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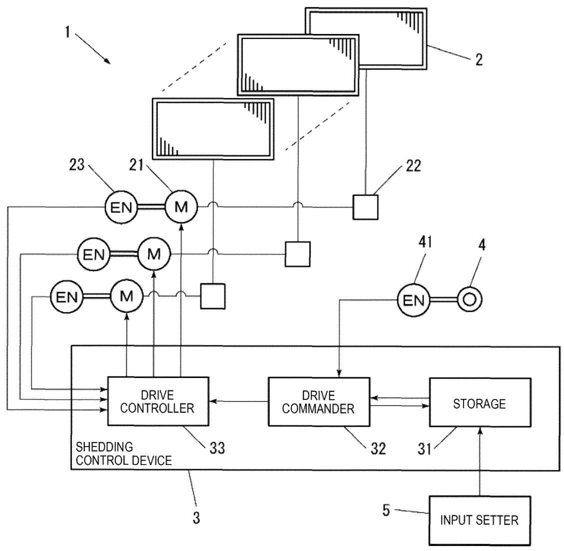
(54) WEAVING METHOD IN LOOM AND SHEDDING DEVICE FOR REALIZING WEAVING METHOD

(57) Provided is a method of weaving a fabric having a special texture and a shedding device (1) for realizing the weaving method in a loom provided with the shedding device (1) for independently driving a dedicated driving motor (21) provided for each heddle frame (2). In a case where a shedding pattern is a pattern in which a staying period exists during weaving according to the shedding pattern, an operation pattern in which a drive pattern composed of the shedding pattern and the drive mode of the driving motor (21) is repeated two or more times is set for each heddle frame (2), the operation pattern set for a target heddle frame with at least a portion of the heddle frames (2) as the target heddle frame is set to include a first drive pattern in which the drive mode is set so that the target heddle frame is stayed at the maximum shedding position at a time of beating a reed in the staying period, and a second drive pattern in which the drive mode is set so that the target heddle frame is positioned at a setting position at the time of beating the reed in the staying period, and weaving is performed by each heddle frame (2) being driven according to the operation pattern.

FIG.1



EP 3 859 065 A1

Description

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] The present invention relates to a weaving method in a loom provided with a dedicated driving motor provided for each heddle frame, and a shedding device in which each driving motor is independently driven according to a predetermined shedding pattern depending on a fabric structure of a fabric to be woven and a drive mode of the driving motor in accordance with the shedding pattern, and the shedding device for realizing the weaving method.

BACKGROUND ART

[0002] In a loom, each heddle frame is driven according to a predetermined shedding pattern during weaving, so that a fabric having a desired fabric structure is woven. The shedding pattern is determined for each heddle frame by specifying whether a position (maximum shedding position) is an over shed position (highest raised position) or an under shed position (lowest lowered position) for each weaving cycle.

[0003] In a case where the fabric structure of the fabric to be woven is a twill fabric or a satin fabric, the shedding pattern of each heddle frame is determined so that the maximum shedding position is the same in two or more continuous weaving cycles. Therefore, in that case, each heddle frame is driven so as to stay at the same maximum shedding position determined by the shedding pattern during a period spanning two or more continuous weaving cycles. In this application, the period during which each heddle frame is stayed is referred to as a staying period.

[0004] Incidentally, the shedding pattern so defined is such that the maximum shedding position is determined as described above for each weaving cycle. On the other hand, the position of each heddle frame may or may not be maintained at the maximum shedding position throughout the weaving cycle, depending on the maximum shedding position specified for the previous and subsequent weaving cycles. However, the position of each heddle frame in each weaving cycle is the maximum shedding position specified by the shedding pattern at least at an intermediate point in time of the weaving cycle (when a rotational angle of a main shaft of the loom is 180°).

[0005] Incidentally, as a shedding device in a loom, for example, as disclosed in JP-A-2018-84007 (Patent Document 1), there is a shedding device provided with a dedicated driving motor for each heddle frame and independently driving each heddle frame. In the loom provided with such a shedding device, a setter or the like for the shedding device is configured so that the shedding pattern as described above can be randomly set, and a drive mode (shedding curve) of the driving motor for operating the heddle frame in accordance with the shedding pattern is stored in a setter, a controller, or the like. Moreover, the shedding device is configured to control the drive of each driving motor according to the drive mode of the driving motor selected based on the shedding pattern so that each heddle frame operates according to the set shedding pattern.

[0006] In a shedding device of Patent Document 1, in a case where weaving is performed based on the shedding pattern in which the heddle frame stays in the staying period as described above, the driving motor is controlled so that a position of the heddle frame to be stayed is a position where the shed is closed by a set amount from the maximum shedding position. However, even in the weaving in which the driving motor is controlled in this manner, each heddle frame is in a state of being stayed at a position where the shed is closed for the staying period.

[0007] PTL 1: JP-A-2018-084007

SUMMARY OF THE INVENTION

[0008] An object of the present invention is to provide a method of weaving a fabric having a special texture and a shedding device for realizing the weaving method in a loom provided with the shedding device for independently driving each heddle frame by a dedicated driving motor as described above.

[Means for solving the problem]

[0009] The present invention is premised on a weaving method in a loom provided with a dedicated driving motor provided for each heddle frame, and a shedding device in which each driving motor is independently driven according to a predetermined shedding pattern depending on a fabric structure of a fabric to be woven and a drive mode of the driving motor in accordance with the shedding pattern, in a case where the shedding pattern is a pattern in which a position of the heddle frame at each intermediate point in time during a staying period including the intermediate point in time in each weaving cycle of two or more continuous weaving cycles is the same maximum shedding position.

[0010] The weaving method in a loom of the present invention includes setting an operation pattern for one repeat of a woven pattern in which a drive pattern composed of a combination of the shedding pattern and the drive mode is repeated two or more times for each heddle frame; setting the operation pattern set for a target heddle frame with at least a portion of the heddle frames as the target heddle frame to include a first drive pattern in which the drive mode is set so that the target heddle frame is stayed at the maximum shedding position at a time of beating a reed in the staying period, and a second drive pattern in which the drive mode is set so that the target heddle frame is positioned at a setting position determined on a center shed position side within a range not exceeding the center shed position at the time of beating the reed in the staying period; and performing weaving by each heddle frame being driven according to the operation pattern.

[0011] In the weaving method in a loom of the present invention, a distance of the setting position to the center shed position may be 50% or less of a distance of the maximum shedding position to the center shed position.

[0012] Furthermore, in the weaving method in a loom of the present invention, the operation pattern set for the target heddle frame may include, as the second drive pattern, a second drive pattern in which the drive mode is determined so that an arrival point in time at which a warp reaches the center shed position is earlier than the arrival point in time in the first drive pattern due to displacement of the target heddle frame between the maximum shedding position in the staying period and the maximum shedding position in a weaving cycle continuous with a weaving cycle including the staying period.

[0013] A shedding device of a loom according to the present invention for realizing such a weaving method is premised on a shedding device of a loom provided with a dedicated driving motor provided for each heddle frame, and a controller that controls a drive of the driving motor according to a predetermined shedding pattern depending on a fabric structure of a fabric to be woven and a drive mode of the driving motor in accordance with the shedding pattern.

[0014] In the present invention, the shedding device includes a setter capable of setting an operation pattern for one repeat of a woven pattern in which a drive pattern composed of a combination of the shedding pattern and the drive mode is repeated two or more times for each heddle frame, in which the setter is configured to selectively set a first drive pattern in which the drive mode is set so that the heddle frame is stayed at the maximum shedding position at a time of beating a reed in the staying period, and a second drive pattern in which the drive mode is set so that the heddle frame is positioned at a setting position determined on a center shed position side within a range not exceeding the center shed position at the time of beating the reed in the staying period, as each of the drive patterns included in the operation pattern in a case where the shedding pattern is a pattern in which a position of the heddle frame at each intermediate point in time during a staying period including the intermediate point in time in each weaving cycle of two or more continuous weaving cycles is the same maximum shedding position, and the controller controls the drive of the driving motor according to the operation pattern.

[0015] In the shedding device of the present invention, the setter may be configured to set the setting position within a range in which a distance of the setting position to the center shed position is 50% or less of a distance of the maximum shedding position to the center shed position.

[0016] Furthermore, in the shedding device of the present invention, the setter may be configured to set the operation pattern to include, as the second drive pattern, a second drive pattern in which the drive mode is determined so that an arrival point in time at which a warp reaches the center shed position is earlier than the arrival point in time in the first drive pattern due to displacement of the heddle frame between the maximum shedding position in the staying period and the maximum shedding position in a weaving cycle continuous with a weaving cycle including the staying period.

[Advantage of the Invention]

[0017] According to the weaving method in the loom of the present invention, the operation pattern set for the target heddle frame described above of the operation patterns for one repeat of the woven pattern including two or more repetitions of the drive pattern set for each heddle frame is set to include the first drive pattern and the second drive pattern described above, and weaving is performed in such a manner that the target heddle frame is driven according to the operation pattern. According to such a weaving method, in a woven portion where the heddle frame is driven by the second drive pattern and the weaving is performed, the tension of the warp at the time of beating the reed is different from the usual one, so that the surface of the fabric is raised as compared with a woven portion where the heddle frame is driven by the first drive pattern and the weaving is performed. As a result, the fabric to be woven has a texture in which irregularities are formed on the surface as a whole, and a fabric having a special texture can be obtained as compared with the case of weaving by a general (normal) weaving method (weaving performed by driving the heddle frame only by the first drive pattern).

[0018] According to the shedding device of the loom of the present invention, in setting the operation pattern in a case where the shedding pattern in the drive pattern is a pattern that causes a staying period of the heddle frame, the setter is configured to selectively set the first drive pattern and the second drive pattern described above as each drive pattern included in the operation pattern. As a result, by setting the operation pattern including two or more repetitions of the drive pattern for any heddle frame to include the first drive pattern and the second drive pattern described above, the fabric having a special texture as described above can be obtained.

[0019] Furthermore, when the operation pattern set to include the second drive pattern includes the second drive pattern in which the drive mode is determined so that the arrival point in time at which the warp reaches the center shed position is earlier than the arrival point in time in the first drive pattern due to the displacement of the heddle frame between the maximum shedding position in the staying period and the maximum shedding position in the weaving cycle continuous with the weaving cycle including the staying period, a state of the surface of the fabric in the woven portion according to the second drive pattern can be made uniform.

[0020] More specifically, according to the present invention, in the weaving by the second drive pattern, the tension of the warp displaced by the target heddle frame is lower than in the case of weaving by the first drive pattern at the time of beating the reed within the staying period. As a result, the raised portion as described above is formed on the surface of the fabric. However, depending on the type of yarn used in weaving or the weaving conditions (set tension of the warp, or the like), the raised state of the fabric surface in the woven portion may not be uniform over the range of weaving by the second drive pattern in relation to the tension state of the warp.

