

Feb. 17, 1970

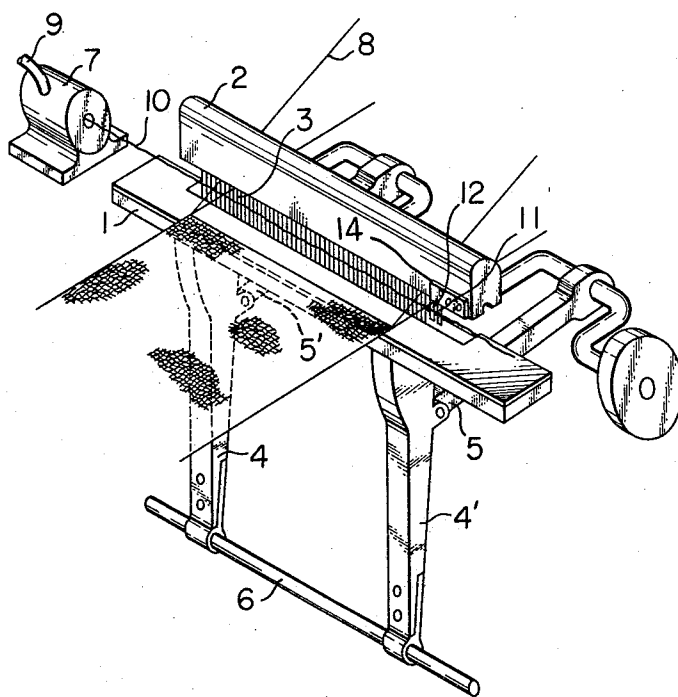
TOEMON SAKAMOTO ETAL 3
APPARATUS FOR DETECTING MISS-INSERTION OF WEFT
ON THE SHUTTLELESS LOOM

3,495,633

Filed April 5, 1967

4 Sheets-Sheet 1

Fig. 1



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Fig. 2A

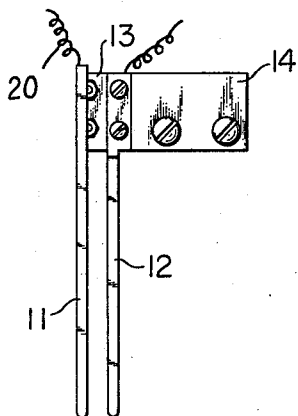


Fig. 2B

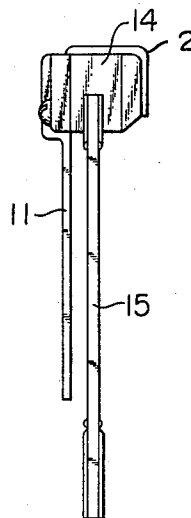


Fig. 3A

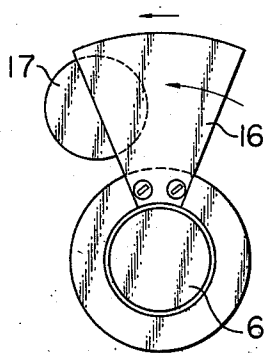
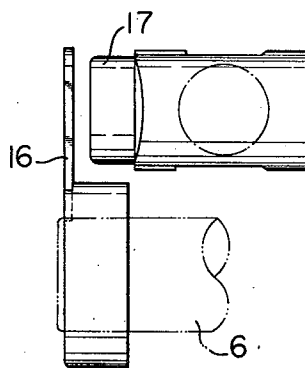


