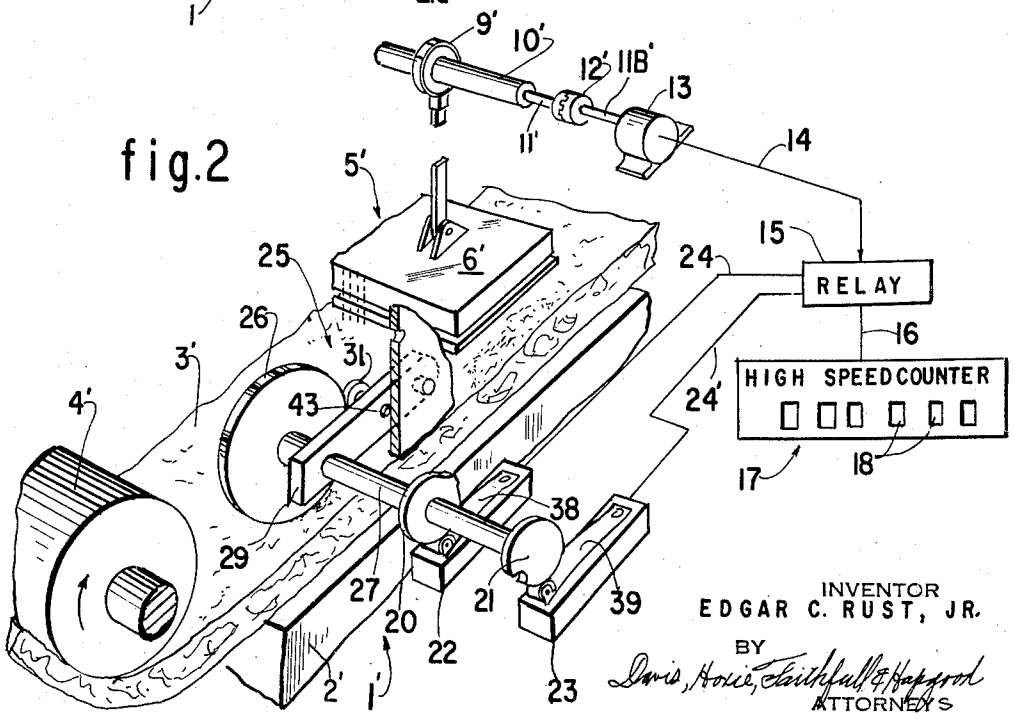


fig.2

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Filed May 22, 1961 3 Sheets-Sheet 2

