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Selected US specifications from IPC sub-classes D04B G05B

(54) Safety device for knitting machines

(57) In a safety device (11) for flat knitting machines, which by means of a switch-off device stops the motion of the carriages in the case of any change, compared with normal operation, in the force needed to move the carriages as a result of fault conditions, an electrical signal proportional to the actual value of the drive torque or force is compared in an adjustable comparator (23) with a threshold value which is given to the comparator (23) from a CPU (24) and is a processed actual value of the torque-proportional signal, e.g. recorded during the previous carriage stroke and held in a latching circuit 22. This avoids the disadvantage of a preset threshold being too high. A similar circuit is associated with piezo-electric sensors which monitor shock pulses in the needle beds. The threshold value may be changed over the width of the needle beds by the CPU 24 with the aid of an erase circuit 26.

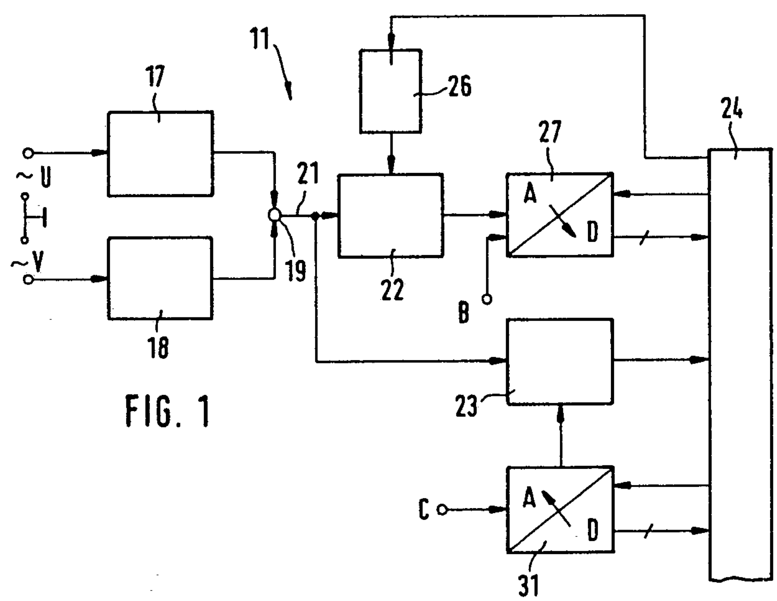

FIG. 1

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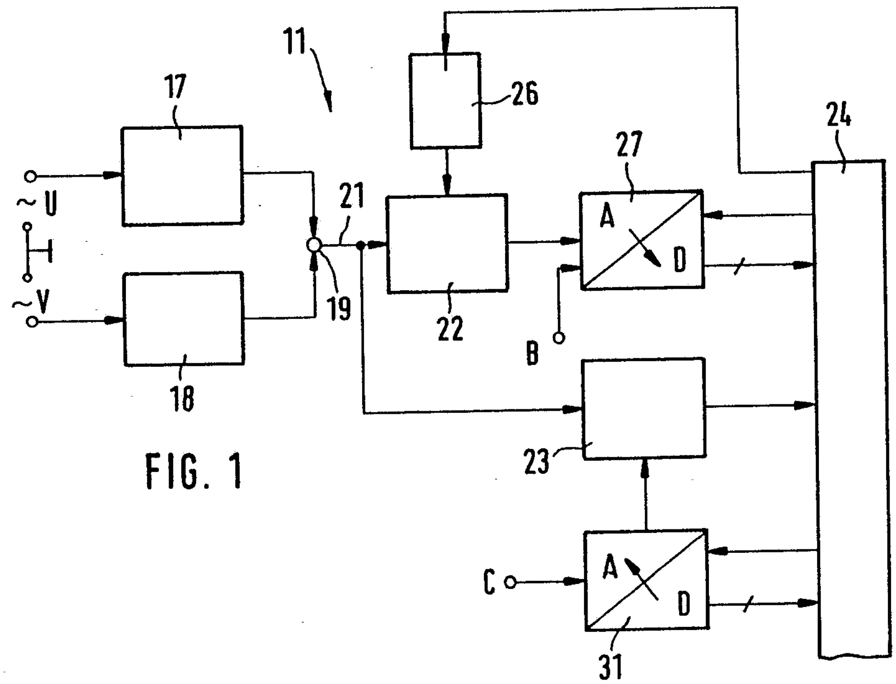