[0021] When the time when the warp reaches the center shed position (shed closing position) is earlier than the time of beating the reed, since the warp is naturally displaced upward or downward with respect to the center shed position at the time of beating the reed, the tension of the warp at the time of beating the reed is higher than that in the case where beating of the reed is performed with the warp in the center shed position. Therefore, by setting the drive mode in the second drive pattern so that the arrival point in time described above is earlier than the case where the drive mode is the same as the drive mode in the first drive pattern which is a normal drive pattern (case no particular change is applied at the arrival point in time), the tension of the warp displaced by the target heddle frame driven thereby at the time of beating the reed is higher than that in the case where the above change is not applied.

[0022] When viewed in units of shedding patterns, a method in which the raised portion is raised due to the beating of the reed with low tension during the staying period as described above changes by changing the tension at the time of beating the reed other than the staying period. Therefore, by setting the tension at the time of beating the reed to an appropriate magnitude, that is, by defining the drive mode in the second drive pattern so that the arrival point in time is an appropriate point in time, it is possible to adjust the state of the fabric surface at the woven portion by the second drive pattern to an appropriate level. As a result, the raised state of the fabric surface at the woven portion according to the second drive pattern can be made uniform over the range of the fabric.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 is a block diagram illustrating an example of a shedding device of a loom according to the present invention.

FIG. 2 is an example of a drive information setting screen displayed on a display.

FIG. 3 is an example of an operation pattern setting screen displayed on the display.

FIG. 4 is a partially enlarged view of a setting field on the operation pattern setting screen.

FIG. 5 is an example of a separate window for assigning drive mode information displayed on the display.

FIGS. 6A to 6C are a graph illustrating displacement of a heddle frame.

DETAILED DESCRIPTION OF THE INVENTION

[0024] FIG. 1 illustrates an example of a shedding device 1 of a loom according to the present invention. The shedding device 1 is provided with a plurality of heddle frames 2, a dedicated driving motor 21 provided for each heddle frame 2, and a motion conversion mechanism 22 for connecting the heddle frame 2 and the driving motor 21. The shedding device 1 is configured such that the rotation of an output shaft of each driving motor 21 is converted by the motion conversion mechanism 22 connected to the rotation, and the corresponding heddle frame 2 is reciprocated in the vertical direction. That is, the shedding device 1 is configured to independently drive each heddle frame 2 by the dedicated driving motor 21.

[0025] The shedding device 1 is provided with a shedding control device 3 that controls the drive of each driving motor 21. The shedding control device 3 includes a storage 31, a drive commander 32 connected to the storage 31, and a drive controller 33 connected to the drive commander 32. The shedding device 1 is provided for each driving motor 21 and is provided with a shedding side encoder 23 that detects a rotational angle of the output shaft of the corresponding driving motor 21. Each of the shedding side encoders 23 is connected to the shedding control device 3 (drive controller 33).

[0026] In the shedding control device 3, the storage 31 stores information on a shedding pattern depending on the fabric structure of the fabric to be woven and a drive mode of the driving motor in accordance with the shedding pattern. The shedding pattern sets the position of the heddle frame 2 (over shed position and under shed position) for each weaving cycle. For example, a shedding pattern of the 3/1 twill fabric, in which one unit (one repeat) of the fabric structure includes four weaving cycles, is set in the form of "upper, upper, upper, and lower". However, the " shedding pattern" referred to in the present invention refers to a pattern set for each heddle frame 2 and corresponding to one unit of the fabric structure.

[0027] The shedding pattern is a pattern for setting the position of the heddle frame 2 (hereinafter, "frame position") in such a weaving cycle unit. However, an actual frame position of each weaving cycle over the weaving cycle is not limited to the heddle frame 2 being maintained at the over shed position (most raised position) over the weaving cycle, for example, in the weaving cycle set to "upper", and includes a portion displaced toward the over shed position and a portion displaced toward the under shed position during the weaving cycle, depending on the frame position set for the previous and subsequent weaving cycles. However, at least at the intermediate point in time in each weaving cycle (when the rotational angle (so-called crank angle) of a main shaft 4 of the loom is 180°), the heddle frame 2 is in a state of being located at the over shed position or the under shed position indicated by the shedding pattern. Therefore, in a case where the same frame position is set for two or more continuous weaving cycles in the shedding pattern, the weaving cycle in which the heddle frame 2 is at the same position at least at the intermediate point in time is continuous by the set amount, and the period including each intermediate point in time at which the frame positions are the same as each other corresponds to the "staying period" in the present invention.

[0028] The drive mode is a mode in which how the operation of the heddle frame 2 is performed in accordance with the shedding pattern is determined. That is, the drive mode is a mode in which the operation of the heddle frame 2 is realized between two continuous weaving cycles in order to realize the state of the frame position set for each weaving cycle in the shedding pattern as described above. Therefore, normally, the drive mode is a mode for driving the heddle frame 2 in a period (period from a crank angle of 180° in the previous weaving cycle to a crank angle of 180° in the subsequent weaving cycle) spanning both intermediate points of time of two consecutive weaving cycles. The drive mode includes the timing at which the heddle frame 2 reaches a center shed position (position where a warp is shed closing), or the maximum shedding position, and the like.

[0029] The loom is provided with an input setter 5 for inputting and setting weaving conditions and the like, and the input setter 5 is also connected to the shedding control device 3 (storage 31). The information regarding the shedding pattern and the drive mode described above (hereinafter, "drive mode information") is input and set by the input setter 5 and stored (set) in the storage 31. Therefore, the input setter 5 also functions as a portion of the shedding device 1. Incidentally, as the input setter 5, for example, a touch panel type setter having a display and capable of inputting the above shedding pattern or the like by operating a setting screen on the display is used.

[0030] The shedding control device 3 is configured such that the drive commander 32 outputs a drive command in accordance with the drive mode to the drive controller 33, and the drive controller 33 controls the drive of the driving motor 21 according to the drive command, so that the heddle frame 2 operates according to the drive mode in accordance with the frame position of the continuous weaving cycle based on the set shedding pattern. However, the drive mode is derived from the drive mode information stored in the storage 31 described above. The drive commander 32 is provided on the main shaft 4 of the loom and is connected to a main shaft side encoder 41 for detecting the crank angle, and a crank angle signal depending on the detected crank angle is input. The drive commander 32 is configured to output the drive command based on the crank angle signal. Furthermore, a rotational angle signal depending on the rotational angle of each driving motor 21 from the shedding side encoder 23 described above is input to the drive controller 33, and the drive controller 33 is configured to perform feedback control based on the rotational angle signal.

[0031] In the shedding control device 3 of the present example, the drive commander 32 is configured to derive the drive mode in accordance with the frame position in the weaving cycle set in the shedding pattern and the frame position in the subsequent weaving cycle from the drive mode information stored in the storage 31 and output the drive command in accordance with the derived drive mode at a crank angle of 180° in the weaving cycle to the drive controller 33, when the crank angle in each weaving cycle reaches a set angle (for example, 60°) before 180°. The drive controller 33 controls the drive of the driving motor 21 according to the drive command, so that the state of the frame position set for each weaving cycle in the shedding pattern is realized.

[0032] In the present example, the shedding control device 3 may be a device including a circuit in which each component thereof includes circuit elements having each function, or may be a device in which a computer programmed for the function of each component operates as the shedding control device 3.

[0033] In the loom provided with the shedding device 1 described above, the present invention is applied to a case where the above shedding pattern is a pattern in which the same frame position is set for two or more continuous weaving cycles, that is, a case where the shedding pattern to be set is a pattern in which the staying period described above exists during weaving according to the shedding pattern. The present example is an example in the case where the shedding pattern is the shedding pattern of the 3/1 twill fabric described above.

[0034] Moreover, in the present example, the input setter 5 (corresponding to the setter referred to in the present invention) described above is configured so that an operation pattern for one repeat of the woven pattern in which the drive pattern for driving the heddle frame 2 is repeated two or more times can be set for each heddle frame 2. However, the drive pattern referred to in the present invention is a pattern composed of a combination of a shedding pattern and a drive mode. Regarding the drive mode, the normal drive mode for the shedding pattern in which the above staying period exists is determined so that the heddle frame 2 stays at the maximum shedding position at the time of beating the reed in the staying period. On the other hand, in the present invention, the drive mode is also determined so that the heddle frame 2 is located at a setting position determined on the center shed position side within a range that does not exceed the center shed position at the time of beating the reed in the staying period. Therefore, the above operation pattern is set to include a first drive pattern in which a normal drive mode is determined and a second drive pattern in which a drive mode is determined such that the heddle frame 2 is located at a setting position at the time of beating the reed in the staying period.

[0035] Hereinafter, an embodiment of the input setter 5 according to the present invention will be described in detail with reference to the drawings. The input setter 5 is provided with a display, and is configured so that a setting screens illustrated in FIGS. 2 and 3 can be read on the display. The display is a touch panel type display as described above, and it is possible to input information in the input field of the setting screen by touch operation.

[0036] The setting screen illustrated in FIG. 2 is a drive information setting screen 6 for setting a setting value (hereinafter, "drive setting value") related to driving the heddle frame 2 as the drive mode information described above. The drive information setting screen 6 includes a plurality of setting items. The input setter 5 is configured so that a drive setting value can be input for each setting item. In the illustrated example, the setting items are dwell (upper dwell and lower dwell), cross timing, and the setting position in the second drive pattern described above, and the input fields 61, 62, 63, and 64 corresponding to each setting item are displayed. The drive information setting screen 6 includes a switching button 65 for switching the ON/OFF setting of the center shed, in addition to the setting items (input fields 61, 62, 63, and 64). That is, in the illustrated example, the drive mode information includes a combination of these setting items and the ON/OFF setting of the center shed. Furthermore, the input setter 5 is configured so that eight types (No. 1 to No. 8) of such drive mode information can be set on the drive information setting screen 6 (eight drive setting values can be set for each setting item). The drive mode information is color-coded (blue, red, yellow, and the like) for each No, and the color is displayed together with the number of No. Each of the setting items is as follows.

[0037] The upper dwell and the lower dwell are items for setting a setting value regarding the displacement of the heddle frame 2 with respect to the maximum shedding position. However, the drive setting value (input value) set there is the range of the crank angle, and is the total value of the same period (range) before and after the crank angle with the crank angle of 180° as a reference, which is the intermediate point in time in the weaving cycle.

