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(54) METHOD AND APPARATUS FOR DETECTING WARP BREAKAGE OF FLUID INJECTION WEAVING MACHINE

(57) A technique to detect a weft shortage is applied to a technique to detect a weft shortage in a fluid jet loom for inserting a plurality of wefts (12) simultaneously into a warp shedding. Such a technique to detect a weft shortage is characterized by measuring an arrival timing of the weft through a weft sensor (34) disposed in a weft moving path, comparing the measured arrival timing with the reference timing, and detecting as a weft shortage when a state that the arrival timing is earlier than the reference timing occurs a predetermined number of times in a row.

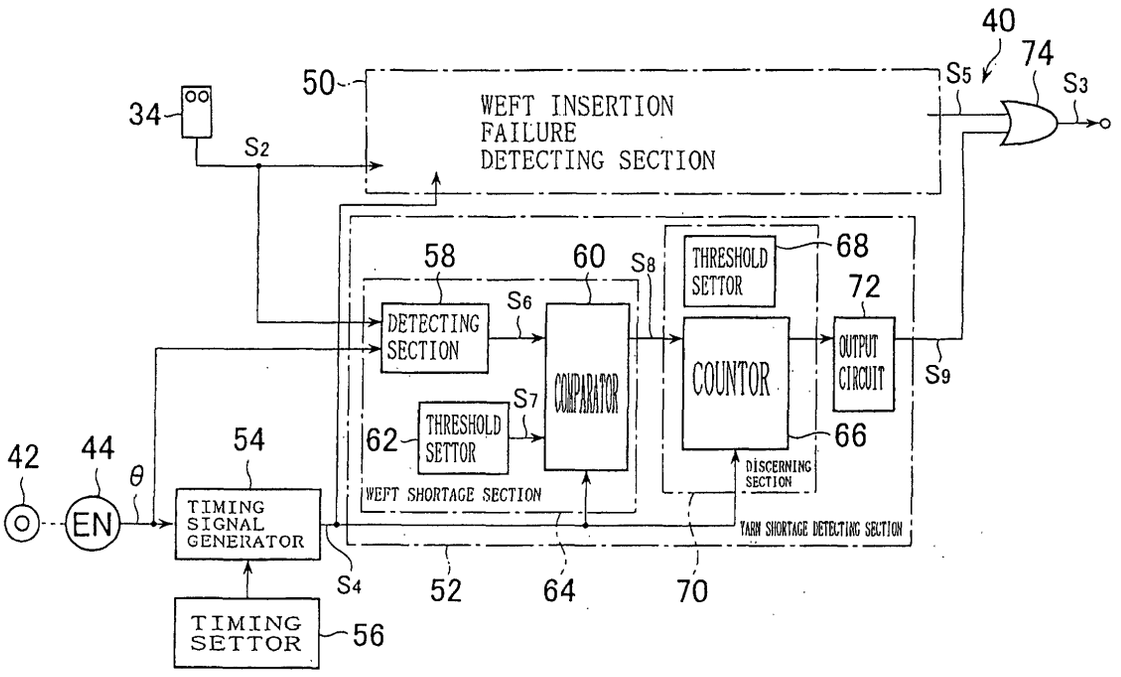

FIG. 2

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a method and an apparatus for detecting a weft shortage in a fluid jet loom, and more particularly, for detecting that one or more wefts used up.

Description of Prior Art

[0002] As one of apparatus for detecting a weft shortage, there is a technique to dispose a weft sensor forming a weft detection area in a weft running path on a non-inserting side and to generate a loom stop signal when the weft is not detected by the weft sensor at a predetermined timing, thereby judging that there is no weft (Japanese Patent Appln. Public Disclosure (KOKAI) No. 58-174660).

[0003] As another one of apparatus for detecting a weft shortage, there is a technique to detect a balloon of the weft pulled out from a weft package to a length measuring storage device by an optical weft sensor, generating a release signal, and to generate a weft shortage signal, thereby judging, when the release signal stops generating, that the weft in the package has run out (Japanese Patent Appln. Public Disclosure No. 3-119146).