Fig. 3B



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Fig. 4

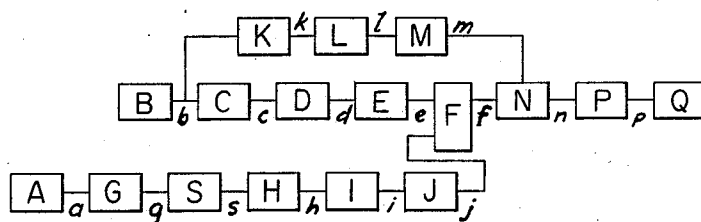


Fig. 5

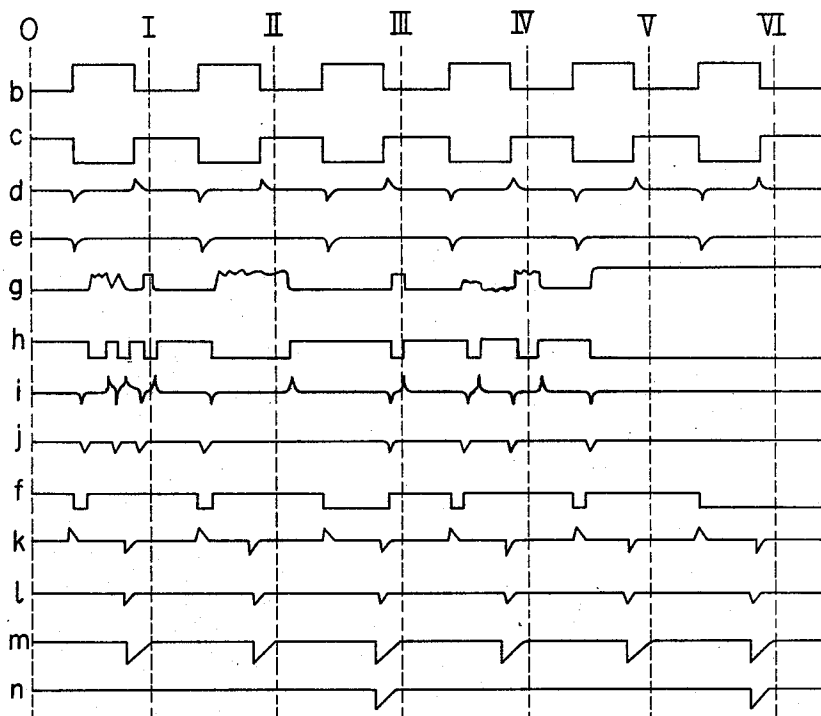
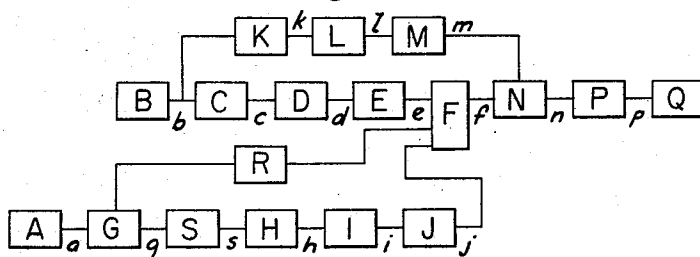