[0038] The dwell is normally a period during which the heddle frame 2 is maintained at the maximum shedding position during the weaving cycle, the start point of the dwell period corresponds to the timing when the heddle frame 2 reaches the maximum shedding position, and the end point thereof corresponds to the timing when the heddle frame 2 starts to be displaced from the maximum shedding position. As described above, the present invention is premised on the case where weaving is performed according to the shedding pattern such that the staying period exists. Therefore, regarding the staying period, the start point of the period before the intermediate point in time derived from the drive setting value is the timing at which the heddle frame 2 reaches the maximum shedding position (start point of the staying period). The end point of the period after the intermediate point in time derived in the same manner is the timing at which the heddle frame 2 starts to be displaced from the maximum shedding position (end point of the staying period).

[0039] Specifically, in the case of the shedding pattern in which the heddle frame 2 is in the over shed position in the staying period, and the drive setting values of the upper dwell and the lower dwell are set to 100° as illustrated in the drawing, the timing at which the heddle frame 2 starts to be displaced from the under shed position is derived from the drive setting value of the lower dwell as a crank angle of 230° (= 180° + 100°/2), and the timing at which the heddle frame 2 reaches the over shed position (start point of the staying period) is derived from the drive setting value of the upper dwell as a crank angle of 130° (= 180° - 100°/2). The timing at which the heddle frame 2 starts to be displaced from the over shed position (end point of the staying period) is derived from the drive setting value of the upper dwell as a crank angle of 230° (= 180° + 100°/2), and the timing at which the heddle frame 2 reaches the under shed position is derived from the drive setting value of the lower dwell as a crank angle of 130 ° (= 180 ° - 100°/2). In the weaving cycle in which the heddle frame 2 reaches the under shed position, the heddle frame 2 is maintained at the under shed position for a period set as the lower dwell.

[0040] The cross timing is an item for setting the timing at which the heddle frame 2 reaches the center shed position when the heddle frame 2 is displaced from one maximum shedding position to the other maximum shedding position. The drive setting value (input value) is the crank angle.

[0041] The setting position is an item for setting the frame position at the time of beating the reed during the staying period in a case where the heddle frame 2 is operated in the drive mode of the second drive pattern described above. The drive setting value (input value) is set as a distance (unit: mm) from a reference position with the center shed position as the reference position. Specifically, in a case where the drive setting value (input value) is set to 0 (mm) as in the illustrated example, the setting position is a position that coincides with the center shed position. The setting position is a position where the heddle frame 2 at the maximum shedding position is displaced and reached at the time of beating the reed during the staying period. Therefore, as the drive mode, the drive amount and the like regarding the displacement are derived from the drive setting value.

[0042] The switching button 65 for switching the ON/OFF setting of the center shed described above on the drive information setting screen 6 is a button for setting whether or not to perform the displacement of the heddle frame 2 to the setting position at the time of beating the reed during the staying period. The switching button 65 is such that the ON/OFF setting can be switched by a touch operation. In a case where the switching button is set to ON, the drive mode is such that the heddle frame 2 is displaced to the setting position at the time of beating the reed during the staying period. On the other hand, in a case where the switching button is set to OFF, the drive mode is such that the displacement of the heddle frame 2 at the time of beating the reed during the staying period is not performed (the heddle frame 2 is maintained at the maximum shedding position) regardless of the drive setting value of the setting position.

[0043] The setting screen illustrated in FIG. 3 is an operation pattern setting screen 7 for setting a drive pattern for driving the heddle frame 2 for each heddle frame 2. However, in the present example, the setting is performed by assigning the drive mode information described above to the previously set shedding pattern. Although the drive mode information is not the drive mode itself described above, since each drive mode between two continuous weaving cycles is derived from the drive mode information and the shedding pattern, it can be said that what is assigned the drive mode information to the shedding pattern is a combination of the shedding pattern and the drive mode, that is, the drive pattern referred to in the present invention.

[0044] The operation pattern setting screen 7 has a setting field 72 in which the setting frames 71 are arranged in a matrix similar to the well-known setting screen of the shedding pattern (FIG. 4 illustrates a partially enlarged view of the setting field 72). The input setter 5 is configured to set the frame position (over shed position and under shed position) for each step with one weaving cycle as one step for each heddle frame 2. Incidentally, the illustrated example illustrates a setting example in the case where weaving is performed using 12 heddle frames 2, and illustrates a state where the shedding patterns from the first (frame No. 1) heddle frame 2 to the 12th (frame No. 12) heddle frame 2 are set. In FIG. 3, Steps 1 to 20 are illustrated, which exemplify the range that can be displayed on the display at one time, and the setting is performed in a number of steps corresponding to one repeat of the woven pattern. In the present example, the number of steps for one repeat of the woven pattern is the number of steps exceeding the 20 steps, and in such a case, the operation pattern setting screen 7 is scrolled on the display.

[0045] On the operation pattern setting screen 7, by selecting the setting frame 71 in the setting field 72, the display state of the setting frame 71 is a colored display state, and the frame position is set to the over shed position. By leaving the default colorless display state without selecting the setting frame 71, the frame position is set to the under shed position. In the present example, since the shedding pattern is the shedding pattern of the 3/1 twill fabric as described above, a setting state is as illustrated in the drawing. That is, the frame position of each heddle frame 2 is set to the over shed position for three continuous steps (display state of the setting frame 71 is a state of colored display), the next one step is set to the under shed position (display state of the setting frame 71 is a state of no color display), and this is repeated. In each heddle frame 2, the step in which the under shed position is set are shifted by one step in the order of the frame No.

[0046] Moreover, the input setter 5 is configured so that the drive mode information described above can be assigned to the shedding pattern so set on the operation pattern setting screen 7. Specifically, the input setter 5 is configured so that any range including a plurality of setting frames 71 can be specified on the setting field 72 on the operation pattern setting screen 7. The operation pattern setting screen 7 includes a setting button 73 for assigning the drive mode information to the set shedding pattern, in addition to the setting field 72 as described above. The setting button 73 is a button for displaying a separate window 8 for assigning the drive mode information to the specified setting frame 71 on the display. The input setter 5 is configured so that the separate window 8 as illustrated in FIG. 5 can be displayed by the touch operation of the setting button 73. The separate window 8 includes a selection button 81 to which numbers 1 to 8 are assigned. The number of each selection button 81 corresponds to No. of the drive mode information illustrated in FIG. 2, and a color in accordance with the drive mode information of the same No. illustrated in FIG. 2 is displayed on the left side of each selection button 81. By touching the selection button 81 on the separate window 8 described above in the state where the range including the plurality of setting frames 71 is specified as described above, the input setter 5 is configured so that the drive mode information of No. corresponding to the selection button 81 is assigned to the setting frame 71 in the specified range.

[0047] Moreover, in the present example, the drive mode information is assigned in units of shedding pattern composed of four steps. That is, in the present example, the drive mode information of the same No. is assigned to the plurality of setting frames 71 forming the shedding pattern in each shedding pattern.

[0048] Regarding the drive mode information, in the example illustrated in FIG. 2, the drive mode information of No. 1 is set to OFF at the center shed, and by assigning the drive mode information to the shedding pattern, the drive pattern is the first drive pattern referred to in the present invention. The drive mode information of No. 2 and No. 3 is set to ON at the center shed, and by assigning the drive mode information to the shedding pattern, the drive pattern is the second drive pattern referred to in the present invention. However, the drive mode information of No. 2 and the drive mode information of No. 3 are set so that the drive setting values regarding the cross timing are different.

[0049] FIG. 3 illustrates a state where such a first drive pattern and a second drive pattern are assigned to each heddle frame 2 on the operation pattern setting screen 7 (setting field 72). In the illustrated state, the second drive pattern is set for the first to fourth heddle frames 2 in the range of 20 steps as described above. The first drive pattern is set for the fifth to 12th heddle frames 2.

[0050] As described above, in the illustrated example, the drive pattern (including the case where the type is different) composed of four steps is set to be repeated five times by the 20th step. In the present example, as a setting (not illustrated), it is assumed that the same drive pattern as in the 17th to 20th steps is set for each heddle frame 2 in the 21st to 24th steps. Moreover, in the present invention, although an operation pattern for one repeat of the woven pattern composed of such a plurality of drive patterns is set, in the present example, the operation pattern is set so as not to be completed in the above-described 24 steps but to be continued until the subsequent steps. The details of the operation pattern are as follows.

[0051] As described above, up to the 24th step, the second drive pattern is set for the first to fourth heddle frames 2, and the first drive pattern is set for the remaining heddle frames 2. In a case where the heddle frame 2 is driven according to the second drive pattern, a warp passed through the heddle frame 2 is in a state where the tension is loosened at the time of beating the reed as compared with a warp passed through the heddle frame 2 driven by the first drive pattern. Therefore, the amount of consumption of the warp consumed during weaving (the amount drawn out from a warp beam) is different between the warp passed through the heddle frame 2 driven by the first drive pattern and the warp passed through the heddle frame 2 driven by the second drive pattern (the amount of consumption of the warp is higher in a case where the heddle frame 2 is driven according to the second drive pattern). Therefore, when weaving is performed with an operation pattern in which the second drive pattern is set only for a portion of the heddle frame 2, the weaving cannot be continued due to the difference in the amount of consumption of the warp.

[0052] Therefore, a second drive pattern is set for the fifth to 12th heddle frames 2 in which a first drive pattern is set in the drawing (not illustrated). Specifically, for the 24 steps (25th to 48th steps) following the 24 steps described above, a second drive pattern is set for the fifth to eighth heddle frames 2, and a first drive pattern is set for the other heddle frames 2, similar to the settings up to the 24th step for the first to fourth heddle frames 2. Furthermore, for the subsequent 24 steps (49th to 72nd steps), a similar second drive pattern is set for the ninth to 12th heddle frames 2, and a first drive pattern is set for the other heddle frames 2. The operation pattern is completed in the 72 steps. That is, in the present example, the operation pattern for one repeat of the woven pattern is set to be composed of 72 steps.

[0053] Regarding the second drive pattern included in the operation pattern set for each heddle frame 2, as described above, in the present example, the drive mode information of the center shed ON for the second drive pattern is set in No. 2 and No. 3 with different contents on the drive information setting screen 6. Moreover, in the present example, among the second drive patterns set over 24 steps, it is assumed that the drive mode information of No. 3 is assigned to the second drive pattern set in the 12 steps in the first half, and the drive mode information of No. 2 is assigned to the second drive pattern set in the 12 steps in the latter half. As described above, in the present example, each operation pattern is set to include two types of second drive patterns as the second drive pattern.

[0054] Each operation pattern for each heddle frame 2 set in this manner is stored in the storage 31 in the shedding control device 3 in a form associated with the frame No.