[0004] In the former, however, in a so-called double pick insertion wherein a plurality of wefts are simultaneously inserted into a warp shedding in order to accelerate weaving on account of short-term delivery of a cloth, it is not possible to detect a weft shortage when any one of the wefts is used up.

[0005] In the latter, a weft shortage in weft feeding such as a used up can be detected, but it is not possible to detect a weft shortage such as weft breakage caused on the side more downstream than the position disposing a yarn sensor. Further, since a weft sensor for exclusive use for every kind of the weft to be inserted should be disposed, which amounts to a considerable sum.

SUMMARY OF THE INVENTION

[0006] An object of the present invention is to enable, in a fluid jet loom for inserting a plurality of weft simultaneously into a warp shedding, to detect a weft shortage in any weft caused on the side more upstream than a weft insert nozzle by means of a device of a simple structure.

[0007] A method and an apparatus for detecting a weft shortage according to the present invention are applied to a technique to detect a weft shortage in a fluid jet loom for inserting a plurality of wefts simultaneously into a warp shedding.

[0008] Such a method for detecting a weft shortage comprises steps of measuring an arrival timing of the weft through a weft sensor disposed in a weft moving path, comparing the measured arrival timing with a reference timing, and detecting as a weft shortage when a state that the arrival timing is earlier than the reference timing occurs a predetermined number of times in a row.

[0009] Such a weft shortage apparatus comprises: an weft shortage detecting section for measuring the weft arrival timing through a weft sensor disposed in a moving path of the weft and for generating a logic signal when the measured arrival timing is earlier than the reference timing; and a discerning section for outputting a weft shortage signal when the logic signal is inputted a plurality of times in a row.

[0010] In a fluid jet loom which inserts a plurality of wefts simultaneously into a warp shedding, if any weft is used up on the side more upstream (weft supply side) than the weft insert nozzle, a jet fluid for weft insertion acts only on a normal weft because the weft which runs out is no longer fed to weft insert nozzle. As a result, the so-called arrival timing for the normal weft to reach a predetermined position becomes earlier in comparison with the normal time.

[0011] In the present invention, therefore, if a state that the arrival timing is earlier than the reference timing occurs a plurality of times in a row, one or more weft shortages can be surely detected. Further, this dispenses with providing the weft detecting section, the weft shortage discerning section or the like per weft, the structure of the apparatus is simplified.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Fig. 1 is a block diagram showing an embodiment of a fluid jet loom provided with the weft shortage detector according to the present invention.

Fig. 2 is a block diagram showing an embodiment of the weft detecting device provided with a weft shortage detector according to the present invention.

PREFERRED EMBODIMENT OF THE INVENTION

[0013] Referring to Fig. 1, the fluid jet loom 10 using the weft shortage detecting apparatus is, in the illustration, constituted as an air jet loom which simultaneously inserts a plurality (two in the illustration) of the wefts 12 into a shedding 14 of the warp by pressurized air.

[0014] In the fluid jet loom 10, each weft 12 is measured per a length of 1 pick from a weft package 16 and engaged with an engagement pin 20 and stored in the length measuring storage device 18 with the front end side passed into a weft insert nozzle 22. When inserted, both wefts 12 are disengaged from the length measuring storage device 18 and inserted simultaneously into the

shedding 14 of the warp from the weft insert nozzle 22 together with the compressed air for weft insertion.

[0015] Halfway of weft insertion into the warp shedding, both wefts 12 further receive running force by the compressed air ejected from a plurality of subnozzles 24. The inserted weft part is beaten by a reed (not shown) against a cloth fell and is woven into a cloth 26, to be thereafter separated by a cutter 28 from the yarn part on the upstream side between the weft insert nozzle and the cloth 26.