Fig. 6



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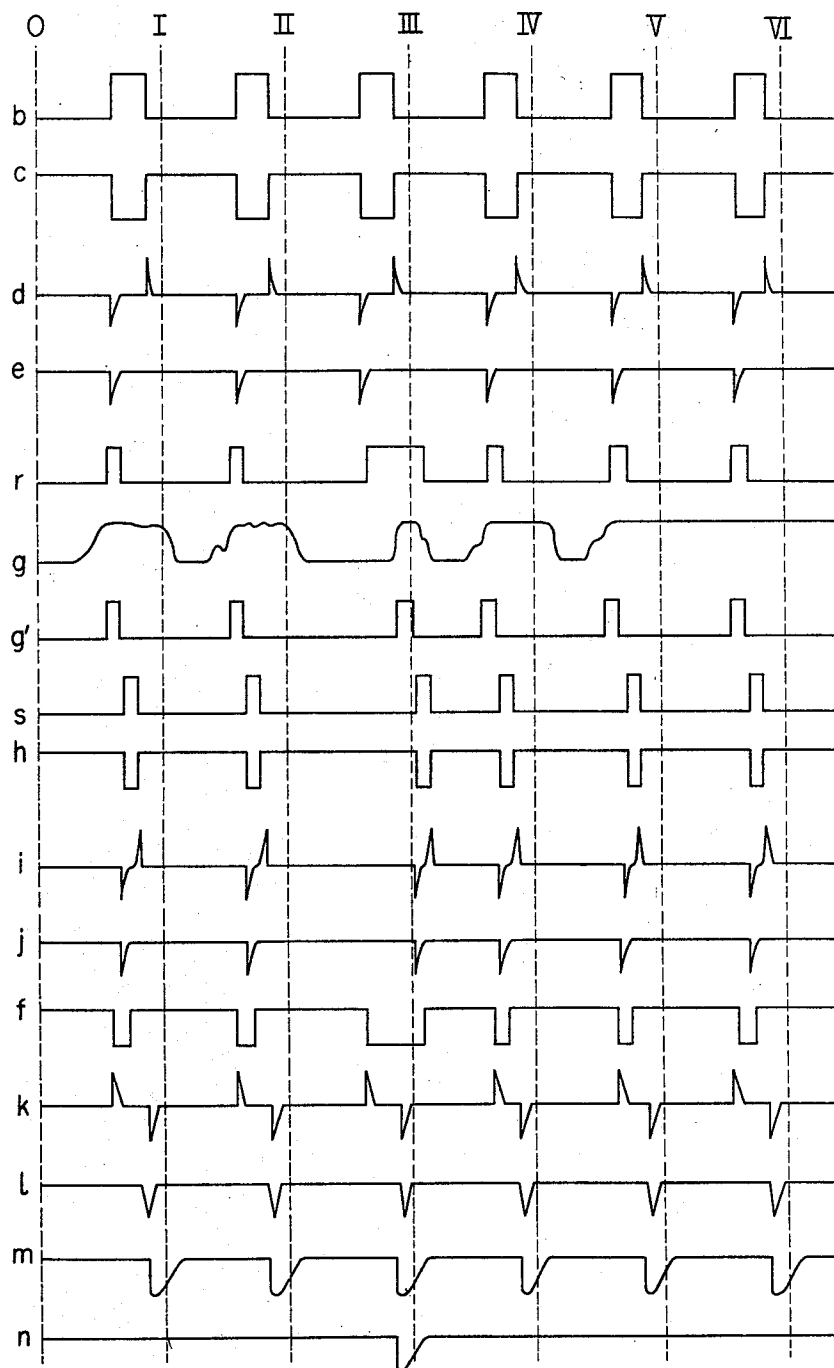


Fig. 7

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APPARATUS FOR DETECTING MISINSERTION OF WEFT ON THE SHUTTLELESS LOOM

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6 Claims

ABSTRACT OF THE DISCLOSURE

This relates to an improved apparatus for detecting misinsertion or entanglement of a weft during the operation of a loom, and is especially suited for use with a shuttleless loom having a water jet nozzle for carrying the weft into warp sheds. Two, spaced apart, electrodes are provided near the reed cap of the loom and form part of an electric circuit for generating sensing pulses indicative of the weft's condition. The weft actually bridges the electrodes and thereby closes the above-mentioned electric circuit. A series of reference pulses are generated in synchronism with the opening and closing of the warp sheds and the reference pulses are varied in response to the sensing pulses to cause actuation of an electric relay to stop the operation of the loom whenever undesirable weft conditions are sensed.

The present invention relates to an improved apparatus for detecting irregular insertion of weft usable in combination with a shuttleless loom, more particularly relates to an improved apparatus for detecting irregular insertion of weft usable in combination with a shuttleless loom having a water jet nozzle for carrying the weft into warp sheds, thereby automatically stopping the running of the loom instantaneously after such irregular insertion of weft is detected.

There have been several known types of apparatus used for a shuttleless loom having a water jet nozzle whereby the running of the loom is stopped at the time of misinsertion of weft, and, in most of such conventional apparatus, an electric feeler mechanism is utilized for the detection of misinsertion of weft. In the mechanism, an electric bridge is formed within the feeler mechanism by the contact of the picked weft when the insertion of weft is completed without mistake while the electric bridge is opened when there is no contact of the weft with the feeler mechanism. The electric signals generated by the formation of the electric bridge caused by the contact of the weft with the feeler mechanism are transmitted to means for stopping the running of the loom and the stopping means is actuated to stop the running of the loom in accordance with the signal thus transmitted.