[0055] In the loom provided with the shedding device 1 as described above, the shedding control device 3 controls the drive of each driving motor 21 so that the heddle frame 2 operates according to the operation pattern for one repeat of the woven pattern set as described above. The drive control is performed as follows.

[0056] As described above, the drive commander 32 in the shedding control device 3 derives a drive mode for each driving motor 21 (heddle frame 2) based on the shedding pattern and drive mode information in the operation pattern stored in the storage 31, when the crank angle reaches the above-described set angle (60°) in each weaving cycle. More specifically, it is assumed that the drive commander 32 sequentially grasps the number of steps of the operation pattern in the current weaving cycle based on the crank angle signal output from the main shaft side encoder 41. Moreover, when it is determined from the crank angle signal that the crank angle is reached the set angle, the drive commander 32 derives a drive mode for each driving motor 21 (heddle frame 2) in order from the one corresponding to the first heddle frame 2. The derivation of the drive mode for each driving motor 21 is performed based on the current grasped weaving step (current step) and the operation pattern associated with the frame No. of the heddle frame 2 among the operation patterns stored in the storage 31.

[0057] Specifically, the drive commander 32 grasps the frame position set for the current step and the subsequent step (next step) from the operation pattern associated with the frame No. of the heddle frame 2 driven by the driving motor 21 for the driving motor 21 for which the drive mode is obtained. Furthermore, the drive commander 32 grasps the drive mode information assigned to the current step and the next step. Moreover, the drive mode of the driving motor 21 from the crank angle of 180° in the current step to the crank angle of 180° in the next step is derived based on the grasped information.

[0058] The derived drive mode is as follows for each frame position and drive mode information grasped described above. In a case where the frame positions set for the current step and the next step are different from each other, the drive mode is a mode in which the heddle frame 2 is displaced from a frame position (up/down) set in the current step to a frame position (down/up) set in the next step. Moreover, in a case where the frame position of the current step is the over shed position (under shed position), the drive mode is derived based on the upper dwell (lower dwell) and cross timing in the drive mode information assigned to the current step and the lower dwell (upper dwell) in the drive mode information assigned to the next step.

[0059] More specifically, the drive mode is a mode based on (including) the following three timings 1) to 3). 1) The timing at which the heddle frame 2 starts displacement from the frame position of the current step derived as described above based on the upper dwell (lower dwell) in the drive mode information of the current step. 2) The timing at which the heddle frame 2 due to the cross timing in the drive mode information of the current step passes through the center shed position. 3) The timing at which the heddle frame 2 reaches the frame position of the next step derived as described above based on the lower dwell (upper dwell) in the drive mode information of the next step.

[0060] In a case where the frame positions set for the current step and the next step are the same (over shed position), the drive mode is a mode for the staying period described above. Moreover, the drive mode is derived based on the ON/OFF setting of the center shed in the drive mode information assigned to the current step, and in a case where the setting of the center shed in the drive mode information is ON, the drive mode is derived based on the drive setting value of the setting position.

[0061] More specifically, in a case where the drive mode information of the current step is set to OFF at the center shed as in No. 1 in FIG. 2, the drive mode is a normal mode in which the heddle frame 2 is maintained at the over shed position.

[0062] On the other hand, in a case where the drive mode information of the current step is set to ON at the center shed as in No. 2 or No. 3, the drive mode is a mode in which the heddle frame 2 is displaced to a setting position derived from the drive setting value of the setting position at the time of beating the reed. Regarding the drive mode, as a premise, since the drive setting value of the setting position is set as the distance from the center shed position as described above, it is assumed that the drive commander 32 is configured to calculate the amount of movement (distance) of the heddle frame 2 from the over shed position to the setting position. Therefore, the distance from the center shed position to the over shed position is stored in the storage 31 separately from the drive mode information described above. Furthermore, the storage 31 also stores the timing at which the displacement of the heddle frame 2 toward the setting position in the staying period is started and the arrival timing at which the heddle frame 2 reaches the over shed position due to the displacement of the heddle frame 2 from the setting position to the over shed position. Moreover, the drive mode includes the start timing and the arrival timing, and is a mode derived based on the amount of the movement from the start timing to the time of beating the reed (crank angle 0°) and from the time of beating the reed to the arrival timing.

[0063] Moreover, when the drive commander 32 determines from the crank angle signal that the crank angle is reached 180°, the output of the drive command in accordance with the drive mode for each driving motor 21 (heddle frame 2) derived as described above is started to the drive controller 33. The drive controller 33 controls the drive of each driving motor 21 according to the drive command output from the drive commander 32, so that weaving is performed.

[0064] FIGS. 6A to 6C are graphs illustrating how the heddle frame 2 is displaced as a result of driving the driving motor 21 according to each of the drive modes described above. In FIG. 6A, illustrates the displacement of the heddle frame 2 in a case where the driving motor 21 is driven in the drive mode of the first drive pattern to which the drive mode information of No. 1 is assigned. FIG. 6B illustrates the displacement of the heddle frame in the case of the drive mode of the second drive pattern to which the drive mode information of No. 2 is assigned. FIG. 6C illustrates the displacement of the heddle frame in the case of the drive mode of the second drive pattern to which the drive mode information of No. 3 is assigned. Details of each of FIGS. 6A to 6C are as follows.

[0065] In FIG. 6A based on No. 1 drive mode information, since the drive setting value of the lower dwell is 100°, the heddle frame 2 is displaced so as to reach the under shed position at a crank angle of 130° from the over shed position to the under shed position. The heddle frame 2 reached the under shed position at a crank angle of 130° is maintained at the under shed position for a period of 100°, and starts again the displacement toward the over shed position at 230°. Since the drive setting value of the cross timing is 350° and the drive setting value of the upper dwell is 100°, the displacement is performed so as to pass through the center shed position at a crank angle of 350° and reach the over shed position at a crank angle of 130°. Since the setting of the center shed is OFF, the heddle frame 2 is maintained at the over shed position for a period (staying period) from the crank angle of 130° to the crank angle of 230° after two weaving cycles, and starts again the displacement toward the under shed position at 230°.

[0066] In FIG. 6B based on the drive mode information of No. 2, since the drive setting values for the upper dwell, lower dwell, and cross timing are the same as the drive mode information of No. 1, the displacement from the over shed position to the under shed position and the displacement from the under shed position to the over shed position are performed in the same manner as in FIG. 6A. However, since the setting of the center shed is ON, the heddle frame 2 is displaced so as to be in a state of being located at the setting position at each time of beating the reed during the staying period.

[0067] More specifically, as described above, since the drive setting value of the setting position in the drive mode information of No. 2 is 0 (mm), the setting position is a position that coincides with the center shed position. That is, the heddle frame 2 is displaced so as to be located at the center shed position at the time of beating the reed during the staying period (when the crank angle is 0°). As described above, the start timing of the displacement of the heddle frame 2 toward the setting position and the arrival timing from the setting position to the over shed position during the staying period are stored in advance in the storage 31, and in the present example, the start timing is 200° and the arrival timing is 160°. Therefore, the displacement of the heddle frame 2 during the staying period is performed so as to start when the crank angle reaches 200°, reach the center shed position at the crank angle of 0°, and thereafter reach again the over shed position at the crank angle of 160°. In the shedding pattern of the 3/1 twill fabric in the present example, since the beating the reed occurs twice during the staying period, such displacement of the heddle frame 2 is repeated twice during the staying period.

[0068] Regarding FIG. 6C based on the drive mode information of No. 3, the setting of the center shed is ON as in the drive mode information of No. 2, and the drive setting value of the setting position is also the same, the displacement of the heddle frame 2 during the staying period is performed in the same manner as in FIG. 6B described above. The drive setting values of the upper dwell and the lower dwell are also the same as that of the drive mode information of No. 2. However, since the drive setting value of the cross timing is different from that of the drive mode information of No. 2, in FIG. 6C, the displacement of the heddle frame 2 from the under shed position to the over shed position, and the displacement from the over shed position to the under shed position are performed so as to pass through the center shed position at a crank angle of 320°.

[0069] In a case where the heddle frame 2 is driven according to the operation pattern for one repeat of the woven pattern composed of the above-described 72 steps based on Fig. 3, for example, the first to fourth heddle frames 2 are displaced in the mode of FIG. 6C in the first to 12th steps, and are displaced in the mode of FIG. 6B in the 13th to 24th steps. In the subsequent 25th to 72nd steps, the heddle frame 2 is displaced in the mode of FIG. 6A.

[0070] As described above, the modes of FIGS. 6B and 6C are displacement modes (second displacement mode) according to the second drive pattern, and the mode of FIG. 6A is a displacement mode (first displacement mode) according to the first drive pattern.

[0071] Any of the displacement modes includes the displacement of the heddle frame 2 from the under shed position to the over shed position and the displacement of the heddle frame 2 from the over shed position to the under shed position so that the heddle frame 2 is located near the center shed position at the time of beating the reed. However, in the second displacement mode, in the staying period in which the heddle frame 2 is maintained at the over shed position in the first displacement mode, the displacement of the heddle frame 2 is included so that the heddle frame 2 is located at the setting position (center shed position in the present example) at each time of beating the reed during the staying period. That is, the second displacement mode is a mode in which the heddle frame 2 is displaced so that the heddle frame 2 is located at or near the center shed position at each time of beating the reed during the weaving cycle.

[0072] The tension of the warp (warp displaced by the heddle frame) passed through the heddle frame 2 is lower when the heddle frame 2 is located at or near the center shed position than when the heddle frame 2 is located at the over shed position.

[0073] Based on the above, when viewed the displacement mode of each heddle frame 2 for each step, in the first to the 12th steps and the 13th to 24th steps, the first to fourth heddle frames 2 are displaced in the second displacement mode, whereas the fifth to 12th heddle frames 2 are displaced in the first displacement mode. Therefore, in the 24 steps, for each weaving cycle (four cycles) forming the shedding pattern (drive pattern) of the 3/1 twill fabric, the fifth to 12th heddle frames 2 are located near the center shed position where the tension of the warp is reduced at the time of beating the reed twice, and are located at the over shed position where the tension of the warp is increased at the time of beating the reed twice in the meantime. On the other hand, the first to fourth heddle frames 2 are located at the center shed position or near the center shed position where the tension of the warp is reduced at all of time of beating the reed.

[0074] As described above, in the 24 steps, for the warp passed through the fifth to 12th heddle frames 2, the beating of the reed is performed in a state where the tension is low, and thereafter the beating of the reed is performed twice in a state where the tension is high. That is, a portion woven with the warp passed through the fifth to 12th heddle frame 2 is a woven portion with the shedding pattern of the normal 3/1 twill fabric. On the other hand, for the warp passed through the first to fourth heddle frames 2, the beating of the reed is performed each time in a state where the tension is low. As a result, a portion woven with the warp passed through the first to fourth heddle frames 2 has a raised surface of the fabric as compared with a normal woven portion. As a result, the fabric has irregularities formed between the normal woven portion and a woven portion whose surface is raised.