FIG. 1

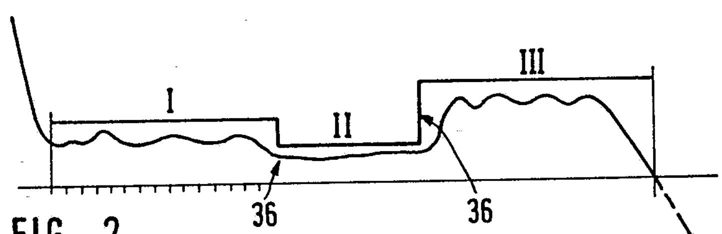

FIG. 2

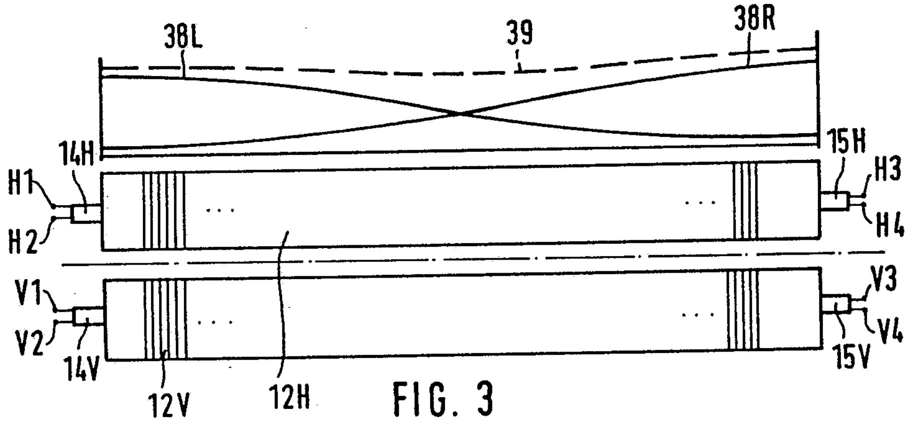

FIG. 3

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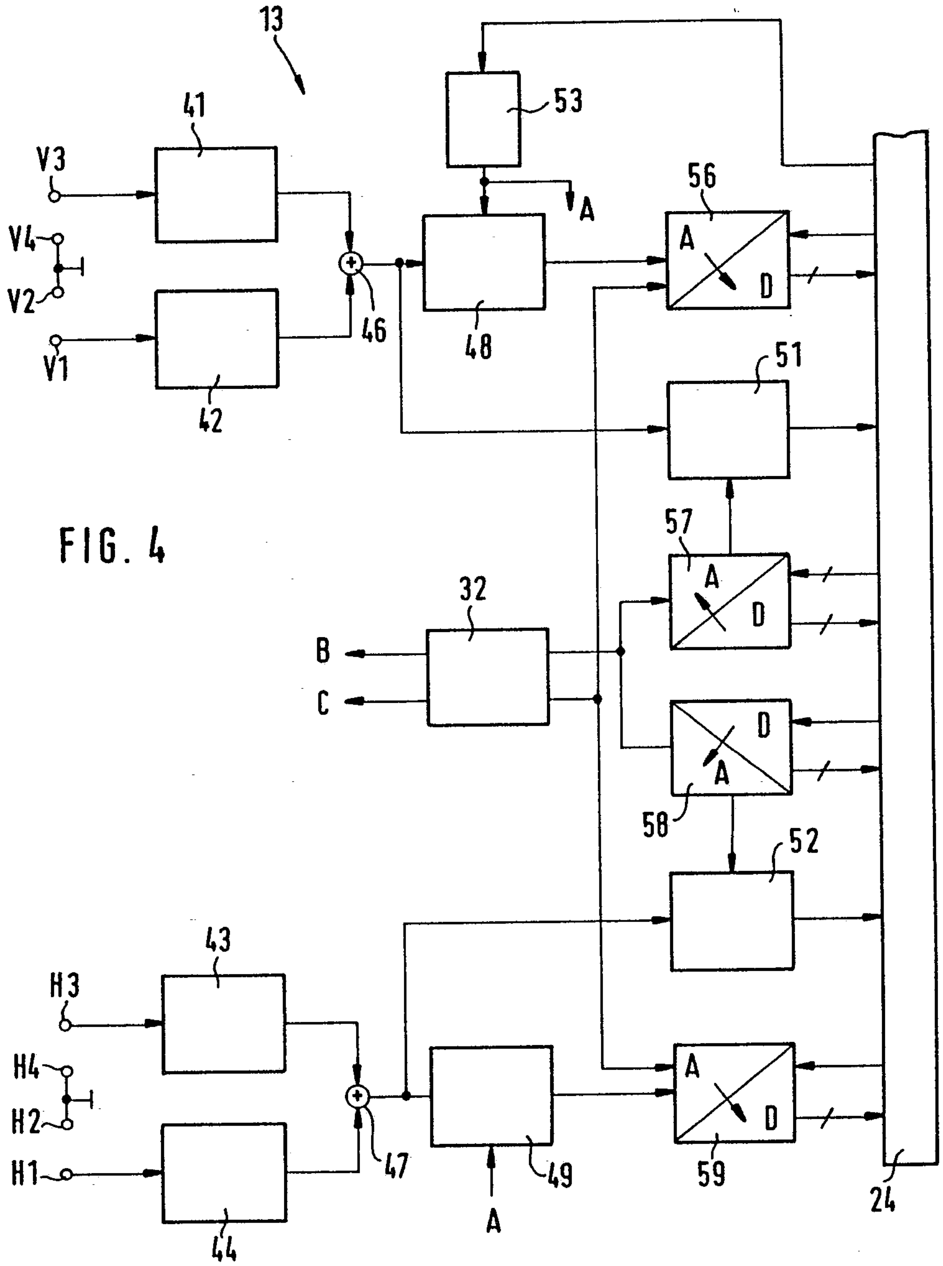