[0016] When inserted, the weft 12 stored in the length measuring storage device 18 is, if disengaged by the engagement pin 28, is pulled out of the length measuring storage device 18 by traction force of the weft insert nozzle 22 and the subnozzle 24 by forming a balloon. This weft balloon is detected by a disengagement sensor per weft 12 using a light sender 30 and a light receiver 32, and its output signal or a release signal S1 is fed to a controller not shown as a signal meaning that one round of weft is pulled out of the length measuring storage device 18.

[0017] The front end portion of the inserted weft is detected by a yarn sensor 34 disposed on the weft non-supply side and also catched by a plurality of catch codes 36. The yarn sensor 34 is provided with a light sender as well as a light receiver, and, when the weft is in a weft detection area between the light sender and the light receiver, outputs a yarn signal S2 of an H level meaning that there is a weft to the weft detecting device 40. A catch code 36 forms a shedding together with the warp 14 and catchs the front end portion of the cut-away weft at an appropriate time.

[0018] Besides the yarn signal S2, an angle signal θ is fed to the weft detecting device 40. The angle signal θ is a signal representing an angle of rotation of the main shaft 42 of the loom and is generated in an encoder 44 for detecting the angle of rotation of the main shaft 42.

[0019] The weft detecting device 40 confirms, based on the yarn signal S2 and the angle signal θ to be supplied, as to whether or not the yarn signal S2 is inputted when the angle of rotation of the main shaft 42 is a predetermined value, and when the yarn signal S2 is not inputted, judges as a failure in weft insertion and outputs a loom stop signal S3 of the H level for stopping the loom to a controller not shown. The loom stop signal S3 at this time is a weft insertion failure signal.

[0020] The yarn signal S2 is generated so long as there is one or more wefts 12 in the weft detection area of the yarn sensor 34. Therefore, even if at least one of the wefts 12 to be simultaneously inserted runs out due to exhaustion, breaking or the like of the weft, if another weft has arrived, it is detected and the yarn signal is outputted, so that the weft shortage cannot be detected.

[0021] In the fluid jet loom 10, however, if any one of the wefts 12 runs short on the side more upstream than the weft insert nozzle 22, the weft which runs short is no longer fed to the weft inset nozzle 22. Due to this, in the weft insertion thereafter, a jet fluid for weft insertion acts only on the normal weft, and the so-called arrival timing that the normal weft arrives at a predetermined position becomes earlier than when inserted normally.

[0022] Then, the weft detecting device 40 measures, on the basis of the yarn signal S2 and the angle signal θ to be fed, the so-called arrival timing when the front end of the weft 12 arrives at the position disposing the yarn sensor 34, compares it with the measured timing with reference timing, judges, if a state that the arrival timing is earlier than the reference timing occurs a plurality of times in a row, the weft detecting device 40, that any one of the wefts runs out, and outputs the loom stop signal S3 for stopping the loom to a controller not shown. The loom stop signal S3 at this time is a weft shortage signal.

[0023] In the fluid jet loom 10, therefore, when a state that the arrival timing is earlier than the reference timing occurs a plurality of times in a row, running out of the weft is detected, so that running out of one or more weft can be surely detected, and since a detection circuit can be shared by a plurality of wefts, the structure of the weft detecting device 40 is simplified.

[0024] Concrete examples of the weft detecting device 40 such as above are explained with reference to Fig. 2.

[0025] The weft detecting device 40 receives the yarn signal S2 from the yarn sensor 34 in a weft insertion failure detecting section 50 as well as in a weft shortage detecting section 52 and receives an angle signal θ from an encoder 44 in the weft shortage detecting section 52 as well as in a timing signal generator 54.

[0026] Based on the inputted angle signal θ , the timing signal generator 54 feeds a timing signal S4 which reaches an H-level only during a period corresponding to a weft detection period to the weft insertion failure detecting section 50 as well as to the weft shortage detecting section 52. The timing for generating the timing signal S4 is set in a timing setter 56. Such a timing signal S4 can be a signal, for example, to turn ON (H-level) at 200° and OFF (L-level) at 290° supposing that beating is done at 0° .