[0075] As described above, the operation pattern for one repeat of the woven pattern of the present example includes 72 steps, and the heddle frame 2 displaced in the second displacement mode is switched every 24 steps. Therefore, irregular portions are formed at different positions for each weaving range of the 24 steps on the surface of the fabric woven according to the operation pattern. As a result, the fabric woven in this manner has a special texture as compared with the fabric woven with the operation pattern in which only the first drive pattern, which is the normal weaving, is set.

[0076] As described above, the operation pattern of the present example includes two types of second drive patterns having different cross timings. That is, the operation pattern includes a second drive pattern (B pattern) forming the displacement mode of FIG. 6B and a second drive pattern (C pattern) forming the displacement mode of FIG. 6C.

[0077] Moreover, regarding the cross timing, the C pattern is set to a crank angle earlier than the B pattern, and in the 24 steps in which the second drive pattern is set, the C pattern is set for the 12 steps in the first half and the B pattern is set for the 12 steps in the latter half. Furthermore, when viewed every 72 steps of one repeat of the woven pattern, for example, for the first to fourth heddle frames 2, the first drive pattern is set for 48 steps following the 12 steps in the latter half described above, and thereafter the 12 steps in the first half described above in which the C pattern in the second drive pattern of the next 72 steps is set are present. That is, the order is C pattern (12 steps) → B pattern (12 steps) → first drive pattern (48 steps) → C pattern (12 steps) → ⋯.

[0078] When the cross timing is different as described above, the position of the heddle frame 2 is different from the center shed position at the time of beating the reed when the heddle frame 2 is displaced from the under shed position to the over shed position or from the over shed position to the under shed position. The earlier the cross timing, the larger the distance to the center shed position at the time of beating the reed, and the higher the tension of the warp at that time. Therefore, in each of the displacement modes of the B pattern and the C pattern, the tensions of the warp at the time of beating the reed in the staying period described above are the same as each other, and at the time of beating the reed at other times, the tension of the warp is slightly higher in the case of the C pattern than that in the case of the B pattern. As a result, the overall tension of the warp in the drive pattern unit (four cycles) is higher in the case of the C pattern than that in the case of the B pattern.

[0079] As described above, the amount of consumption due to weaving the warp passed through the heddle frame 2 in a case where the heddle frame 2 is displaced in the second displacement mode is larger than that in a case where the heddle frame 2 is displaced in the first displacement mode. Therefore, when a portion of the heddle frame 2 continues to be displaced in the second displacement mode, the tension is increased due to the amount of consumption being larger than that of the warp of the other heddle frame 2. The raised state of the warp is achieved by lowering the tension as described above, and when the tension is increased due to the amount of consumption, the raised state changes.

[0080] Therefore, in the step in which the heddle frame 2 is displaced in the second displacement mode, by setting the second drive pattern in the latter half so that the tension of the warp due to the displacement of the heddle frame 2 is lower than that in the case of the C pattern in the first half as in the B pattern described above, the raised state in the weaving range is uniform.

[0081] The present invention is not limited to one embodiment (above-described example) of the shedding device described above, and can also be implemented in other embodiments (modifications) such as the following (1) to (8).

[0082] (1) Regarding the setting position which is the frame position at the time of beating the reed during the staying period in a case where the heddle frame is operated in the drive mode of the second drive pattern, in the above-described example, the setting position is set by a distance (unit: mm) with respect to the reference position with the center shed position as the reference position.

[0083] However, in the present invention, the setting position is not limited to the position set with the center shed position as the reference position, and may be the position set with the maximum shedding position as the reference position. The setting of the setting position is not limited to being set by the distance (unit: mm), and may be set by, for example, % or the like as a ratio of the distance from the center shed position or the maximum shedding position of the setting position to the maximum shedding amount (distance from the center shed position to the maximum shedding position).

[0084] (2) In the above-described example, the drive setting value regarding the setting position is set to 0 (mm). That is, the setting position is set to coincide with the center shed position.

[0085] However, in the present invention, the setting position is not limited to a position that coincides with such a center shed position, and may be a position closer to the center shed position than the maximum shedding position within a range not exceeding the center shed position. The setting position is appropriately set in the above range in consideration of the weaving conditions such as the type of warp, the set tension of the warp, or the like, the raised state of the surface required for the fabric, and the like. Moreover, by setting the setting position to a position closer to the center shed position than the position 50% of the maximum shedding amount (intermediate position between the maximum shedding position and the center shed position), a fabric having a more preferable texture can be obtained.

[0086] (3) In the above-described example, the control for displacing the heddle frame toward the setting position during the staying period is performed based on the start timing of the displacement to the setting position from the over shed position stored in advance in the storage and the arrival timing from the setting position to the over shed position, in addition to the drive setting value of the set setting position.

[0087] However, in the present invention, the control is not limited to be performed based on such start timing and arrival timing as setting information set in advance, and may be performed based on the displacement speed (driving speed of the driving motor) when the heddle frame is displaced toward the setting position as the setting information. In that case, the drive commander is configured to obtain the start timing and the arrival timing from the setting position and the speed as the setting position is set. The drive commander outputs a drive command in accordance with a drive mode based on the set setting position, the speed, and the obtained start timing and arrival timing to the drive controller, so that the control is performed based on the set setting position, the speed, and the obtained start timing and arrival timing.

[0088] (4) In the above-described example, the second drive pattern is set for 24 steps for every four sheets in the 12 heddle frames, and as a result, the operation pattern for one repeat of the woven pattern includes 72 steps.

[0089] However, in the present invention, the number of heddle frames in which the second drive pattern is set in the same step or the number of steps in which the second drive pattern is set is not limited to the number of the above-described example, and is appropriately set depending on a target fabric.

[0090] Moreover, in the above-described example, two types of second drive patterns (above-described B pattern and C pattern) having different drive setting values of the cross timing are included in the range of the step in which the second drive pattern is set.

[0091] However, depending on various conditions (weaving conditions such as type of warp, set tension of warp, or the like, number of steps to displace the heddle frame in the second displacement mode, and the like), even in a case where the heddle frame is displaced in the second displacement mode, the change in tension due to the consumption of warp as described above may be small, and the change in tension may have little effect on the raised state of the surface of the fabric. Therefore, in that case, only one type of second drive pattern included in the operation pattern may be used. On the other hand, in the case of the various conditions in which the change in tension due to the consumption of the warp described above has a significant influence on the raised state, it is preferable that the second drive pattern included in the operation pattern is three or more types having different drive setting values of the cross timing.

[0092] (5) In the above-described example, the information on the drive mode (drive mode information) is set to include settings regarding a dwell (upper dwell and lower dwell), a cross timing, and a center shed operation (setting position, ON/OFF setting of center shed) as a single piece of information that can correspond to the shedding pattern composed of a plurality of cycles regarding the displacement to the over shed position or the under shed position.

[0093] However, in the present invention, the information set as the drive mode combined with the shedding pattern is not limited to such a form. For example, in the case of the above-described example, although three types of information are set as the drive mode information, there is only one type of drive setting value regarding the dwell, and there are only two types of drive setting value regarding the cross timing, setting regarding the center shed operation, and the drive setting value. Therefore, each of these settings may be set separately (set individually). Moreover, when combining the shedding pattern and the drive mode, each of the settings individually set in this manner may be assigned to the shedding pattern. Incidentally, the display mode of each setting frame on the setting screen in that case is preferably a display in which another display mode (for example, hatching or the like) is combined in addition to the colored display mode as in the above-described example. In a case of being individually set as described above, all may be set to the same value (one type) as the drive setting value regarding the dwell of the above-described example, and in a case where the drive setting value is basically not changed in the weaving with the loom, the drive setting value may be stored in the storage as a fixed value in advance.

[0094] In the above-described example, the drive mode information includes information on the dwell as described above, and each timing of the timing of starting the displacement and the timing of reaching the maximum shedding position is derived from the drive setting value in the displacement of the heddle frame from one maximum shedding position (under shed position and over shed position) to the other maximum shedding position (over shed position and under shed position). However, the setting regarding each timing is not limited to setting the dwell as in the above-described example, and each timing may be directly set as a drive setting value. Regarding each of the timings described above derived in a case where the drive mode information includes information on the dwell as described above, in the above-described example, each timing is derived from the drive setting value of the dwell with reference to the crank angle of 180°, which is the intermediate point in time of the weaving cycle. However, the reference point in time in a case where each of the above timings is obtained using the drive setting value of the dwell is not limited to the intermediate point in time of the weaving cycle, and may be a point in time obtained based on the cross timing. Specifically, for example, in a case where the cross timing is a crank angle of 350°, the reference point in time is the crank angle of 170°, which is 180° before the crank angle of 350°.

[0095] (6) In the above-described example, a range of the assignment of the drive mode information to the shedding pattern is specified on the setting field on the operation pattern setting screen, and the drive mode information is assigned to the setting frame of the specified range. Moreover, in the above-described example, the assignment is performed in units of shedding patterns (in the form in which the same drive mode information is assigned to a plurality of setting frames forming the shedding pattern in each shedding pattern).

[0096] However, in the configuration of the above-described example, the range is specified in a predetermined range as described above. Therefore, the range to which the drive mode information is assigned is not limited to the shedding pattern unit as in the above-described example, and may be a range in which the drive mode information is switched at a step in the middle of a certain shedding pattern in the operation pattern. Specifically, in the case of the above-described example, for the first to fourth heddle frames, the C pattern of the second drive pattern is set for the 3 unit shedding pattern (to the 12th step) from the first step, and the B pattern of the second drive pattern is set for the subsequent 3 unit shedding pattern (13th step to 24th step). That is, the drive mode of the second drive pattern is set so as to be switched between the 12th step and the 13th step. For example, the drive mode may be set so as to be switched between the 14th step and the 15th step. That is, in the shedding pattern in which one unit is formed of four steps from the 13th step to the 16th step, the C pattern may be set for the 13th and 14th steps, and the B pattern may be set for the 15th and 16th steps. Regarding the drive mode of the first drive pattern, in a case where a plurality of drive mode information of the first drive pattern is set, the drive mode may be set so as to be switched at a step in the middle of the shedding pattern similar to the above.

[0097] Furthermore, in a case where the drive pattern is set for each shedding pattern unit as in the above-described example, assignment of drive mode information to the shedding pattern is not limited to specifying the range on the setting field on the operation pattern setting screen as described above. For example, the assignment of drive mode information may be set by a numerical value or the like in what order and how many times (how many units of the shedding pattern) each drive mode information is repeated for each heddle frame, and the drive mode information may be assigned to the shedding pattern based on the setting.