FIG. 4

SPECIFICATION

Safety device for knitting machines

The present invention concerns a safety device for knitting machines in particular for flat knitting machines which device is intended, in the case of a flat knitting machine, to record the force needed to move the carriages.

Hitherto, under fault conditions a mechanical safety device has been used with a lever or slide which is pretensioned by one or two springs which by their pre-tension determine the permissible resistance load limit, the exceeding of which stops the carriage drive. A state of the art mechanical safety device is described for example in the introduction to published German specification DE 21 20 824.

This known safety device has the disadvantage that it begins to work relatively sluggishly and only after a certain time lapse, since in order to release the safety mechanism the safety member must travel a certain distance against the force of the spring or springs. A further disadvantage is that such a safety device can only be set at one clearly defined threshold value. The force necessary to move the cam carriage or carriages along the needle beds is not however of constant magnitude but depends on the number of working needles, the number of cams used, the type of operation, the firmness of the stitches and the like.

Furthermore, the force is dependent on individual machines even of the same type. Therefore with the known safety device the threshold value must be set at at least the maximum value (to be expected on the basis of experience) of the force for moving the carriages of the machine type in question. Moreover, when flat knitting machines are operated again after standing still for some time, e.g. overnight, it is a problem that the necessary force is greater than it is when the machine has warmed up. As a rule the operator takes this into consideration by adjusting the safety device by hand, but not re-adjusting it once the machine has warmed up.

Over against this the invention relates to a safety device in particular for flat knitting machines which device is intended to record pulsating mechanical loads on the needle bed.

In a safety device of this kind known from published German specification DE 21 20 824, piezo-electric vibration absorbers are used, one of which is arranged at each needle bed. Evaluation of the output signals of these two piezo-electric vibration absorbers for each flat knitting machine takes place in a parallel manner with the help of a voltage divider circuit and one energising circuit connected therewith for the switch-off device. Here also there is the disadvantage that each piezo-electric vibration absorber is set a quite definite fixed threshold value. The mechanical loads on the needle beds are however dependent on the speed of the carriage arrangement, the number of cams and also on the production tolerances of the machine. Thus it is necessary, in this case also, to set the threshold value of the known safety device according to experience, namely above that value which can be expected in the worst case in trouble-free operation. Here again it may not be taken into account that knitting conditions can vary from machine to machine and also that knitting conditions when the machine starts after a considerable rest time are very different from operation when the machine has warmed-up.

Over against this, the present invention relates to a safety device for flat knitting machines, with which both the changes occurring in force for moving the carriages and the changes occurring in the mechanical load on the needle beds are recorded which can lead to the knitting machine being switched off. None of the various kinds of breakdown can record optimally only by one part of the safety device. For example, European Patent Specification No.0079386 reveals a safety device based on monitoring the change in carriage speed. With modern drives however the carriage speed does not change, in the case of the first faults mentioned in the introduction, when the carriage moves sluggishly, and even in the case of the second possibile fauilt, that of jolts caused by broken needles, no reduction in speed can be expected, since the moved mass of the carriage arrangement is so great that needle butts or jack butts can be sheared off without having any effect on the carriage speed.

The invention therefore sets out to solve the problem of creating a safety device with which it is possible to take into account the varying knitting conditions in individual flat knitting machines of the same type or of different types and with the same or different operating programmes, in such a way that the safety device can be made sufficiently sensitive in each case. It is also intended to create a safety device which respond in an exceedingly sensitive way both to any change in the force needed to move the carriages and to any change in the mechanical load on the needle beds.