However, it is impossible to detect such accidents other than the absence of the weft, as entanglement of the picked weft around the feeler mechanism or accumulation of water fur to the feeler mechanism after long use because an electric bridge is formed within the feeler mechanism in case of such accidents.

The principal object of the present invention is to provide an electric apparatus having an electric feeler mechanism for detecting irregular insertion of weft into warp sheds, including entanglement of the picked weft around the feeler mechanism or accumulation of water fur to the feeler mechanism, and for stopping the running of the loom automatically and usable in combination with a shuttleless loom having a water jet nozzle.

The device according to the present invention comprises an electric feeler mechanism disposed at an end portion of a reed of the loom on a side opposite the water jet nozzle for to contact the picked weft, an electric

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computer for analyzing the contacting condition of the feeler with the picked weft and an electric stop means for stopping the loom when the output signal of the electric computer indicates an irregular insertion.

Further features and advantages of the present invention will be apparent from the ensuing description with reference to the accompanying drawings to which the scope of the invention is in no way limited.

FIG. 1 is an explanatory perspective view of an apparatus of the present invention and its related parts of a shuttleless loom,

FIGS. 2A and 2B are side and front views of an electric feeler mechanism of the apparatus of the present invention,

FIGS. 3A and 3B are side and front views of means for generating a periodical rectangular pulse according to the present invention,

FIG. 4 is a block diagram showing the relations among the elements of the detecting device of the invention,

FIG. 5 is an explanatory view showing the relations among the generated signals of the elements of the device of the present invention,

FIG. 6 is a block diagram showing the relations among elements of the other embodiment of the apparatus of the present invention,

FIG. 7 is an explanatory view showing relations among generated signals of the elements of the embodiment shown in FIG. 6.

Referring to FIGS. 1, 2A, 2B, 3A, 3B and 4, a reed 3 with a reed cap 2 is supported by a lathe 1, which is supported by a pair of lathe swords 4 and 4'. The respective lathe swords 4 and 4' are connected to a crank shaft of the loom by the respective crank arms 5 and 5' and are swung around an axis of a swing rail shaft 6. A water jet nozzle 7 is disposed to the machine frame in such a way that the column of water jetted from the nozzle passes through the warp shed. The jet nozzle 7 is connected to a high pressure water supply source by way of a metallic pipe 9. The jet nozzle 7 jets water synchronously with the shedding motion of the loom whereby a weft 10 is carried through the warp shed by the above-mentioned column of water from the jet nozzle 7 and, thereafter, beat up to the cloth-fell by the reed 3. The abovementioned operation is performed in the same manner as that of the well-known water jet loom. A pair of electric feelers 11 and 12 are disposed at one end portion of the reed cap 2 by a supporting bracket 14 on a side opposite the setting position of the water jet nozzle 7 as shown in FIG. 1. As shown in FIG. 2A, there is disposed an electric insulator 13 on the bracket 14 between the pair of feelers 11 and 12 in order to form an electric insulation between the feelers 11 and 12. Relative disposition of the feelers 11 and 12 with respect to a reed wire 15 is shown in FIG. 2B, wherein the feelers 11 and 12 are disposed to the reed cap 2 in front of the reed wire 15 with a given intervening clearance. Both of the feelers 11 and 12 are connected to the input terminals of the detecting device shown in FIG. 4A by respective wires 20 and 21 as shown in FIG. 2A. When the picked weft 10 carried by the jetted water comes in contact with the feelers 11 and 12, there is formed an electric bridge between the feelers 11 and 12 by the weft 10 soaked with water.

Referring to FIGS. 4 and 5, the electric circuit generates a series of pulses in the form of voltage variations corresponding to the resistance variation feelers 11 and 12 by the water-soaked and electrically conductive weft. In the explanation described hereinafter, the capital letters of the alphabet designate the elements of the electric circuit and the small letters designate the series of pulses generated by the respective elements of the electric circuit. The element of the device B generates a series of electric

pulses *b* in a rectangular form in such a way that the electric pulses *b* synchronize with the picking motion of the loom. The rectangular pulses *b* are transmitted to two series of electric circuits, one series of pulse is transmitted to a turn-off element C, thereby the pulse *b* is turned off into a series of periodic rectangular pulses *c* of inverted form.