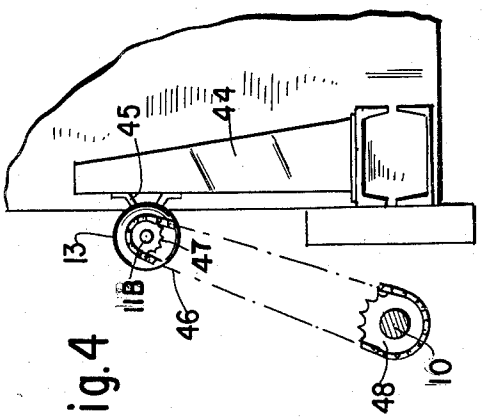


fig.4

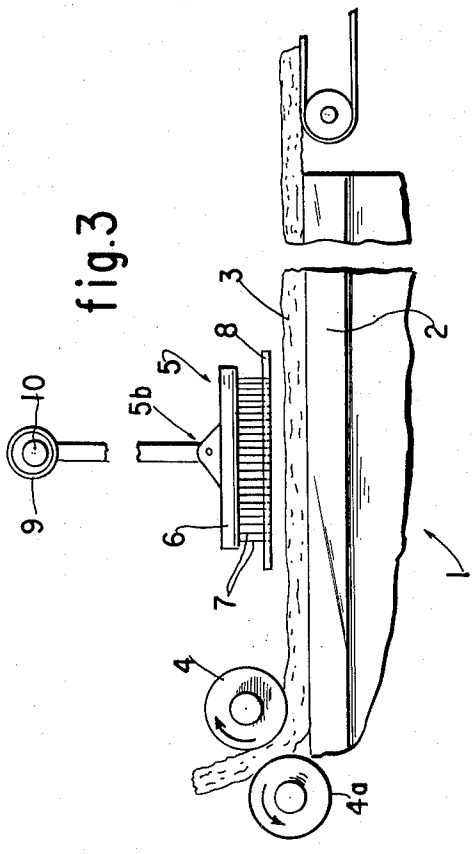


fig.3

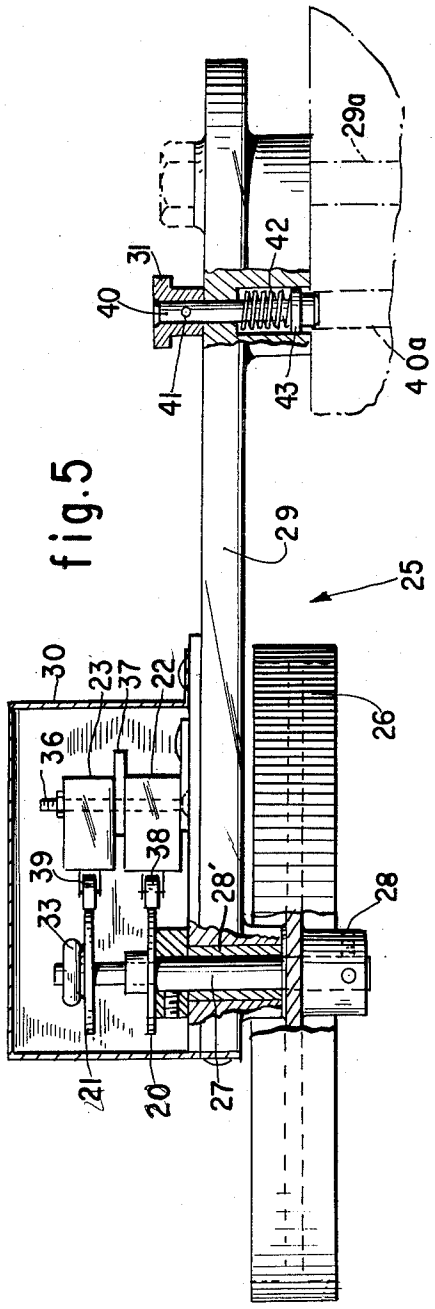


fig.5

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Filed May 22, 1961 3 Sheets-Sheet 3