In accordance with the present invention there is provided a safety device for flat knitting machines particularly, including a switch-off device which arrests movement of the carriages should any change, (as compared with normal operation) occur in the force required to move the carriages as a result of a fault condition such as when fabric is being taken down, forming and transferring stitches, too high a setting of stitch firmness or the like, in which a measuring device is provided for recording a signal proportional to the torque applied by a drive device to the carriages, the actual values of the torque-proportional signal being conveyable to a central processing unit and to an adjustable comparator, threshold values for the torque-proportional signal being supplied to the comparator from the CPU as processed actual values of the torque-proportional signal, the switch-off device being energisable by the comparator as soon as the relevant threshold value is exceeded.

Also in accordance with the present invention there is provided a safety device for flat knitting machines having piezo-electric vibration absorbers fixed on the needle beds, which absorbers, via a switch-off device, stop the carriages in the event of a change (as compared with the normal operation) in the mechanical load on the needle beds as a result of e.g. jolts or the like, by means of a comparator whereby the switch-off device is energisable as soon as a pre-selected threshold value is exceeded, each needle bed being provided at each of its longitudinal ends with a piezo-electric vibration absorber the outputs of which are connected with a respective adjustable comparator, the actual values of a load-proportional signal for each needle bed being conveyed to a CPU and to the relevant comparator, and the actual values, processed by the CPU, of the relevant load-proportional signal are fed to each comparator as threshold values for comparison with the load-proportional signal.

The safety device according to the invention responds to a change in the force required to move the carriage and uses advantageously a torque-proportional signal which is thus also proportional to the force needed to move the carriage. Since the threshold values are preselected by the CPU, they can in each case be brought very close to the values which actually occur, thus enabling sensitivity of essentially equal quality to be achieved for every flat knitting machine.

When the drive device is a hydraulic drive the torque-proportional signal can for example be the hydraulic fluid pressure. In a preferred embodiment of the present invention an electric drive is used which is set at or regulated to a constant number of revolutions and it is the motor current which is used to provide the torque-proportional signal. According to the present invention, the preferred electric drive means is of a three-phase current synchronous motor, the motor current of which is recorded by the measuring device in at a least two phases, the sum of the two values being conveyed to the comparator circuit.

In the alternative aspect the safety device according to the invention responds to change in the mechanical load on the needle beds and is made considerably more sensitive by the fact that each needle bed is provided, at each of its longitudinal ends, with a piezo-electric vibration absorber, and also by a special evaluation circuit. In this way the vibrations which occur in any case with different machines are recorded in a differentiated way and the pre-selected threshold values can be adjusted to them.

A further increase in sensitivity is possible when, as is achieved in a preferred embodiment of the invention, the two piezo-electric vibration absorbers of each needle bed are connected with the comparator circuit via a summing circuit. This makes it possible to maintain essentially the same measurements, at least at both ends of the needle beds, irrespective of the point on the needle bed from which a pulse wave starts. This is true also for the central region of each needle bed, where the magnitudes of the two vibration absorbers are added here also.

In the safety device according to the invention of the two types described, the torque-proportional or load-proportional signal respectively is continuously measured and discontinuously stored in a holding circuit during a preselected period in the form of the highest value likely to arise in each case, and the holding circuit is connected with the CPU for the purpose of interrogating the stored values by the CPU, the interrogated stored values forming the basis for an alteration of the preselected threshold values. In this way an envelope curve corresponding to the actual course of loading can be drawn. Furthermore it is possible, on the basis of experiences or of measurements of trouble-free operation, to pre-select threshold values which take into account the maximum occurring loads and which therefore contribute to a high degree of sensitivity of the safety device.

Depending on whatever changes in the force needed to move or displace the carriage and/or in the mechanical load on the needle beds occur during one stroke of the carriage, it is advantageous either to store the highest value of the torque-proportional or load-proportional signal, over the course of one carriage stroke in each case and to use this value to alter the threshold value for the following stroke; or to subdivide the carriage stroke into a plurality of working ranges which demand about the same force on the carriages and/or about the same mechanical loading on the needle beds. Within these ranges the highest value of the torque-proportional or load-proportional signal is stored, and it is advantageous to use these values to alter the relevant threshold values in corresponding working ranges of the subsequent carriage stroke. If the changes resulting during the carriage stroke are slight, the procedure according to the first alternative can be followed in a simple way, whereas in the case of greater changes it is advantageous, in view of the sensitivity of the safety device, to follow the procedure of the second alternative.