[0027] The weft insertion failure detecting section 50 is a publicly known circuit which, on the basis of the yarn signal S2 and the angle signal θ, confirms as to whether or not the yarn signal S2 is inputted when the rotation angle of the main shaft 42 is at a predetermined value, judges as a weft insertion failure when not inputted, and outputs a weft insertion failure signal S5 of the H-level.

[0028] The weft shortage detecting section 52 receives the yarn signal S2 and the angle signal θ in an arrival angle detecting section 58. The arrival angle detecting section 58 detects a rotation angle $\theta 1$ of the main shaft when the front end of the weft reaches a position disposing the yarn sensor 34, and based on the received yarn signal S2 and angle signal $\theta 1$, outputs the detected arrival angle $\theta 1$ as an arrival timing S6 to a comparator 60. The arrival angle $\theta 1$ can be the value of the angle signal θ (the rotation angle of the main shaft 42), for ex-

ample, at the time the yarn signal S2 turns ON.

[0029] The comparator 60 compares the arrival timing S6 with a reference timing S7 set in a threshold setter 62 every time the timing signal S4 is inputted and, when the arrival timing S6 is earlier than the reference timing S7, generates a pulse-like signal S8 to that effect. The arrival angle detector 58, the comparator 60 and the threshold setter 62 acts as an weft shortage detecting section 64 which determines that the arrival timing of the weft at a predetermined position is earlier than the normal timing.

[0030] The reference timing S7 set in the threshold setter 62 can be a timing that all the wefts to be inserted simultaneously arrive normally at the position disposing the yarn sensor 34. In view of a dispersion when all the wefts are normally inserted, such reference timing S7 is preferably in a range without such a dispersion.

[0031] An output signal S8 of the weft shortage detecting section 64 is fed to a counter 66. The counter 66, counting the signal S8, compares the count value, every time the timing signal S4 is inputted, with a reference frequency set in the threshold setter 68, and when the count value reaches the reference frequency or over, generates a weft shortage signal S9 of the H-level. The counter 66 and the threshold setter 68 acts as a discerning section 70 for judging whether or not the number of times that the arrival timing S6 is earlier than the reference timing S7 continued a predetermined number of times.

[0032] In case, for example, the weft arrival timing at a normal time causes a dispersion of ±6° to the main shaft angle 230° , the reference timing of the threshold setter 62 is set at 220° in anticipation thereof and the reference number of times of the threshold setter 68 is set at 2. When weft shortage occurs in either of two wefts simultaneously inserted while the loom is running, since the weft arrives earlier by 12° than the ordinary 230° (that is, at 218°) and the jet stream at the time or after the second pick insertion acts on the normal (not running out) weft, acceleration of weft arrival, like in case of the first pick, continuously occurs. Namely, since at the time or after the occurrence of weft shortage the signal S8 is continuously generated at every weft insertion and is counted by the counter 66, the weft shortage detecting section 52 can stop the loom by generating a stop signal at the second or third pick from the occurrence of the weft shortage.

[0033] The reference number of times frequency set in the threshold setter 68 is a frequency for judging as weft shortage, for which a value of 2 or more is set. The greater the reference frequency is, the more the loom stop is delayed, while if the reference frequency is too small, stop in error (stop by running out) due to the abrupt acceleration occurs. It is, therefore, desirable to determine the reference frequency in view of the actual running conditions.

[0034] The weft shortage signal S9 is fed to one of the input terminals of an OR circuit 74 through an output circuit 72. The OR circuit 74, receiving the weft insertion failure signal S5 at the other input terminal, outputs an OR signal of both input signals S5 and S9 as the loom stop signal S3.

[0035] Since the weft detecting device 40 detects the weft shortage by the fact that the state where the arrival timing is earlier than the reference timing continuously occurs a plurality of times, one or more weft shortage can be surely detected, and since the weft shortage detecting section 64, the discerning section 70 and the output circuit 72 can be shared by a plurality of wefts, the structure of the device is simplified.