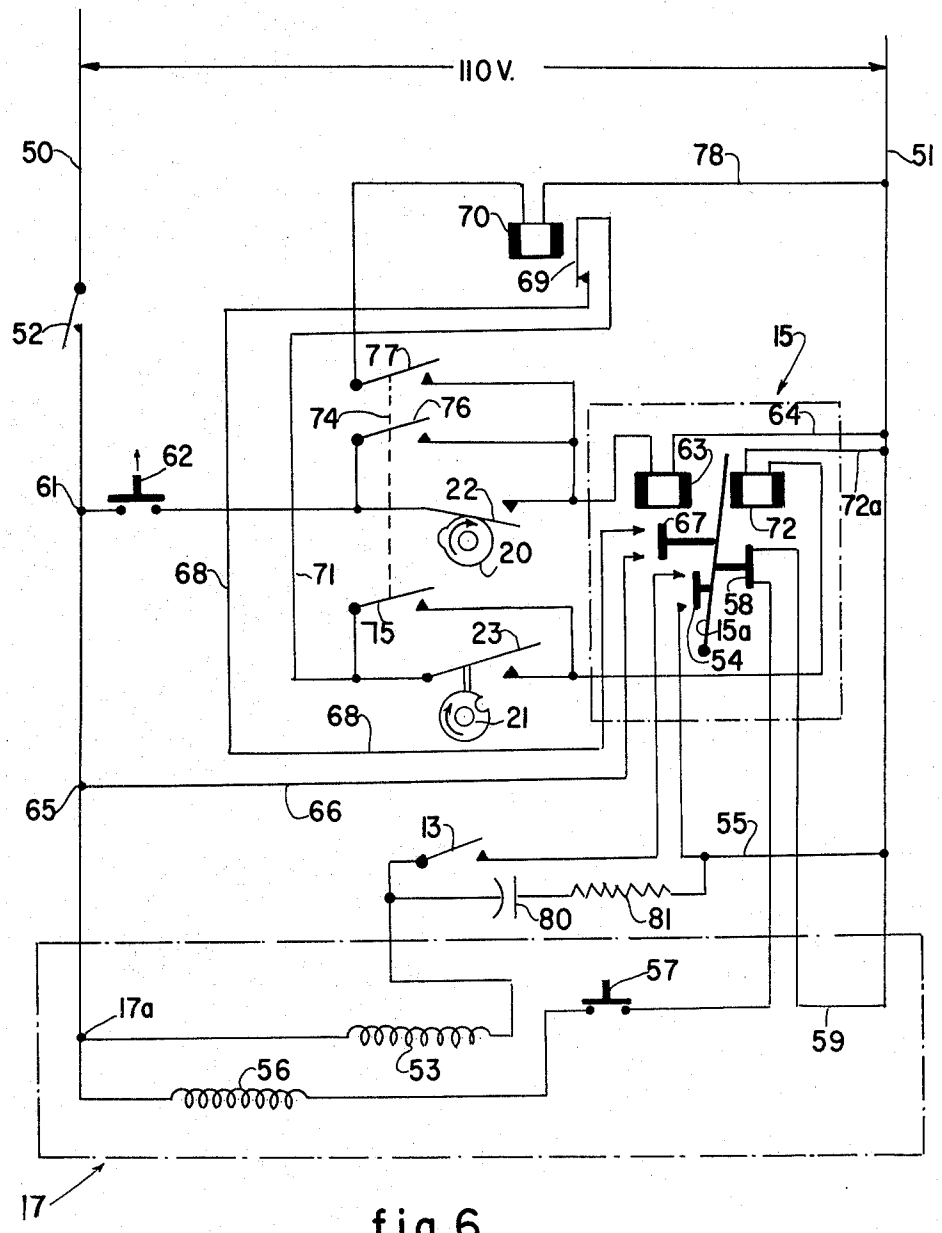


fig.6

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LOOM NEEDLE PENETRATION COUNTER

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17 Claims. (Cl. 28—4)

The present invention relates to needle looms and more particularly to apparatus for counting the needle penetrations made by a loom.

In the production of felt, a web or batt of fibers, usually compressed fibrous material, is drawn step-by-step under the needle board of a needle loom. The board has a series of depending needles which are repeatedly driven through the web and then withdrawn from it to form the web into a coherent felt material.

Needle looms as commonly made comprise a bed plate upon which the fibrous web is advanced step-by-step, a needle board having a plurality of projecting needles, and means for reciprocating the needle board to drive the needles in and out of the web during the periods of pause between advances of the web. The efficiency of the needling (felting) process depends upon a number of factors including the nature of the raw material of the web, orientation of its fibers, weight and uniformity of the web, the pattern in which the needles are arranged on the board, and the number of penetrations by the needles. With the other factors constant, the degree of felting action varies with the number of needle penetrations per square inch.

Heretofore, the number of needle penetrations has been calculated from a determination of the rate of stroking of the needle board of the loom expressed in strokes per one inch of advance movement of the web through the loom. This determination is made, for example, by a tachometer and by timing the stroking with a stop-watch. The necessary calculations to arrive at the penetrations per square inch may utilize the formula: $P=ND/12S$, where P is the number of needle penetrations per square inch, N is the number of strokes per minute of the loom, S is the speed of lengthwise advance of the web in feet per minute, and D is the number of needles on the board per inch of width. This procedure is time-consuming, does not permit immediate corrective changes in the loom settings, and is subject to errors in the stop-watches, tachometers, and human calculation.

It is an object of the present invention to provide a mechanism for automatically deriving and indicating the number of needle penetrations in a felt loom, either directly in terms of penetrations per unit area of the felt web or indirectly in terms of loom strokes per unit length of the felt web, from which the penetrations per unit area can be readily determined by application of a multiplier representing the number of needles per unit width.

It is a further objective to provide a mechanism for automatically deriving and indicating the number of needle penetrations per unit of time in the loom operation.

In an apparatus made according to the invention, a counter is operated from the loom shaft (preferably from an electrical contactor driven by the loom shaft) through a connection which includes either limit switch means actuatable in response to advance of the web or a timing device, for operatively connecting the counter to the electrical contactor only during advance of the web through a predetermined distance or during a predetermined time interval, respectively. Preferably, the apparatus includes both the limit switch means and the timing device, and means for selectively connecting one or the other into the connection between the electrical contactor and the counter, whereby the latter is operable to indicate either the number of needle penetrations per unit of web area or

the number of such penetrations per unit of time. The limit switch means may be actuated directly from a draw roll which advances the web intermittently along the bed plate, or such switch means may be actuated indirectly from the web advancing means by a wheel which rides on the intermittently advancing web.