It is also advantageously possible to define the appropriate working ranges in accordance with whatever knitting programme is fed in, i.e. depending on machine speed, number of jacks, number and type of working needles, and the like.

A safety device in which the recording both of the force on the carriage and of the mechanical load on the needle beds may be combined and has the advantage that all the fault conditions mentioned can be reliably recorded with high sensitivity and also differentiated from each other.

The invention will now be described further by way of example with reference to the accompanying drawings in which:

Figure 1 shows a block wiring diagram with the drive current monitor of a safety device according to a preferred embodiment of the present invention;

Figure 2 is a schematic diagram of the current and/or torque output of the drive device which occur for example during one carriage stroke, and an envelope curve derived therefrom;

Figure 3 is a schematic representation of the mechanical part of a pulse monitor of the safety device according to the preferred embodiment of the present invention, and

Figure 4 is part of a block wiring diagram with the pulse monitor of the safety device according to the invention.

The safety device acording to a preferred embodiment of the present invention, shown in the drawing, is particularly suited for flat knitting machines but may also be used for circular knitting machines. The device consists of two parts, namely of a drive current monitor 11 and a pulse monitor 13. The drive current monitor 11 stops movement of the cam carriages (not shown) over the needle beds 12, in the case of any change in the force needed to drive the cam carriages as compared with normal operation, resulting from faults when taking down fabric or forming and transferring stitches, from a too high given level of stitch firmness or the like. The pulse monitor 13 which, by means of piezo-electric vibration absorbers 14, 15 (so-called piezo-elements) secured on the needle beds 12, stops the motion of the cam carriages in the case of any change from relevant normal operation in the mechanical load on the needle beds 12 resulting from e.g. pulses or the like. While the drive current monitor 11 monitors any sluggishness, compared with normal operation, of the cam carriages, which sluggishness occurs with increases torque output of a drive device of the cam carriages and thus with the increased current consumption when an electric drive is used, pulsating or sudden strains on the front and/or rear needle bed 12V or 12H respectively, caused by for example shearing-off of needle butts or jack butts, are monitored with the help of the pulse monitor 13.

In all cases, the knitting machine is switched off. It is to be understood however that in the safety device according to the invention, instead of the combination of the two monitors, only one of the two monitors 11 or 13 can be provided. The drive current monitor 11 can record, instead of the current taken by the motor of an electric drive, also a different torque-proportional signal (e.g. hydraulic flow volume and/or flow pressure), if a different drive, e.g. a hydraulic motor, is used.

The electric drive is in the form of a constant speed three-phase synchronous motor in order to move the carriage to and fro in the flat knitting machine which is to be monitored, a measuring device being provided in two of its three phases (e.g. U and V) to measure the current consumed and thus give a signal proportional to the torque produced. In the measuring circuit of each of the two measuring phases is provided with a peak value or full-wave rectifier 17 or 18 respectively, the outputs of which are conveyed to a summing circuit 19, at the output 21 of which the sum of the outputs of the two peak value rectifiers 17, 18 always appears. The output 21 of the circuit 19 is conveyed both to a first input of a peak value holding or latching circuit 22 and to a first input of a pre-adjustable comparator 23. The output of the comparator 23 is connected with a CPU or computer 24.

A further input of the peak value holding circuit 22 is connected with a peak value erase circuit 26 to which an input signal from the CPU 24 is conveyed. The output of the peak value holding circuit 22 is conveyed to a first input of an A/D converter 27, the first output of which serves to interrogate peak values, and the second output of which is connected with the CPU 24. With a second input of the comparator 23 is connectd a D/A converter 31, the first input of which serves to set the comparator threshold, and the second input of which is connected with the CPU 24. The connections B and C of the A/D converter 27 and the D/A converter respectively are connected with the relevant outputs of a reference voltage circuit 32 (Fig. 4).

It is understood that a constant speed d.c. motor can also be used as the elctric drive source. In this drive the armature current is measured and this measuring circuit connected with the peak value holding circuit 22. The drive used is in each case preferably reversible (to reverse the direction of rotation), therefore any desired lengths of carriage stroke can be pre-selected. The drive current monitor 11 works in the following way:

The adjustable comparator 23 is set to a current threshold value at the beginning of machine operation or of a new knitting programme. This threshold value is slightly higher than the maximum current consumption to be expected in the phase or phases during one carriage stroke (without including the carriage stroke reversal). During operation, that is for example during the first carriage stroke, the currents measured in phases U and V are carried to the peak value rectifier 17 or 18, from which the sum reaches the peak value holding circuit 22. This holding circuit 22, which has previously been set at zero, records and holds the highest current value consumed by the drive during the relevant carriage stroke. This current peak value is interrogated according to the programme by the CPU 24 via the A/D converter 27 at the end of the carriage stroke; it is then processed (safety addition) and carried as possibly a new current threshold value via the converter 31 to the pre-adjusted comparator 23. If,for example,a too high current peak value has been used when selecting the pre-adjustment of the adjustable comparator 23, a lower current threshold value is now selected for the subsequent carriage stroke if the current peak value measured over the length of the carriage stroke is less. This will also occur in the same way in the second and subsequent carriage strokes. Thus the measurements carried out and/or the experience obtained from past events in the preceding carriage stroke via the CPU 24 can be used again as a new predetermination for the comparator 23. This is of special importance e.g. when introducing a new knitting programme or beginning a new knitting cycle by the flat knitting machine at the beginning of a new day, since in the former case the torque output values and thus the current consumed values may change, these values depending,-for example,on the number of working needles, on stitch firmness, on the number of working cams, on whether or how many needles work on knitting, transferring, tucking or non-knitting, and the like; while in the second case the fact is taken into account that in cold operation the force required to move the carriage is greater than in normal warmed-up operation.

Should there now occur, during one of the carriage strokes, a change in the force required to move the carriage and thus in the torque output and/or current consumed to such an extent that the pre-selected current threshold value is exceeded, the comparator 23, which constantly carries out a comparison between a nominal value (threshold value) and the actual value conveyed from the circuit 19, gives at its output a switch-off signal which is conveyed via the CPU 24 to a switch-off device, not shown, by means of which the drive of the carriage arrangement is switched off and thus the flat knitting machine brought to a standstill and a detailed fault announcement given. This kind of change in the drive current consumed and/or the torque output may be caused for example by, when the fabric is not correctly taken down, the needles reaching into several stitches of the fabric which is no longer lying correctly in the needle space, or by needle head breakages occuring when the pre-selected firmness value for the needles is actually too high, so the stitch is too narrow.

In the above description the peak current consumed is stored in the holding circuit 22 and is the one which appears along a complete carriage stroke (without reversal), an erase impulse being given to the holding circuit at the end of each carriage stroke. However, it is also possible to sub-divide the carriage stroke into one, two or more ranges in which more or less the same knitting conditions occur (each case regarded separately) as regards the force needed to move the carriage and thus of the torque output and/or current consumption of the electric drive motor. In Fig. 2 for example three ranges along a carriage stroke are drawn (or reversed ranges) in which about the same knitting conditions occur in each case, which curve 36 can be approximated according to the actual course by for example an envelope curve 37 for threshold values to be selected range by range. For example, range I is essentially in a transferring mode whereas in range II many of the needles are set at non-knitting, while in range III practically all the needles are knitting. If the peak current consumed is now to be stored in the holding circuit 22 with the help of the drive current monitor 11 during each of the ranges I to III along the length of a carriage stroke, it is necessary that the CPU 24 interrogates the peak value at the end of each relevant range I, II, III, processes it,and stores it as a new theshold value which is however only given to the comparator 23 for the relevant range I, II, III of the following stroke. At the same time the CPU 24 gives, after each measurement, an erase impulse via the peak value erase circuit 26 to the holding circuit 22 which can then record and store a new current peak value in the subsequent range I-III. In this way the envelope curve 37 (already mentioned), which is derived from the curve 36 with a safety addition, can be produced within the CPU 24. After this the CPU 24 pre-selects the profile of the threshold values. During this operation it is also possible for the CPU 24 to change the envelope curve or profile taking into account the knitting programme fed in, i.e. taking into account the number of needles working or knitting, transferring, working on tucking or non-knitting; the number of cams being used, the stitch firmness pre-set in each case, etc. Should the knitting conditions change to any considerable extent during knitting, a new threshold value having been pre-selected at the beginning of such an alteration, the new threshold value is then altered to an extent determined by experience, as described above. It is understood that, depending on the type of fabric and thus of knitting programme, subdivision into more or fewer ranges, in which about the same or a comparable torque output occurs, can also take place.

Furthermore, the CPU 24 sees that during carriage stroke reversal the threshold value of the current is raised in such a way that the high positive or negative (brake) torque output which occurs during carriage stroke reversal lies within this threshold value. This is particularly necessary where direction-reversible drives are used to achieve variable strokes.

Fig. 3 shows diagrammatically the front needle 12V and the rear needle bed 12H of a flat knitting machine, at each longitudinal end of which is secured a piezo-electric vibration absorber 14V, 14H or 15V, 15H respectively. Piezo-electric vibration absorbers and their arrangements at one end of a needle bed are known *per se* for example from German published specification DE 21 20 824 mentioned in the introduction.

