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L. STRACH
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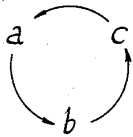


Fig. 1.

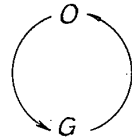


Fig. 2.

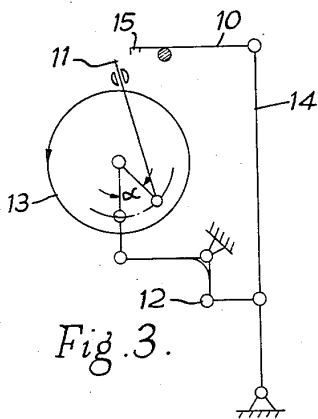


Fig. 3.

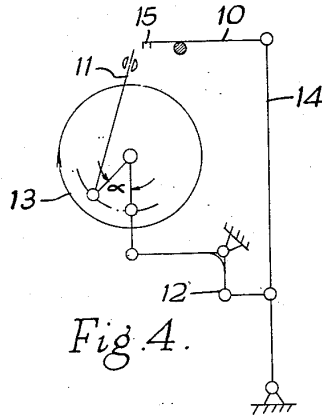


Fig. 4.

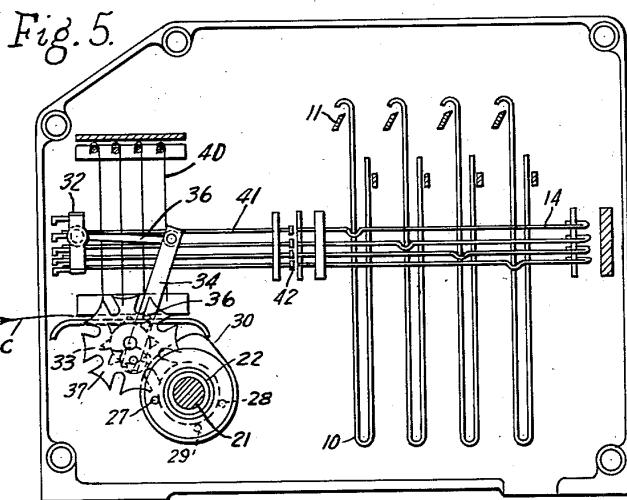


Fig. 5.

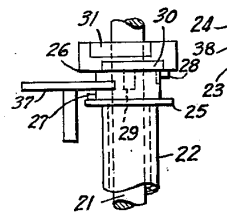


Fig. 6.

INVENTOR
LOTHAR STRACH
BY
Norriat Bateman
ATTORNEYS

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JACQUARD MACHINES
Lothar Strach, Kohlhofweg 13, Wilhelmsfeld,
Heidelberg, Germany
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If a weft breakage occurs in a Jacquard loom, then the loom is automatically stopped by mechanism responsive to the weft thread shortly before the shed is closed, consequently the griffe and needle engagement at that time is for the particular shed corresponding to the broken weft thread. At that time, however, a pattern card for the next pick has already been brought into operative position by the card feeding mechanism. If it is now necessary to take out the broken weft thread, and also a few previously woven weft threads, the loom is turned backwards one pick at a time, and the correct pattern card for each pick or shed must be returned to the cylinder. It will be understood that references to pattern cards and the cylinder are intended to include the Verdol type Jacquard which uses continuous paper pattern strips and a presser frame with which the paper strips co-operate as well as the conventional Jacquard which employs laced cards and a cylinder or prism, because the same considerations apply to both types of machine, and the invention is applicable to both types of Jacquard mechanisms. This reverse operation, or "backward weaving" as it is sometimes called, is difficult to perform and requires careful manipulation of the mechanism so as to ensure continuity of the pattern when normal weaving is re-commenced.

The present invention is designed to provide automatic or semi-automatic means for reverse operation of Jacquard mechanisms whereby the correct relationship of pattern card to shed opening is maintained to permit weft threads to be removed and fresh weft threads to be inserted.