Other objectives will be apparent from the following detailed description and the accompanying drawings in which:

FIG. 1 is a schematic perspective view of one embodiment of the present invention;

FIG. 2 is a similar view of another embodiment of the present invention;

FIG. 3 is a schematic view of a felt loom;

FIG. 4 is a side view of an alternative mounting of one portion of the device;

FIG. 5 is a plan view, partly in section and cut away, of the wheel and switches of the embodiment of FIG. 2; and

FIG. 6 is a schematic diagram of a circuit suitable for the embodiments of FIGS. 1 and 2.

In FIGS. 1 and 3, the felt loom shown generally at 1 comprises a sationary horizontal bed plate 2 on the surface of which a web of fibrous material 3 is drawn step-by-step by suitable web-advancing means 4. For simplicity, the latter is shown in FIG. 1 as a single rotatably mounted draw roll which is driven intermittently by a conventional power drive (not shown) in the direction to advance the web, although normally the roll 4 will coact with an oppositely driven draw roll *4a* shown in FIG. 3, so that the web 3 passes through the nip between the intermittently driven draw rolls 4—*4a*, as is well known in the needle loom art. Draw roll 4 is rotatably mounted at its ends in the usual bearings (not shown). A needle board 5, comprising a horizontal rectangular plate 6 from which a plurality of needles 7 project downwardly, is positioned above the bed plate 2.

Needle board 5 is adapted to be reciprocated vertically by means of the loom shaft 10, as through a pivotal connection *5b* from the board to a crank or eccentric 9 on the shaft, it being understood that the needle board 5 is guided in its vertical movements by the usual vertical stationary guides (not shown). A stationary stripper plate 8 is positioned above the bed plate 2 and has holes through which the needles 7 are movable. Web 3 extends from a feed apron *2b* (FIG. 3) into the space between the plates 2 and 8 and thence to the web advancing means 4. As the board 5 reciprocates up and down, its needles 7 are first driven downwardly through web 3 on bed plate 2, with the needles moving within aligned holes in the bed plate 2. The needles 7 are than raised to withdraw their barbed ends from the web, the stripper plate 8 holding the web against upward movement with the needles and thereby stripping the web from the needles.

As is conventional in needle looms, the draw roll 7 of the web advancing means is driven intermittently from the same shaft 10 which reciprocates the needle board 5, so that roll 7 is driven only during the periods when the needles are disengaged from web 3. The needles are therefore engaged with the web only during the dwell periods between the intermittent advances of the web along the bed plate 2. Driving means for thus synchronizing the web advances with the needle board movements are well known in the needle loom art, as are the other details of the needle loom described above in connection with the drawings.

Loom shaft 10 has an end portion 11 which is mechanically coupled to the shaft 11B of an electrical contactor 13 by a coupling 12. The contactor 13 is of the type which opens and closes a pair of contacts once in each revolution of loom shaft 10, so that an electric pulse is produced by contactor 13 every time shaft 10 rotates

through a complete revolution. Various contactors of this type are available commercially, an example being that sold by Veeder Root, Inc., Hartford, Connecticut, for use with magnetic counters and identified as Series 1048. Contactor 13 is electrically connected by wiring 14 to relay 15 and, upon closing of relay 15, by wiring 16 to counter (indicating instrument) 17 which counts and displays the number of electrical pulses transmitted by contactor 13. Preferably, counter 17 is a resettable rapid magnetic counter which is actuated by electromagnets and which displays the number of pulses by a digital presentation 18. A six figure, 1000 count per minute (maximum), 115 volt A.C. magnetic counter is satisfactory. An example of such a counter is the Reset Magnetic Counter, Series 1205, sold by said Veeder Root, Inc.