[0036] In the above embodiment, variation as follows is feasible. The number of the wefts simultaneously inputted is not limited to 2 but may be 3 or more. Also, in case a plurality of wefts inserted at the same time are changed to different kinds per pick, in correspondence therewith a plurality of weft insert devices such as a length measuring storage device and a weft insert nozzle are disposed, but in the present weft shortage detector, since the reference timing in the weft shortage detecting section and the reference frequency in the discerning section are set according to the kinds of yarn, thereby enabling to do weft insertion and weft shortage detection in correspondence with switching of selected kinds of yarn.

[0037] In the above embodiment, in place of using a signal of the yarn sensor 34 disposed on the non-inserting side, it is possible to use, for the detection of weft shortage, an output signal of another yarn sensor disposed in a weft running path such as a yarn sensor disposed within a warp shedding for controlling weft insertion, a yarn sensor disposed on the downstream side of the main nozzle or the like, or an output signal of a yarn sensor disposed in a remaining weft moving path excepting the weft running path such as a yarn sensor for detecting a balloon disposed between the weft package 16 and the length measuring storage device 18 in Fig. 1.

[0038] In case of using an output signal of a release sensor in Fig. 1 for detection of a weft shortage, as a release timing relates to the arrival timing, the release signal S1 indirectly relates to the front end position of the weft, so that when acceleration of the arrival timing (timing for release) occurs continuously, it is possible to discern as a weft shortage.

[0039] As a yarn sensor for detecting the weft, not only optical one but also a yarn sensor of an appropriate type such as contact, non-contact, electrostatic capacity, reflex, translucent types, etc., can be used.

[0040] In place of disposing a weft shortage detecting section in a conventional weft detecting device as in case of the embodiment shown in Fig. 2, it is possible to make the weft shortage detector independent from the weft detecting device. Also, as a criterion of the arrival timing, the lapsed time from the reference angle may be used in place of using a rotation angle of the main shaft.

[0041] A function of detecting a weft shortage is not

necessarily operated at all times while the loom is running, but may be made inoperable depending on the control at the side of the loom. For example, by using jointly a publicly known weft control such as the fluid jet timing control or the pressure control for making the arrival timing constant, for changing the roll diameter of the weft package or the like, the function for detecting a weft shortage may be made inoperable while the weft insertion is under control (while changing the fluid jet timing and fluid pressure).