[0098] (7) Regarding the drive pattern composed of a combination of the shedding pattern and the drive mode, in the above-described example, the drive pattern is set by assigning the drive mode information to the shedding pattern set in advance.

[0099] However, in the present invention, the drive pattern is not limited to the setting of the drive mode information assigned to the shedding pattern on the setting field of the operation pattern setting screen, a plurality of drive patterns for each drive mode in which the drive mode information is assigned to one unit of the shedding pattern may be prepared in advance and stored in the storage, and the drive pattern may be assigned to the setting field in accordance with the operation pattern for one repeat of the woven pattern. Regarding the setting for the setting field, instead of setting in the shedding pattern unit as such, the setting information in step units combining the frame position (over shed position and under shed position) and the drive mode may be prepared in advance only for the combination of the assumed frame position and the drive mode and stored in the storage, and the setting information may be set in step units (for each setting frame) in the form of setting the shedding pattern. In that case, the drive pattern is formed by the setting information for the number of steps, which is one unit of the shedding pattern.

[0100] (8) The weaving to which the weaving method according to the present invention is applied is described in the above-described example by taking the case of weaving a fabric in which the fabric structure is a 3/1 twill fabric as an example. However, the present invention is applicable as long as the weaving (reciprocating drive of the heddle frame) is performed with a shedding pattern in which the frame positions are maintained at the same position in two or more continuous weaving cycles, as in the case of weaving other fabrics such as a twill fabric (2/2 twill fabric, and the like), a satin fabric, or the like.

[0101] The present invention is not limited to the above-described example, and can be appropriately modified without departing from the spirit of the present invention.

REFERENCE SIGNS LIST:

[0102]

1	Shedding device
2	Heddle frame
21	Driving motor
22	Motion conversion mechanism
23	Shedding side encoder
3	Shedding control device
31	Storage
32	Drive commander
33	Drive controller
4	Main shaft
41	Main shaft side encoder
5	Input setter
6	Drive information setting screen
61, 62, 63, 64	Input field
65	Switching button
7	Operation pattern setting screen
71	Setting frame
72	Setting field
73	Setting button
8	Separate window
81	Selection button

Claims

1. A weaving method in a loom provided with a dedicated driving motor (21) provided for each heddle frame (2), and a shedding device (1) in which each driving motor (21) is independently driven according to a predetermined shedding pattern depending on a fabric structure of a fabric to be woven and a drive mode of the driving motor (21) in accordance with the shedding pattern, in a case where the shedding pattern is a pattern in which a position of the heddle frame (2) at each intermediate point in time during a staying period including the intermediate point in time in each weaving cycle of two or more continuous weaving cycles is the same maximum shedding position, the method comprising:

setting an operation pattern for one repeat of a woven pattern in which a drive pattern composed of a combination of the shedding pattern and the drive mode is repeated two or more times for each heddle frame (2);
setting the operation pattern set for a target heddle frame with at least a portion of the heddle frames (2) as the target heddle frame to include a first drive pattern in which the drive mode is set so that the target heddle frame is stayed at the maximum shedding position at a time of beating a reed in the staying period, and a second drive pattern in which the drive mode is set so that the target heddle frame is positioned at a setting position determined on a center shed position side within a range not exceeding the center shed position at the time of beating the reed in the staying period; and
performing weaving by each heddle frame (2) being driven according to the operation pattern.

2. The weaving method in a loom according to claim 1, wherein
a distance of the setting position to the center shed position is 50% or less of a distance of the maximum shedding position to the center shed position.

3. The weaving method in a loom according to claim 1 or 2, wherein
the operation pattern set for the target heddle frame includes, as the second drive pattern, a second drive pattern in which the drive mode is determined so that an arrival point in time at which a warp reaches the center shed position is earlier than the arrival point in time in the first drive pattern due to displacement of the target heddle frame between the maximum shedding position in the staying period and the maximum shedding position in a weaving cycle continuous with a weaving cycle including the staying period.

4. A shedding device (1) of a loom provided with a dedicated driving motor (21) provided for each heddle frame (2), and a controller that controls a drive of the driving motor (21) according to a predetermined shedding pattern depending on a fabric structure of a fabric to be woven and a drive mode of the driving motor (21) in accordance with the shedding pattern, the shedding device (1) comprising:

a setter capable of setting an operation pattern for one repeat of a woven pattern in which a drive pattern composed of a combination of the shedding pattern and the drive mode is repeated two or more times for each heddle frame (2), wherein
the setter is configured to selectively set a first drive pattern in which the drive mode is set so that the heddle frame is stayed at the maximum shedding position at a time of beating a reed in the staying period, and a second drive pattern in which the drive mode is set so that the heddle frame is positioned at a setting position determined on a center shed position side within a range not exceeding the center shed position at the time of beating the reed in the staying period, as each of the drive patterns included in the operation pattern in a case where the shedding pattern is a pattern in which a position of the heddle frame (2) at each intermediate point in time during a staying period including the intermediate point in time in each weaving cycle of two or more continuous weaving cycles is the same maximum shedding position, and
the controller controls the drive of the driving motor (21) according to the operation pattern.

5. The shedding device (1) of a loom according to claim 4, wherein
the setter is configured to set the setting position within a range in which a distance of the setting position to the center shed position is 50% or less of a distance of the maximum shedding position to the center shed position.

6. The shedding device (1) of a loom according to claim 4 or 5, wherein
the setter is configured to set the operation pattern to include, as the second drive pattern, a second drive pattern in which the drive mode is determined so that an arrival point in time at which a warp reaches the center shed position is earlier than the arrival point in time in the first drive pattern due to displacement of the heddle frame between the maximum shedding position in the staying period and the maximum shedding position in a weaving cycle continuous with a weaving cycle including the staying period.

FIG.1

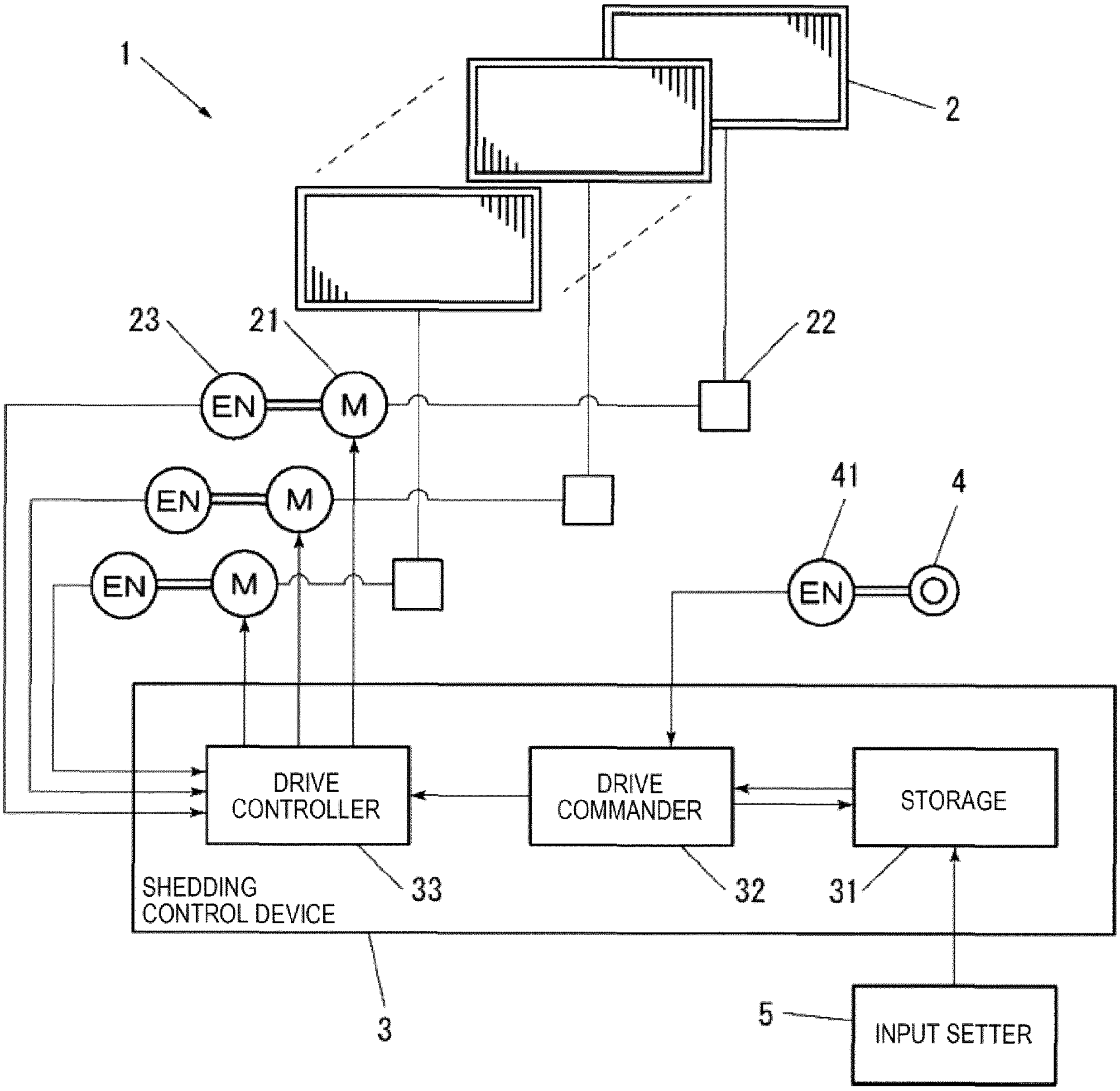

1
2
23
21
22
EN
M
EN
M
EN
M
41
4
EN
DRIVE CONTROLLER
DRIVE COMMANDER
STORAGE
SHEDDING CONTROL DEVICE
33
32
31
3
5
INPUT SETTER