One particular arrangement according to the invention will now be described by way of example only, with reference to the accompanying drawings, in which:

FIGURE 1 is a diagram representing the governing cycle of a Jacquard mechanism,

FIGURE 2 is a diagram representing the lifting cycle of the shed forming mechanism,

FIGURE 3 is a diagram representing the reverse operation of the mechanism,

FIGURE 4 is a diagram similar to FIGURE 3 but showing the relationship of the parts during reverse operation,

FIGURE 5 is a side elevation of part of a Jacquard mechanism, and

FIGURE 6 is a plan view of part of the mechanism shown in FIGURE 5.

The mechanism of a Jacquard loom can be divided into two groups or cycles, the governing cycle and the lifting cycle. FIGURE 1 represents the governing cycle in which *a* is the delivery movement of a pattern card, *b* is the dropper needle downstroke and *c* the presser frame needle actuating movement and in this order comprises a constant repeating working cycle. The action of the governing cycle results in the selection of the hooks which are to be raised and which are elements of the lifting cycle.

The lifting cycle as indicated in FIGURE 2 forms the open shed O and the closed shed G, also in constant repetition, and it will be appreciated that the governing cycle must be completed in the same period of time as that of the lifting cycle.

The mechanisms of the governing cycle as well as those of the lifting cycle are oscillating mechanisms. It is necessary for co-operation between these two mechanisms that the return points at the completion of a cycle

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of the governing cycle oscillating mechanism and of the lifting cycle mechanism should be phased to one another about the angle α , as will be explained later.

It will be appreciated that FIGURES 3 and 4 are purely diagrammatic or symbolic, and consequently the members bear little resemblance to the actual parts of a Jacquard mechanism, but these two figures are intended to illustrate the relationship of the governing cycle to the lifting cycle. In FIGURES 3 and 4, 10 is a Jacquard hook, 11 is a griffe, 12 represents the presser frame, and the circle 13 represents one cycle, the arrow indicating the direction of operation. In FIGURE 3, the elements of the two mechanisms are shown at the moment of maximum deflection of the hooks 10, that is when the hooks are "on press." If the hook 10 is not to be raised by the griffe 11 it must remain deflected by the presser frame, through the needle 14 when the griffe 11 passes the neb 15 of the hook 10 on its upward movement.

If the mechanism of FIGURE 3 was to be run backwards, i.e. in the opposite direction to the arrow, as is necessary, for example, in weft-seeking arrangements or reverse weaving, then it will be seen that after the griffe 11 passes through the lower dead point, the hook 10 would not be on press and pattern formation would not be possible. Therefore, when running in reverse, the governing cycle must be phased at double the angle α relatively to the lifting cycle, as shown in FIGURE 4. Taking FIGURE 3, the vertical axis must be regarded as a datum line, and by reference to FIGURE 2, it is evident that the griffe is at its lowest point at the bottom of this datum. So long as the Jacquard is weaving forwards, the needles must be "on press" during angle α as shown in FIGURE 3 so that a proper selection occurs. When the Jacquard is weaving backwards griffe is moving down (towards the datum) through α as seen in FIGURE 3 and if the needles were "on press" during this period there would be no useful result. When going backwards, the needles must be on press through the angle α as seen in FIGURE 4 (i.e. on the opposite side of the datum) if a selection is to occur as the griffe is beginning to rise.

Assuming that a weft breakage has occurred, then, as previously mentioned, the loom will be stopped shortly before shed closure, and the pattern card for the said shed has already been replaced by the pattern card for the next succeeding shed. The loom must now be turned backwards one pick at a time and the correct pattern card brought into operative position for each shed to be formed. This must be done according to the following procedure, in which the letters denote the pattern cards to be positioned, and the numbers denote the sheds.