In FIG. 4, an alternative mounting of electrical contactor 13 is shown which is preferable for some purposes. In this alternative, contactor 13 is not directly coupled to the loom shaft 10 but rather is mounted on a bracket 44 by mounting members 45, and its shaft 11B is driven by sprocket gear 47 connected to the shaft. Sprocket gear 47 is driven through sprocket chain 46 from sprocket gear 48 which is mounted on and rotates with loom shaft 10. By proper selection of the relative diameters of gears 47 and 48, the necessary multiplier (representing the number of board needles per unit of width) is introduced so that the reading of counter 17 can be directly in terms of needle penetrations per unit of web area.

Draw roll 4 terminates at one end in a draw roll shaft 9. Two cams 20 and 21 are affixed to shaft 9 and positioned to operate electrical switches 22 and 23, respectively, through their respective switch arms 38 and 39. Switches 22—23 are normally open; but during rotation of shaft 9 switch 22 is momentarily closed by detent 20*a* on cam 20, and after further rotation of this shaft through a certain angle switch 23 is momentarily closed by entry of a follower on arm 39 onto a notch 21*a* in cam 21. Switches 22 and 23 are connected to relay 15 by wiring 24 and 24′, respectively. Relay 15 prevents pulses from one cycle of counting being added to the subsequent counting cycle.

FIGS. 2–6 illustrate a preferred embodiment of the present invention. In this embodiment, the loom parts are similar to those of the first embodiment, with batt 3′ being drawn on bed 2′ by draw roll 4′ so that it is intermittently advanced under needle board 5′ having needles 7′. Needle board 5′ is reciprocated by rotation of loom shaft 10′ and its eccentric 9′. Electrical contactor 13 is connected by coupling 12′ to the end portion 11′ of shaft 10′. Contactor 13 is electrically connected by wiring 14 to relay 15 and is connected through relay 15, when closed, to counter 17 by wiring 16. A large knurled lightweight wheel 26 of a wheel assembly 25 rides upon web 3′. This wheel enables the counting control mechanism to be independent of the draw roll 4′, so that errors do not occur due to slippage between the web and the draw roll.

Wheel assembly 25 comprises the large wheel 26 and a shaft 27 affixed to the hub of wheel 26 by screw 28 (FIG. 5). Shaft 27 extends through bushing 28*b* in support member 29 and into enclosure box 30 (shown in FIG. 5 but omitted in FIG. 2), which is fastened to support member 29. The two eccentric cams 20 and 21 are secured to shaft 27 within box 30, cam 21 being releasably secured on the shaft 27 by hub clamp 33. The two electrical switches 22 and 23 are fastened to support member 29 by bolt 36 and are positioned by spacer 37 so that their respective arms 38 and 39, each having a freely rotating wheel, are contacted by cams 20 and 21, respectively. In order to secure wheel assembly 25 to the loom frame, support member 29 is pivotally mounted at 29*a* for vertical swinging movement on the frame, so that wheel 26 can rest on the web and move up and down with irregularities in the web thickness. The pivoted support member 29 carries a knob 31 attached to a transversely slidable shaft 40 by a pin 41. A spring 42, engaging shoulder 43 of shaft 40, urges shaft 40 into a hole 40*a* in the frame when wheel 26 is raised from the web, whereby the wheel assembly 25 can be releasably locked in an inoperative position.

It will be apparent from the foregoing that in the illustrated embodiments of the invention, the apparatus comprises limit switch means including switches 22—23, cams 20—21, and the connection 9 or 27 through which the cams are driven from draw roll 4 or wheel 26, respectively, whereby the limit switch means are actuated in response to the web advance to delineate a predetermined length of this advance. The length of web advance thus delineated is determined by the angular displacement of cam notch 21*a* from cam detent 20*a* and is adjustable by releasing hub clamp 33 (FIG. 5) to permit rotation of cam 21 relative to cam 20. The apparatus also comprises an electrical contactor 13 operable by loom shaft 10 to produce electrical impulses at a rate proportional to the number of strokes per minute of the loom, a counter 17, and a connection 14—16 from the contactor to the counter including relay 15 and the limit switch means, the latter controlling the relay to electrically connect the conductor 13 to counter 17 only during the time interval represented by the aforementioned predetermined length of the web advance. As the wiring of the above-mentioned electrically components is shown only schematically in FIGS. 1 and 2, I have shown in FIG. 6 a wiring diagram suitable for the purpose, it being understood that the wiring diagram of FIG. 6 is applicable to the FIG. 1 embodiment as well as that of FIG. 2. The wiring diagram of FIG. 6 also includes means for operating the counter in an alternative manner whereby it counts the number of needle penetrations per unit of time rather than the number of needle penetrations per unit of web area, the limit switches 22—23 being rendered inoperative during this alternative operation.