FIG.2

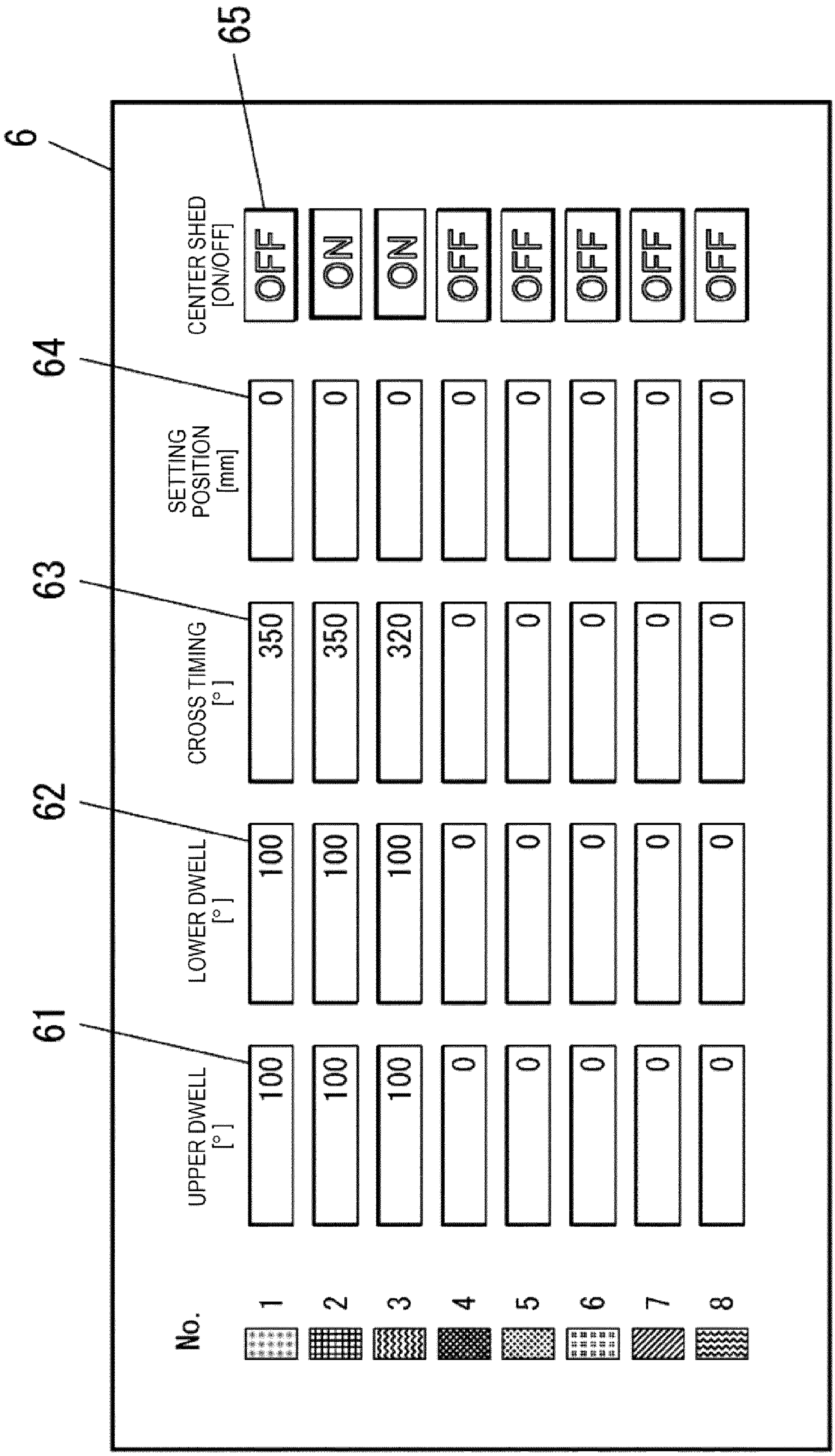
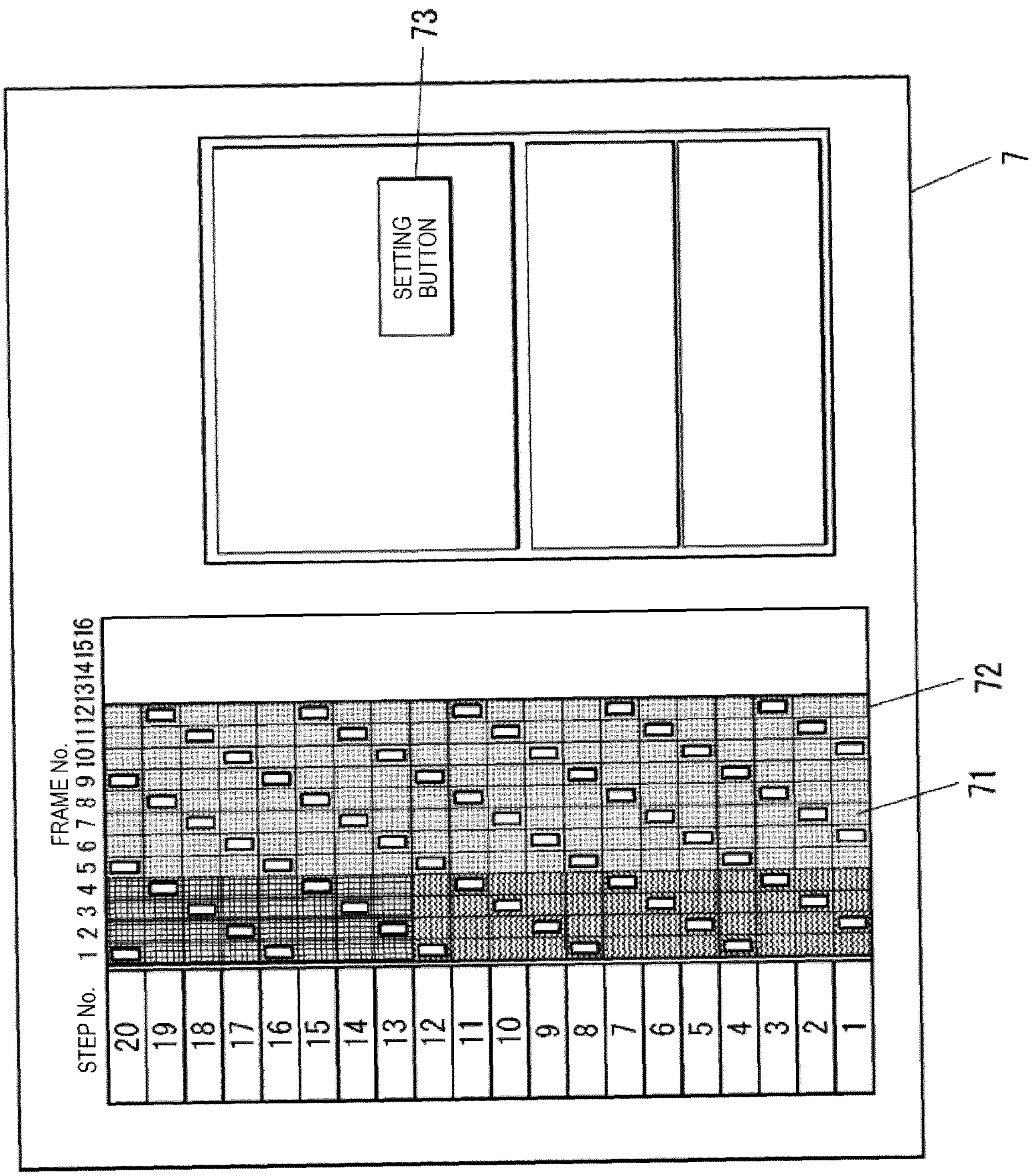

6
61
62
63
64
65
No.
UPPER DWELL [°]
LOWER DWELL [°]
CROSS TIMING [°]
SETTING POSITION [mm]
CENTER SHED [ON/OFF]
1 100 100 350 0 OFF
2 100 100 350 0 ON
3 100 100 320 0 ON
4 0 0 0 0 OFF
5 0 0 0 0 OFF
6 0 0 0 0 OFF
7 0 0 0 0 OFF
8 0 0 0 0 OFF

FIG.3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SETTING BUTTON
7
FRAME No.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
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19
18
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7
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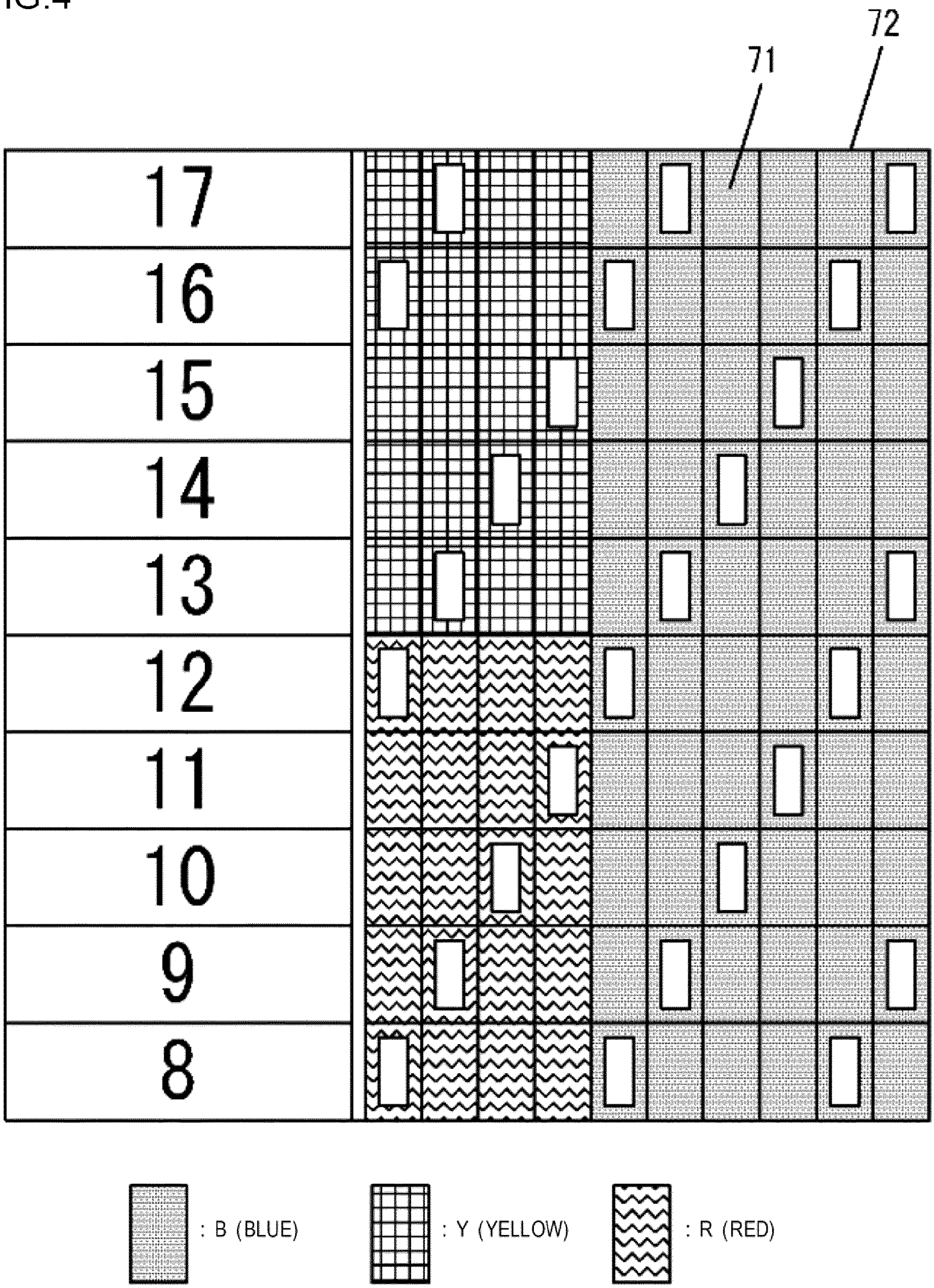
5
4
3
2
1
72
71