Weaving backwards $a^1, b^1, c^1, d^2, e^3, f^4, g^5$
Thence forwards again, $g^1, f^1, e^1, d^2, c^3, b^4, a^5$

The cards are the usual Jacquard pattern cards and the identification letters are conventional in the industry. The above sequence is correct and during reverse weaving the first three cards *a*, *b* and *c* are positioned to be presented by the action of the pegs 27, 28 and 29 during one cycle of the operating mechanism, and then each of the cards *d*, *e*, *f* and *g* are presented in ascending order, one during each cycle. When forward weaving recommences, cards *g*, *f* and *e* are all positioned during one cycle and cards *d*, *c*, *b* and *a* each have one cycle. The whole process of reverse weaving followed by forward weaving is necessary to "find the pick" after a stoppage.

The necessity for the above sequence can be explained as follows:

It is assumed that the pattern is so arranged that in ordinary forward weaving the cards are positioned to be presented to the needles or dropper wires in the sequence *g*, *f*, *e*, *d*, *c*, *b*, *a*. Supposing that the loom is stopped

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to remove weft *b*, but the weaver finds it necessary to remove also wefts *c*, *d*, *e*, and *f*, before weaving can recommence. The loom is stopped on pick *b* and will come to rest just before front center, with the griffes on their downward movement, but the griffes will still be in engagement with the hooks according to the pattern of card *b*. However, before the loom stops, the pattern card mechanism will have switched card *a* into the reading position.

The weaver then turns the loom backwards to the rear center position where the shed is fully open. This will still be according to the pattern of card *b*, because despite the fact that card *a* is on the reading position, the griffes have not been disengaged with the hooks. When the shed is fully open the weaver then removes the faulty weft *b*, and continues to wind the loom backwards. Before the griffes again ascend (or the continued backward rotation of the loom crankshaft) the pattern card *c* must be brought into the reading position and its pattern impressed on the hooks, because it is weft *c* which has to be removed next. But as has been mentioned, at the commencement of winding back, card *a* was in the reading position, so it is necessary to operate the card mechanism twice in the one shed, to bring first card *b* and then card *c* into the reading position. Hence cards *a*, *b*, and *c* are all positioned to be presented in the first shed. Thereafter, one card is presented for each shed in the usual manner (but in the reverse sequence).

When the weaver has removed sufficient weft threads, and is about to start weaving forwards, the reverse action takes place. That is to say, it will be necessary to operate the card mechanism to switch the cards twice in a forwards direction during the first shed forwards after the loom has stopped.

The connection g^1 is necessary in synchronised running of the governing and lifting cycles because of the position of the striking nose of the loom.

The reverse running of the loom can be carried out manually or by power drive with the weaver counting off the correct pattern cards.

In mechanical or automatic backward weaving, the correct adjustment of the phasing of the governing cycle and the lifting cycle according to FIGURE 4 must be made as well as the correct placing of the pattern card sequence.

The present invention makes provision for automatic and simultaneous correction of phasing of the governing cycle to the lifting cycle and the pattern card sequence in weft seeking or reverse weaving, and has a so called card storing arrangement whereby the correct placing of the pattern card sequence is provided at the beginning of reverse weaving as well as at the beginning of subsequent forward weaving.

The mechanism for this purpose is shown in FIGURES 5 and 6, in which 21 is the main shaft of the Jacquard mechanism and a hollow shaft 22 on the main shaft rotates with the main shaft but is moved axially in the directions indicated by the arrows 23 and 24 of FIGURES 6 according to whether the shaft is rotating forwardly during normal forward weaving, or reversely for reverse weaving. Incorporation of the mechanism of FIGURE 5 into a conventional Jacquard machine is disclosed in my co-pending application Serial No. 37,898 to which reference may be had for more detail. The mechanism for displacing the hollow shaft 22 axially is not illustrated but it is connected to the reverse running mechanism and may be of any convenient construction. The hollow shaft 22 is suitably interconnected with the main shaft. The hollow shaft 22 has two spaced apart flanges 25, 26, a pin 27 being secured on the flange 25 and two pins 28 and 29 being secured on the flange 26. Two cams or tappets 30 and 31 are also secured on the hollow shaft 22, the cams 30 and 31 being adapted to move the presser frame 32 by engaging a roller 33 on a

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lever 34 pivoted at 35 and connected to the presser frame by a rod 36.