Referring to FIG. 6, an electrical current source of 110 volts A.C. is placed across lines 50 and 51. Line 50 leads through a manually operated on-off switch 52 to a terminal 17*a* of counter 17. The latter includes a coil 53 connected at one side to terminal 17*a* and at the other side through the electrical contactor 13 to one side of normally open switch 54 of relay 15. The other side of switch 54 is connected through wire 55 to the other side 51 of the current source. Thus, with relay switch 54 held closed, each closing of contactor switch 13 will momentarily energize the coil 53 and thereby cause this coil to register a single count in the counter 17. The counter 17 also includes a reset coil 56, one side of which is connected to terminal 17*a* and the other side of which is connected through manually operable reset switch 57, normally closed switch 58 of relay 15, and wire 59 to the other side 51 of the current source. Thus, with relay switch 58 closed, the reset switch 57 may be operated to energize reset coil 56 and thereby returning the digital indicators 18 of the counter to their initial "0" positions.

The terminal 61 of line 50 is connected through a normally open "Count" switch 62 and through limit switch 22 to one side of a coil 63 of relay 15, the latter being shown as a relay of the differential type. The other side of coil 63 is connected through wire 64 to line 51. Another terminal 65 of line 50 is connected through wire 66, normally open switch 67 of relay 15, wire 68, normally closed switch 69 of a time delay relay 70, wire 71, and limit switch 23 to one side of the other coil 72 of relay 15. The other side of the latter coil is connected through wire 72*a* to line 51.

A single-throw switching device 74 is provided with three switches 75, 76 and 77, the switch arms of which are mechanically interconnected so that the three switches may be opened or closed manually in unison. When closed, switch 75 short-circuits the limit switch 23, while

switch 76 short-circuits limit switch 22. With switch 77 closed, the closing of "Count" switch 62 establishes a circuit from terminal 61 through switches 76 and 77, coil 70 of the time delay relay, and wire 78 to line 51, thereby energizing the time delay relay and opening its switch 69.

To prevent or reduce arcing in the electrical contactor 13, the usual electrical components 80—81 may be connected across the contactor as well as its associated relay switch 54.

Time delay relay 70 is of the type which, when momentarily energized, will open its switch 69 and hold the latter open for a predetermined time interval, at the end of which interval the switch 69 will automatically close. As previously mentioned, the relay 15 is of the differential type in which the switch arm 15*a* is swung to the left by momentary energizing of coil 63 and remains in its left-hand position until momentary energizing of the other coil 72, which returns the arm to its normal right-hand position as shown, the arm 15*a* remaining in the latter position until coil 63 is again momentarily energized.

If it is desired to count the number of needle penetrations per unit of web area, the switching device 74 is operated to hold its switches 75—76—77 open as shown in FIG. 6. With switch 52 closed, the operator closes the "Count" switch 62 and holds it closed until the advance of web 3 causes limit switch 22 to be closed by cam 20, the latter being evidenced by the counter 17 starting to count, at which time "Count" switch 62 is released. Upon closing of limit switch 22 with "Count" switch 62 held closed, relay coil 63 is momentarily energized to open switch 58 and close switches 54 and 67. With switch 54 thus closed, the operating coil 53 of counter 17 is connected in series with electrical contactor 13 across the power lines 50 and 51. Accordingly, each cycle of closing and opening of contactor switch 13 will pulse the coil 53 electrically to register a single count in the counter 17, the total of the counts thus registered being shown by the digital presentation 18 of the counter, as will be readily understood. When the web 3 has been advanced a predetermined distance along bed plate 2 by the intermittent operation of draw roll 4 or 4', the other limit switch 23 is momentarily closed by cam 21 and thereby energizes relay coil 72 momentarily through switches 67 and 69. As a result, switches 54 and 67 are now opened and switch 58 is reclosed, this opening of switch 54 preventing the counter coil 53 from being pulsed by continued operation of electrical contactor 13. Thus, the counting cycle is started upon closing of limit switch 22 and is terminated upon closing of limit switch 23. It will also be observed that during the counting cycle, the counter reset coil 56 cannot be energized by operation of reset switch 57, due to the fact that switch 58 is held open.