FIG.4



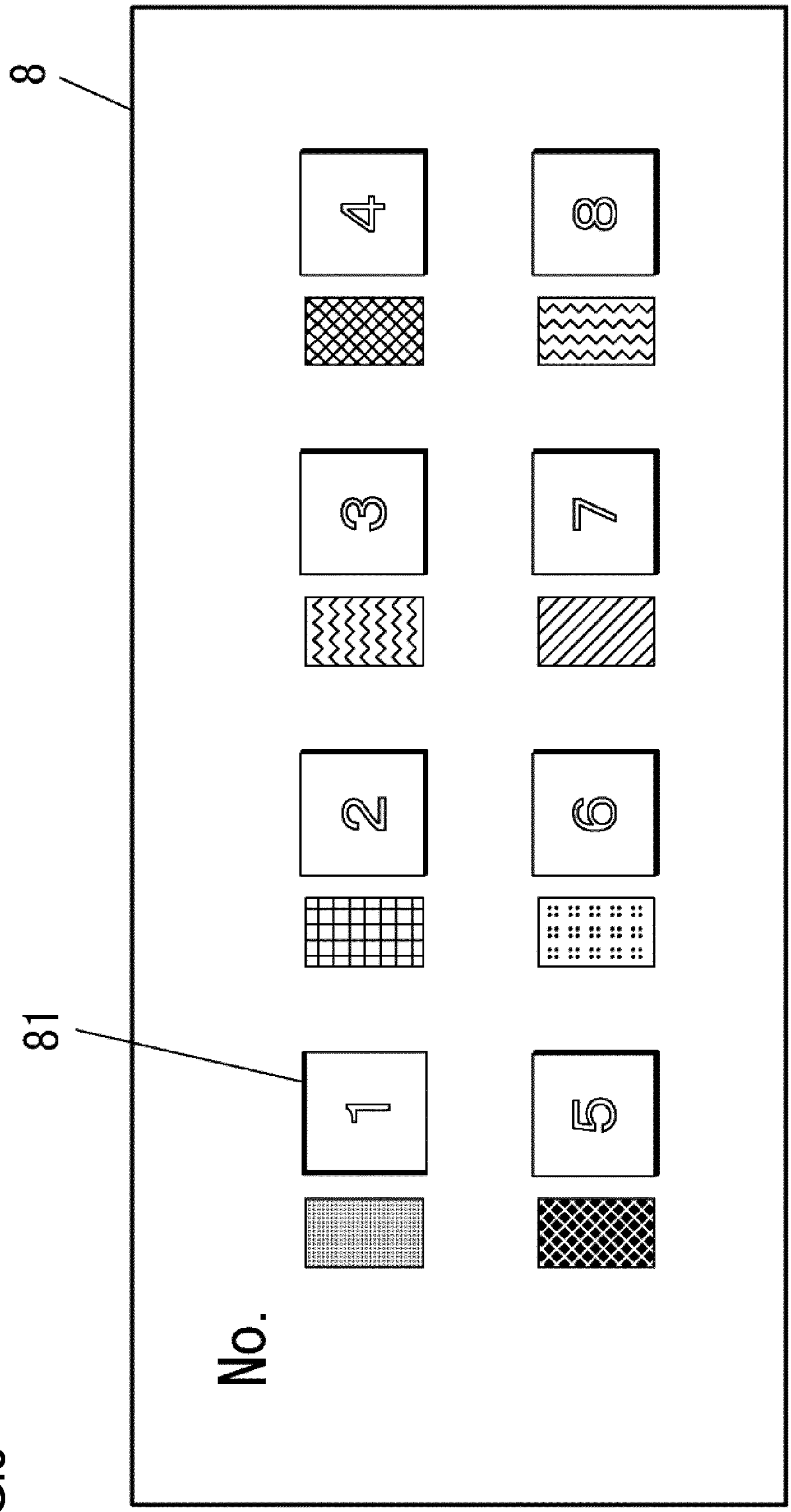


FIG.5

FIG.6A No. 1

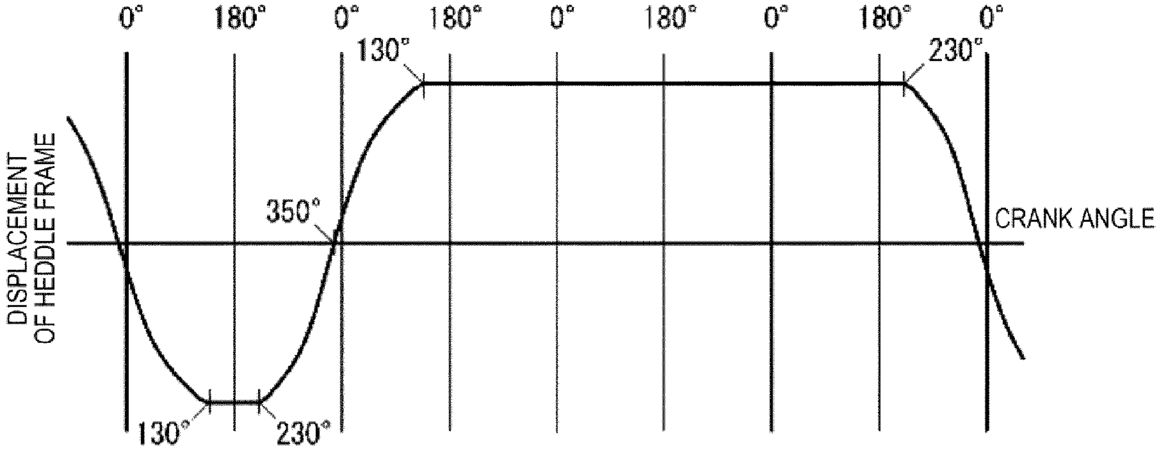


FIG.6B No. 2

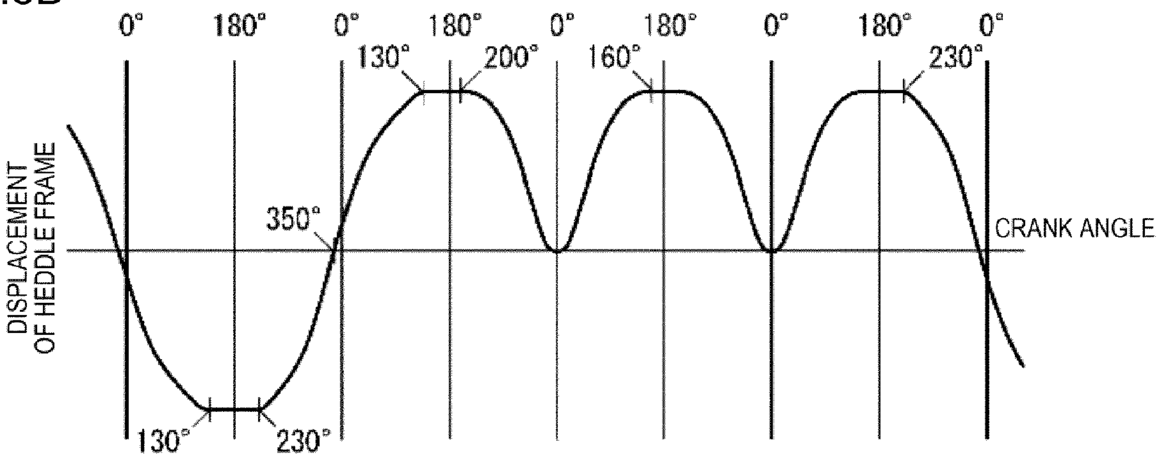
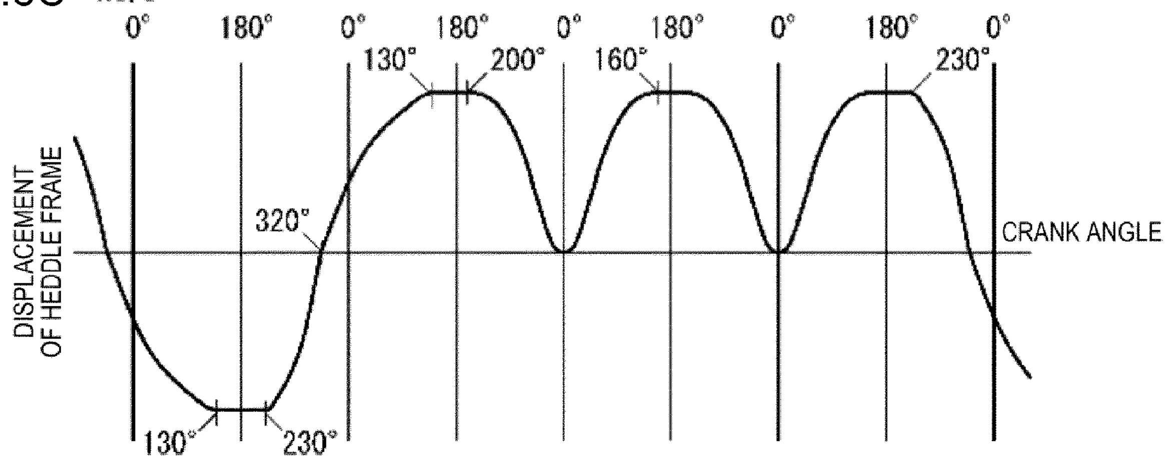


FIG.6C No. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 21 15 4087

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 3 327 190 A1 (TOYOTA JIDOSHOKKI KK [JP]) 30 May 2018 (2018-05-30) * paragraphs [0007] - [0012], [0034] - [0036], [0045], [0046]; figures 1-7 * -----	1-6	INV. D03C13/00
A	EP 2 357 271 A1 (STAEUBLI FAVERGES [FR]) 17 August 2011 (2011-08-17) * paragraphs [0004] - [0006], [0032]; figures 1-7 * -----	1-6	
			TECHNICAL FIELDS SEARCHED (IPC)
			D03C

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	12 April 2021	Louter, Petrus

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12-04-2021

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