If the hollow shaft 22 is moved in the direction of the arrow 24 the pin 27 will engage with the star wheel 37 which is a common element of a Jacquard mechanism to provide for the feeding of the pattern cards. This will be the engagement for forward or normal operation of the Jacquard mechanism, and the cam 30 will be positioned to engage with the roller 33 of the lever 34 to actuate the presser frame 32. On reverse operation the hollow shaft 22 is moved axially to the limit of movement in the direction of the arrow 23 in which the pin 27 will be clear of the star wheel and the pin 29 will engage with the star wheel, to move the card *a* backwards and position the card *b*, and the pin 28 will then actuate the star wheel to move the card *b* backwards and bring card *c* into position. This takes place during one cycle during which cards *a* and *b* have been moved away from the operative position and the card *c* has been positioned ready for the next cycle. On further reverse rotation, the hollow shaft 22 is moved axially to an intermediate position indicated by 38 in which position both the pins 27 and 28 will be clear of the star wheel 37 and the pin 29 being longer than the pin 28 will alone engage with the star wheel and so takes over the normal reverse or backward engagement. During continued reverse operation, the card positioning will follow the sequence described above. Also a similar effect will be provided on subsequently commencing forward weaving.

The cams 30 and 31 move axially with the hollow shaft 22 and are so disposed that when the pin 27 is positioned to engage with the star wheel, the cam 30 actuates the presser frame 32, and when either or both of the pins 28 and 29 are positioned to engage with the star wheel, the cam 31 actuates the presser frame 32. It will be seen that for this purpose the cam 31 is wider than the cam 30. The cams 30 and 31 are phased to each other by double the angle α which is necessary as mentioned above and provides a lost motion or dwell in the drive to the presser frame.

FIGURE 5 illustrates a preferred mechanism in further detail. The entering pattern card *c* fed by the star wheel coacts with vertical feeler wires 40 each of which has a loop through which an auxiliary needle 41 passes. Each auxiliary needle 41 has a head 42 cooperating with a needle 14.

When using the arrangement described above, there is no necessity for watching the correct operation of the governing cycle when weft seeking or reverse weaving. The counting of the pattern card sequence by the weaver is eliminated, and the loom is consequently easier to operate. Furthermore, this solution of an automatic reverse engagement mechanism is compact, thus saving space and materials.

As stated above, any convenient mechanism, either mechanical or electrical may be employed for moving the hollow shaft 22 axially. For example, an electro-magnet may be provided for this purpose, contacts in a circuit for energising the magnet being incorporated in a circuit with the reverse weaving mechanism whereby the said contacts will be operative only during reverse weaving.

I claim:

1. In a Jacquard weaving machine, a rotatable drive shaft, a movably mounted Jacquard hook, a Jacquard pattern feeding mechanism having a rotatable star wheel input, means axially shiftably mounted relatively to and connected for rotation with said main shaft mounting three pins for selective engagement with said star wheel, said means also mounting a pair of cams in angularly displaced relation for rotation with said main shaft and for axial movement with said pins, and means operatively correspondingly connecting the cams selectively to control movement of said hook when said pins are shifted for selective engagement with said star wheel.

2. In the Jacquard weaving machine defined in claim 1,

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a hollow shaft surrounding said main shaft and on which said pins and cams all being mounted in fixed relative position.

3. In the Jacquard weaving machine defined in claim 1, one of said cams being wider axially than the other so as to have operative association with said hook control means when either or both of two of said pins has operative engagement with said star wheel.

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