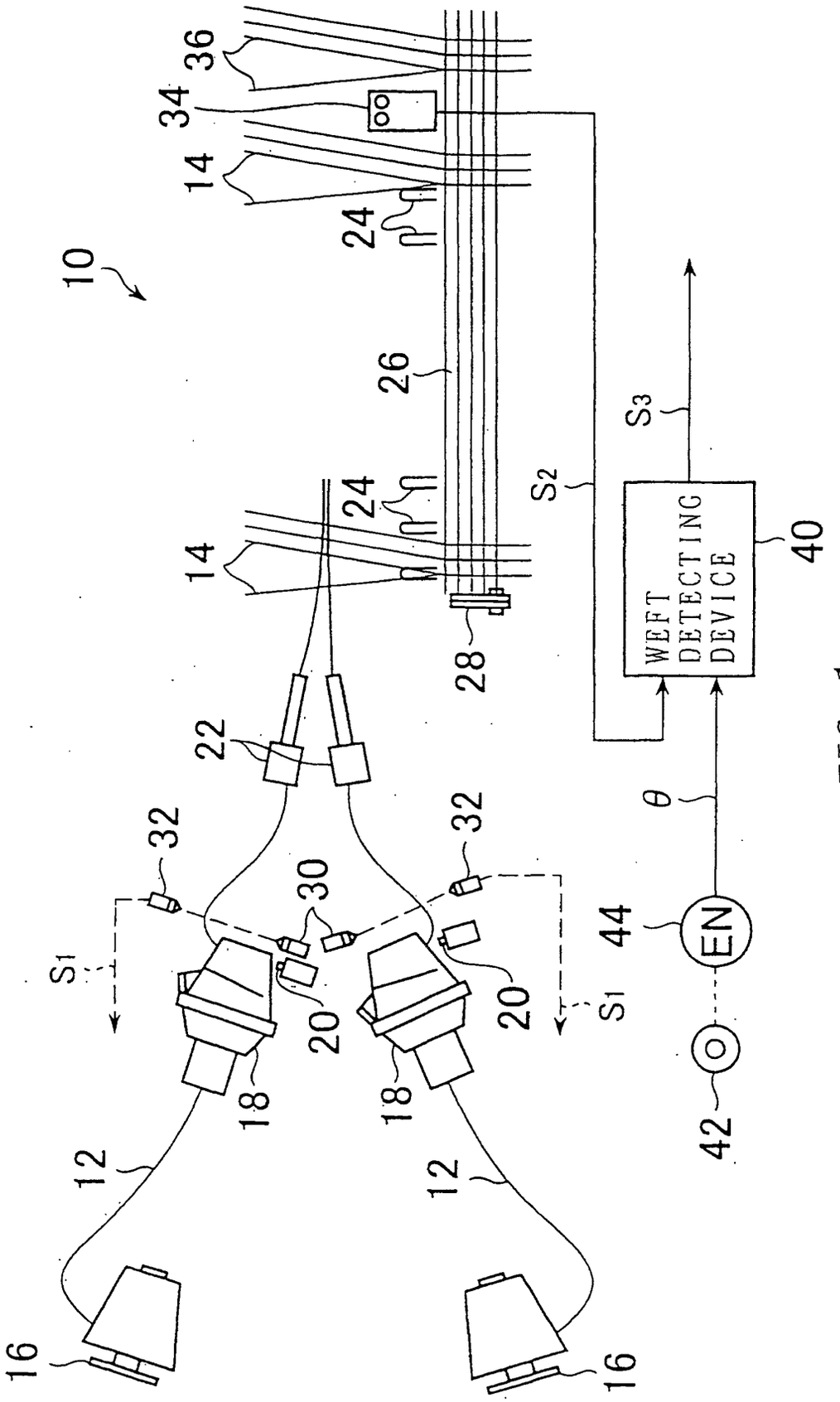
[0042] The present invention can be applied also to a weft shortage detecting apparatus of another fluid jet loom such as a liquid jet loom using a liquid such as pressurized water as a fluid for weft insertion.

[0043] The present invention is not limited to the above embodiments but can be variously changed without deviating from its purpose.

Claims

1. A method for detecting a weft shortage in a fluid jet loom for inserting a plurality of wefts (12) simultaneously into a warp shedding, comprising steps of: measuring an arrival timing of the weft through a weft sensor (34) disposed in a weft moving path; comparing the measured arrival timing with a reference timing; and detecting as the weft shortage when a state that the arrival timing is earlier than the reference timing occurs a predetermined number of times in a row.

2. An apparatus for detecting a weft shortage in a fluid jet loom for inserting a plurality of wefts (12) simultaneously into a warp shedding, comprising: an weft shortage detecting section (64) for measuring an arrival timing of the weft through a weft sensor (34) disposed in a weft moving path and generating a logic signal when the measured arrival timing is earlier than a reference timing; and a discerning section (70) for outputting a weft shortage signal when the logic signal is inputted a plurality of times in a row.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WEFT DETECTING DEVICE