It will be apparent that the final count reading thus obtained in counter 17 will represent the number of cycles or pulses of electrical contactor 13 during a predetermined length of advance of web 3 along bed plate 2. By proper setting of this predetermined length of web advance in relation to the speed ratio between loom shaft 10 and electrical contactor 13 driven from this shaft, the final reading of counter 17 may be made to indicate directly the number of needle penetrations per unit of web area. For example, assume that the pattern of the needles 7 on board 6 is such that there are 46 needles per inch of board width (the board width being its dimension transversely of the web length) and that the setting of cam 20 relative to cam 21 is such that the web is advanced through a distance of 20 inches between the closing of switch 20 by cam detent 20*a* and the subsequent closing of switch 23 by cam notch 21*a*. In this case, by using the driving connection shown in FIG. 4 between loom shaft 10 and electrical contactor 13, wherein the contactor 13 is driven through 2.3 revolutions for each

revolution of shaft 10, the final reading of counter 17 will show the number of needle penetrations of the web per square inch of web area. In other words, such final reading of counter 17 is obtained by driving contactor 13 from loom shaft 10 at a speed, in terms of r.p.m., equal to DN/L, where D is the number of needles on the board per inch of width, N is the number of r.p.m. of shaft 10, and L is the predetermined distance of the web advance in inches as determined by cams 20—21.

When it is desired to count the number of needle penetrations of the web per unit of time, for example one minute, the switching device 74 is operated to close switches 75, 76 and 77, thereby short-circuiting the limit switches 22—23 and preparing a circuit for energizing the time delay relay 70. The operator then momentarily closes "Count" switch 62, whereby coil 63 of relay 15 is momentarily energized through switch 76 to open switch 58 and close switches 54 and 67. At the same time, time delay relay 70 is energized through switches 76—77 to open relay switch 69. As a result of this closing of switch 54, the electrical contactor 13 will now begin to pulse the counter coil 53 electrically, this pulsing action continuing for the set period of one minute, that is, until time delay relay 70 recloses its switch 69. Upon closing of switch 69, the other coil 72 of relay 15 is energized through switches 67, 69 and 75, thus opening switches 54 and 67 and breaking the pulsing circuit of counter coil 53. Accordingly, the final reading of counter 17 will show the number of cycles of contactor 13 per minute of loom operation. By using a direct drive between loom shaft 10 and contactor 13 as shown in FIGS. 1 and 2, or by using the drive shown in FIG. 4 with a 1:1 driving ratio between loom shaft 10 and contactor 13, the final counter reading will show the number of needle board reciprocations per minute, which can be readily transposed into needle penetrations per minute by application of a muiltiplier representing the number of needles on the board which are operable on the web 3.

I claim:

1. In combination with a needle loom including a bed plate, a needle board mounted for vertical movements above said plate and having a series of depending needles, a drive shaft operatively connected to said board for reciprocating it vertically to alternately drive the needles through a web of fibrous material on the bed plate and withdraw the needles from the web, and web advancing means operable in synchronism with the needle board for advancing the web step-by-step along the bed plate while the needles are disengaged from the web during each reciprocating cycle of the board, a needle penetration counter comprising an electrical contactor operatively connected to the drive shaft for producing electrical impulses at a rate proportional to the rate of reciprocation of the needle board, an electrical impulse counter, and a connection between the contactor and counter including limit switch means actuatable in response to said advance of the web for operatively connecting the counter to the contactor only during said web advance through a predetermined distance.

2. The combination defined in claim 1, in which the web advancing means include a rotatable draw roll, the limit switch means including switch means and also including an operative connection between the draw roll and said last-mentioned means for actuating said switch means.

3. The combination defined in claim 1, in which the web advancing means include a rotatable draw roll, the limit switch means including switch means and also including cam means driven by the draw roll for actuating the switch means.

4. The combination defined in claim 1, comprising also a wheel engageable at its periphery with the web and rotatable by said advance of the web, the limit switch means including switch means and also including an op-

erative connection between the wheel and said last-mentioned means for actuating said switch means.

5. The combination defined in claim 1, comprising also a wheel engageable at its periphery with the web and rotatable by said advance of the web, the limit switch means including switch means and also including cam means driven by the wheel for actuating the switch means.