It is an essential feature in the pulse monitor 13 according to invention, of the safety device, that each needle bed 12V, 12H has piezo-electric vibration absorbers 14 and 15 at two points facing away from each other on the pulse wave expansion. This creates heightened sensitivity when recording the pulse waves caused by percussive alterations in the mechanical load on the needle beds, as shown in the graphics drawn above the needle beds 12, since the pulse waves are recorded by both absorbers 14 and 15 over the length of the needle bed and their values (curve 38L,R) add (curve 39) resulting in more or less uniform sensitivity over the length of the needle bed.

The electric outputs V1-V4 and H1-H4 respectively of the piezo-electric vibration absorbers 14V, 14H, 15V, 15H which are secured on the front needle bed 12V as well as on the rear needle bed 12H, at their left and at the right-hand end in each case, are each conveyed to a full-wave peak rectifier 41, 42, 43, 44 respectively. The rectified electric output signals of the vibration absorbers 14V and 15V or 14H and 15H respectively (which are each associated with one another) of one of the needle beds 12V or 12H are fed to an summing circuit 46 or 47. Further evaluation of these peak current values given out and added by a pair of piezo-electric vibration absorbers 14, 14 correspond to the evaluation shown in Fig. 1 of the absorption current peak values of the electric drive.

The output of the summing circuit 46, 47 is thus conveyed both to a peak value holding circuit 48 or 49 and to a pre-adjustable comparator 51 or 52. The two peak value holding circuits 48, 49 are connected with a mutual peak value erase circuit 53, the input of which is connected with CPU 24 common to both monitors 11 and 13. The peak value holding circuit 48, 49 is connected with a first A/D converter 56 or 59. A D/A converter 57, 58 is connected with the pre-adjustable comparator 51 or 52. The outputs and inputs for interrogating the peak value and/or for setting a threshold value of the A/D converter 56, 59 or the D/A converter 57, 58 respectively, and the switch-off output of the pre-adjustable comparators 51, 52 are connected with the CPU 24. The two A/D converters 56, 59 and the two D/A converters 57, 58 are in each case connected parallel with an output of the reference voltage circuit 32.

The pulse monitor 13 makes it possible to switch off the carriage drive and thus stop the flat knitting machine under selected conditions i.e. whether in the front needle bed 12V or in the rear needle bed 12H a sudden change in the mechanical load occurs through pulse-like or percussive strain. The function of the pulse monitor device 13 is directly comparable with the function of the working current monitor 11 both for the front and rear needle beds. At the beginning of a knitting programme of a working day, a threshold value is pre-set here also for the mechanical load permissible in normal operation on the front and the rear needle bed, and these two threshold values are corrected by the CPU 24 via the interrogation of the measured highest actual values. Here also it is possible to store either a peak value in each case per carriage stroke or a peak value in each case for each of several ranges (e.g. I-III) along the length of the carriage stroke, and to have it interrogated by the CPU 24, resulting in an envelope curve or a profile of threshold values of which the basis is the measured values. Here also the threshold values can be pre-adjusted depending on the knitting programme or on a change in the mode of operation of the machine, which needs to be taken into account, within the knitting of one fabric. Furthermore, here also the threshold values are set appropriately high by the CPU 24 during stroke reversal, so that the mechanical vibrations in the needle beds occurring during stroke reversal are below the threshold values. Should a sudden change occur in the mechanical load on the front or rear needle bed, caused e.g. by a needle butt and/or the lowering mechanism butt hitting a clearing cam or a similar projecting cam part, without being inserted into a duct, resulting in the butt in question being sheared off, the peak value resulting therefrom, which exceeds the threshold value, has the effect that the relevant comparator 51 or 52 gives a switch-off signal to the CPU 24. During this a display appears stating in which of the two needle beds this unacceptable change in the mechanical load has occured and to what extent.

CLAIMS

1. A safety device for flat knitting machines particularly, including a switch-off device which, arrests movement of the carriages should any change, (as compared with normal operation) occur in the force required to move the carriages as a result of a fault condition such as when fabric is being taken down, forming and transferring stitches, too high a

setting of stitch firmness or the like, in which a measuring device is provided for recording a signal proportional to the torque applied by a drive device to the carriages, the actual values of the torque-proportional signal being conveyable to a central processing unit and to an adjustable comparator, threshold values for the torque-proportional signal being supplied to the comparator from the CPU as processed actual values of the torque-proportional signal, the switch-off device being energisable by the comparator as soon as the relevant threshold value is exceeded.