FIG. 1

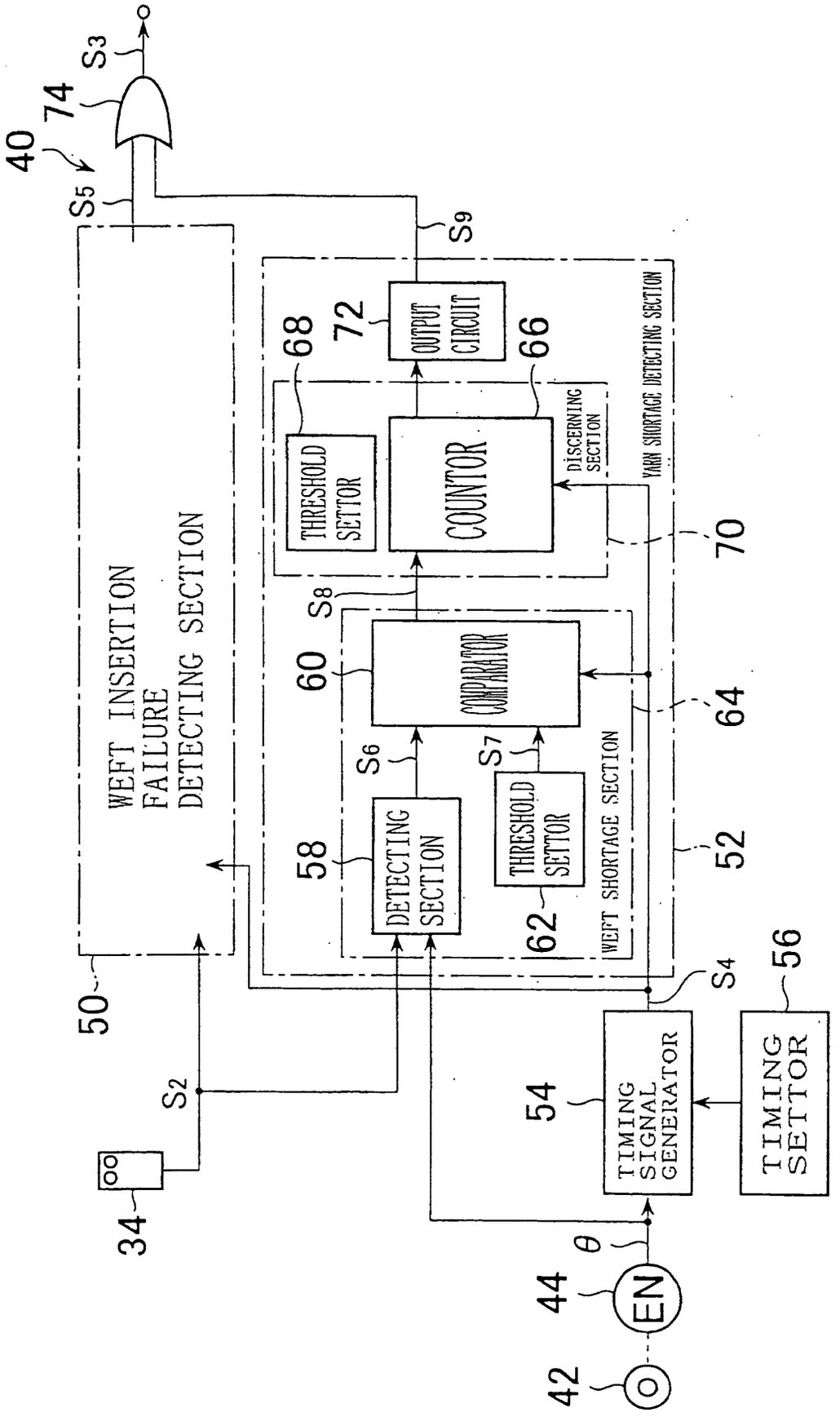
WEFT INSERTION FAILURE DETECTING SECTION
YARN SHORTAGE DETECTING SECTION
WEFT SHORTAGE SECTION
DISCERNING SECTION
DETECTING SECTION
COMPARATOR
COUNTOR
THRESHOLD SETTOR
THRESHOLD SETTOR
OUTPUT CIRCUIT
TIMING SIGNAL GENERATOR
TIMING SETTOR
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FIG. 2