6. The combination defined in claim 1, in which the limit switch means include a pair of limit switches, one of said switches being operable to electrically connect the counter and contactor through said connection, and the second switch being operable to break said electrical connection.

7. The combination defined in claim 1, in which the limit switch means include a pair of limit switches, one of said switches being operable to electrically connect the counter and contactor through said connection, and the second switch being operable to break said electrical connection, the limit switch means also including cams operable to actuate the respective switches in sequence and movable with said advance of the web.

8. The combination defined in claim 1, in which the limit switch means include a pair of limit switches, one of said switches being operable to electrically connect the counter and contactor through said connection, and the second switch being operable to break said electrical connection, the limit switch means also including cams operable to actuate the respective switches in sequence and movable with said advance of the web, one of said cams being adjustable relative to the other cam to vary said predetermined distance of the web advance.

9. The combination defined in claim 1, in which the limit switch means are adjustable to vary said predetermined distance of the web advance.

10. The combination defined in claim 1, in which said connection between the contactor and counter also includes a relay operable by the limit switch means to electrically connect the counter to and disconnect it from the contactor.

11. The combination defined in claim 1, comprising also a driving connection through which said contactor is operatively connected to the drive shaft and rotated therefrom at a speed, in terms of r.p.m., equal to DN/L, where D is the number of needles on the board per inch of width, N is the number of r.p.m. of the shaft, and L is said predetermined distance of the web advance in inches.

12. The combination defined in claim 1, in which said connection between the contactor and counter also includes a relay operable by the limit switch means to electrically connect the counter to and disconnect it from the contactor, the combination comprising also a timing device, and means for operatively connecting the timing device to the relay while rendering the limit switch means inoperable on the relay, whereby the relay is operable under control of the timer to electrically connect the counter to and disconnect it from the contactor.

13. The combination defined in claim 1, comprising also a timing device, and means for rendering the limit switch means inoperable in said connection while inserting the timing device in said connection to electrically connect the counter to the contactor only during a time interval determined by the timing device.

14. In combination with a needle loom including a bed plate, a needle board mounted for vertical movements above said plate and having a series of depending needles, a drive shaft operatively connected to said board for reciprocating it vertically to alternately drive the needles through a web of fibrous material on the bed plate and withdraw the needles from the web, and web advancing means operable in synchronism with the needle board for advancing the web step-by-step along the bed plate while the needles are disengaged from the web during each reciprocating cycle of the board, a needle penetration counter comprising an electrical contactor operatively connected to the drive shaft for producing electrical impulses at a rate proportional to the rate of reciprocation of the needle board, an electrical impulse counter, and a connection between the contactor and the counter including a timing device for operatively connecting the counter to the contactor only during a time interval determined by said device.

15. The combination defined in claim 14, in which said connection between the contactor and counter also includes a relay operable by the timing device to electrically connect the counter to and disconnect it from the contactor.

16. In combination with a needle loom including a bed plate, a needle board mounted for reciprocating movements opposite said plate and having a series of projecting needles, a drive shaft operatively connected to said board for reciprocating it to alternately drive the needles through a web of fibrous material on the bed plate and withdraw the needles from the web, and web advancing means operable in synchronism with the needle board for advancing the web along the bed plate during each reciprocating cycle of the board, a needle penetration counter comprising an electrical contactor operatively connected to the drive shaft for producing electrical impulses at a rate proportional to the rate of reciprocation of the needle board, an electrical impulse counter, and a connection between the contactor and counter including limit switch means actuatable in response to said advance of the web for operatively connecting the counter to the contactor only during said web advance through a predetermined distance.

17. In combination with a needle loom including a bed plate, a needle board mounted for reciprocating movements opposite said plate and having a series of projecting needles, a drive shaft operatively connected to said board for reciprocating it to alternately drive the needles through a web of fibrous material on the bed plate and withdraw the needles from the web, and web advancing means operable in synchronism with the needle board for advancing the web along the bed plate during each reciprocating cycle of the board, a needle penetration counter comprising an electrical contactor operatively connected to the drive shaft for producing electrical impulses at a rate proportional to the rate of reciprocation of the needle board, an electrical impulse counter, and a connection between the contactor and the counter including a timing device for operatively connecting the counter to the contactor only during a time interval determined by said device.

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