2. A safety device as claimed in claim 1 in which the drive device comprises a constant speed electric motor, the measuring device recording the motor current as proportional to torque.

3. A safety device as claimed in Claim 2 in which, when the drive device is a three-phase synchronous motor, the measuring device records the motor current in at least two of the three phases, the sum of the two values being conveyed to the comparator and the CPU.

4. A safety device as claimed in claim 1, 2 or 3 in which the torque-proportional signal is continuously measured and discontinuously storable in a holding circuit at the highest value during a pre-determined period, the holding circuit for the purpose of interrogation by the CPU being connected with the latter and the interrogated stored values forming the basis for an alteration of the pre-selected threshold values.

5. A safety device as claimed in Claim 4 in which the holding circuit is provided with an erase input.

6. A safety device as claimed in Claim 4 or 5 in which over the length of one carriage stroke in each case, the highest value of the torque-proportional signal is stored and used to alter the threshold value for the subsequent stroke.

7. A safety device as claimed in Claim 4 or 5 in which the carriage stroke is subdivided into a plurality of sub-ranges requiring about the same force to move the carriages, within which in each case the highest value of the torque-proportional signal is stored, these values being used to alter the relevant threshold values in the corresponding working ranges of subsequent carriage strokes.

8. A safety device as claimed in Claim 7 in which the corresponding sub-ranges are determined by the knitting programme fed in.

9. A safety device as claimed in any one of the preceding claims, in which during carriage stroke reversal the threshold value fed to the comparator is adjusted to an appropriately high value.

10. A safety device as claimed in Claim 4 or 5 in which, at the beginning of a working cycle of the machine and/or of a new knitting machine programme, the comparator is adjusted by hand for an initial threshold value.

11. A safety device for flat knitting machines having piezo-electric vibration absorbers fixed on the needle beds, which absorbers, via a switch-off device, stop the carriages in the event of a change (as compared with the normal operation) in the mechanical load on the needle beds as a result of e.g. jolts or the like, by means of a comparator whereby the switch-off device is energisable as soon as a pre-selected threshold value is exceeded, each needle bed being provided at each of its longitudinal ends with a piezo-electric vibration absorber the outputs of which are connected with a respective adjustable comparator, the actual values of a load-proportional signal for each needl bed being conveyed to a CPU and to the relevant comparator, and the actual values, processed by the CPU, of the relevant load-proportional signal are fed to each comparator as threshold values for comparison with the load-proportional signal.

12. A safety device as claimed in Claim 11 in which the two piezo-electric vibration absorbers of a needle bed are connected with the comparator via a summing circuit.

13. A safety device as claimed in Claim 11 or 12 in which the load-proportional signal is continuously measured and discontinuously storable in a holding circuit in the form of the highest value in each case during a pre-determined period, and in which the holding ciruit is connected with the CPU for interrogation by the latter, the interrogated stored values forming the basis for an alteration of the preselected threshold values.

14. A safety device as claimed in Claim 13 in which the holding circuit is provided with an erase input.

15. A safety device as claimed in Claim 13 or 14 in which the highest value, over the length of a carriage stroke in each case, of the load-proportional signal is stored and used to change the threshold value for the following stroke.

16. A safety device as claimed in Claim 13 or 14 in which the carriage stoke is subdivided into a plurality of ranges each requiring about the same mechanical load on the needle beds, within each of which ranges the highest value of the load-proportional signal is stored, and in which these values are used to change the relevant threshold values in the corresponding ranges of subsequent carriage strokes.

17. A safety device as claimed in Claim 16, in which the extent of the ranges is determined in dependence on the knitting programme fed in.

18. A safety device as claimed in any one of Claims 11 to 17, in which during carriage stroke reversal the threshold value fed to the comparator is adjustable to an appropriately high value.

19. A safety device as claimed in any one of Claims 11 to 18, in which at the beginning

of a working cycle of the machine and/or of a new knitting programme each comparator is adjustable by hand for an initial threshold value.

20. A safety device, comprising the combination of the features of at least Claim 1 and, if required, of one of the dependent Claims 2 to 10 with the features of at least Claim 11 and, if required, of one of the subsequent Claims 12 to 19.

21. A safety device as claimed in Claim 20 in which a common CPU is used.

22. A safety device for flat knitting machines as claimed in Claim 1 and substantially as herein described with reference to and as illustrated in the accompanying drawings.

23. A safety device for flat knitting machines as claimed in claim 11 and substantially as herein described with reference to and as illustrated in the accompanying drawings.

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