The periodic inverted pulse *c* is transmitted to a differential element D and converted into the differential pulse *d*, and the differential pulse *d* is rectified by a rectifying element E and converted into a trigger pulse *e* which is further supplied to an input terminal of a flip-flop element F.

The detected pulse *a* from the detecting element A is transmitted to an inter-electrode amplifying element G and amplified, into the pulse *g* which has an irregular wave-form in accordance with the contacting condition of the picked weft 10 with the electric feelers 11 and 12. The dotted lines from 0 to VI, FIG. 5, represent the beating point of the crank circle, the intervening distance between the adjacent dotted lines corresponds to one crank cycle of the loom. The periodic pulse *b* is generated before the beating point of the respective cycle. In the FIG. 5, a pulse is generated when the electric feelers 11 and 12 come in contact with the cloth fell at each beating point of the cycle. The above-mentioned pulses are shown in the portion corresponding to each cycle in the series of pulse *g*, the first cycle shows the intermittent contact of the picked weft 10 with the electric feelers 11 and 12 caused by the accidental vibration of the picket weft 10 during the contact, the second cycle shows the stable and continuous contact of the picked weft 10 with the electric feelers 11 and 12, the third cycle shows a misinsertion or the absence of contact of the picked weft 10 with the feelers 11 and 12, the fourth cycle shows accidental and instantaneous contact of only the water column jetted from the jet nozzle 7 but not the weft 10 itself, and the fifth and further cycles shows the entangled condition of the picked weft 10 with the electric feelers 11 and 12 or accumulated condition of water fur between the feelers 11 and 12 caused by long time running of the loom. However, the scale of the pulse generated by the contact of only the water column is too small to cause pulses in the subsequent elements. Consequently, the generating condition of pulses in the fourth cycle is substantially similar to that in the third cycle. The amplified detected pulse *g* is transmitted to a Schmitt element S and converted into sharply rising pulses, and the pulse is converted into the turned-off pulses *h* by a NOT element H. The pulse *h* is transmitted to a differential element I and converted into a differential pulse *i*, and the differential pulse *i* is further rectified by a rectifier J and converted into a series of negative trigger pulses *j*. The negative trigger pulse *j* is transmitted to a flip-flop element F and both trigger pulses *e*, *j* are combined in to the flip-flop element F and then converted into the pulse *f*. As shown in FIG. 5, the pulse *f* returns to the positive electric potential, only when a trigger pulse *j* is generated at the time corresponding to the generation of the trigger pulse *e* in the corresponding cycle. When a misinsertion occurs as shown in the third cycle, or an electric bridge is formed between the electric feelers 11 and 12 by the entanglement of the weft or the formation of water fur as shown in the portion just before the fifth cycle, the pulse *f* is maintained at the zero level of electric potential for a definite period of time which is clearly different from the normal condition of the first or second cycles. The periodic and rectangular pulse *b* bypassed from the detecting element B, is transmitted to a differential element K and is converted into a differential pulse *k* and the pulse *k* is rectified by a rectifying element L and is converted into a trigger pulse *l*. The trigger pulse *l* is generated at the termination of the respective pulse *b* and transmitted to an AND element N, while the trigger pulse *e* is generated at the starting time of the respec-

tive periodic rectangular pulse *b*. The pulse *n* is generated only when the trigger pulse *l* coincides with the pulse *f* which is maintained at the zero level of electric potential for a definite period of time. A one shot multi-vibrator M is disposed between the rectifying element L and the AND-element N, and extends the effective time of the sharpened trigger pulse *l*. The pulse *m* operates a magnetic relay which stops the operation of the loom. The AND-element N generates a pulse *n* only when pulse *f* is maintained at the zero level of electric potential for a definite period of time, while the pulse *m* is generated at the corresponding time of the respective pulse *f*. The pulse *n* is amplified by an amplifying element P and operates a stop relay Q. When the detecting faculty of the electric feelers 11 and 12 is disturbed by adherence of water drops, the same irregular pulse *f* as shown in the above-mentioned case of the sixth cycle is generated, consequently, the loom is stopped by the operation of the stop relay Q.

An embodiment for generating periodic rectangular pulse *b* synchronized with the picking motion of the loom according to the invention is shown in FIGS. 3A and 3B. In the drawings, an operator 16 is secured to an end portion of a crank shaft 6 of the loom in such a way that the operator 16 can be turned at the outside of the machine frame. A detecting head 17 of a transistorized proximity switch is secured to the machine frame maintaining the relative position shown in the drawings with the operator 16. When the operator 16 faces the head of the transistorized proximity switch once during one turning cycle of it, the head 17 detects the passing of the operator 16, consequently the output of the switch forms a series of electric signals having periodic rectangular pulse, as shown in the series of pulses *b* in FIG. 5.

A simple clamping circuit R can be added to the electric circuit of the first embodiment shown in FIG. 4, so as to prevent unstable detecting pulse which may be generated when excess jet water contacts with the electric feelers 11 and 12. Referring to FIGS. 6 and 7, another embodiment of the apparatus of the present invention including the clamping circuit R is shown. In the present embodiment, the functions of the elements except the clamping circuit R are the same as those of the first embodiment of the invention shown in FIGS. 3, 4 and 5. The clamping circuit R is inserted between the amplifying element G and the flip-flop element F. The clamping circuit R generates a series of pulses *r* when the trigger pulse *e* corresponding to the rectangular pulse *b* generated by the transistorized proximity switch B is supplied to the input terminal of the flip-flop element F. The pulse *r* cuts off a large portion of the detecting pulse *g* leaving only portion *g'* in FIG. 7, and is thereafter transmitted to the Schmitt trigger circuit S. As shown in FIG. 7, the wide pulse *g*, which is due to contact of excess jet water with the electric feelers 11 and 12 before and after the picked weft contacts with the feelers 11 and 12, generates unstable electric pulse, however, if the setting position of the transistorized proximity switch is set in such a way that the proximity switch operates just before the contact of the picked weft with the feelers 11 and 12, a large portion of the wire pulse *g* can be cut off, leaving only the portion *g'* by the pulse *r* of the clamping element R, consequently, the unnecessary portion of pulse *g* which is due to the contact of excess jet water with the feelers 11 and 12 can be cut off.

While the invention has been described in conjunction with certain embodiments thereof, it is to be understood that various modifications and changes may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. Apparatus for detecting misinsertion and irregular insertion of weft into the shed of a loom comprising; pulse generating means generating pulses in synchronism with the opening and closing of a warp shed in said loom,

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means for sensing the insertion of weft, which is in an electrically conductive condition, in said warp shed, said sensing means including means directly responsive to the electrical condition of the weft, and means responsive to said sensing means to vary said pulses in dependence upon the sensing of said sensing means of a misinsertion and irregular insertion of weft in the warp shed.

2. Apparatus according to claim 1, including means receiving at least the varied pulses responsive to the varied pulses for stopping said loom.

3. Apparatus according to claim 1, in which said means directly responsive to the electrical condition of the weft comprises two, spaced, sensing electrodes and means connecting said electrodes to the last-mentioned means.

4. Apparatus according to claim 1, in which said means to vary said pulses comprises circuitry receptive of said pulses in synchronism with said opening and closing of said warp shed and means for varying the pulses only when a misinsertion and an irregular insertion of weft in said shed is detected by said sensing means.

5. Apparatus according to claim 1, in which said pulse generating means comprises a pulse generator timed with the crankshaft cycle of said loom.

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6. Apparatus according to claim 1, in which said loom is a water-jet loom and includes means for wetting the weft during operation, and in which said means directly responsive to the electrical condition of the weft comprises electrodes bridged by said wetted weft during operation upon insertion of said weft in said warp shed, and in which said means to vary said pulses comprises circuitry connected to said electrodes receptive of said pulses in synchronism with said opening and closing of said warp and comprising means for varying the pulses only when a misinsertion and an irregular insertion of said weft in said shed occurs and is detected by said sensing means.

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