Dec. 29, 1959 E. PFARRWALLER 2,918,946

FILLING OR WEFT THREAD DETECTION IN WEAVING MACHINES

Filed Dec. 20, 1956 4 Sheets-Sheet 1

Fig. 1.

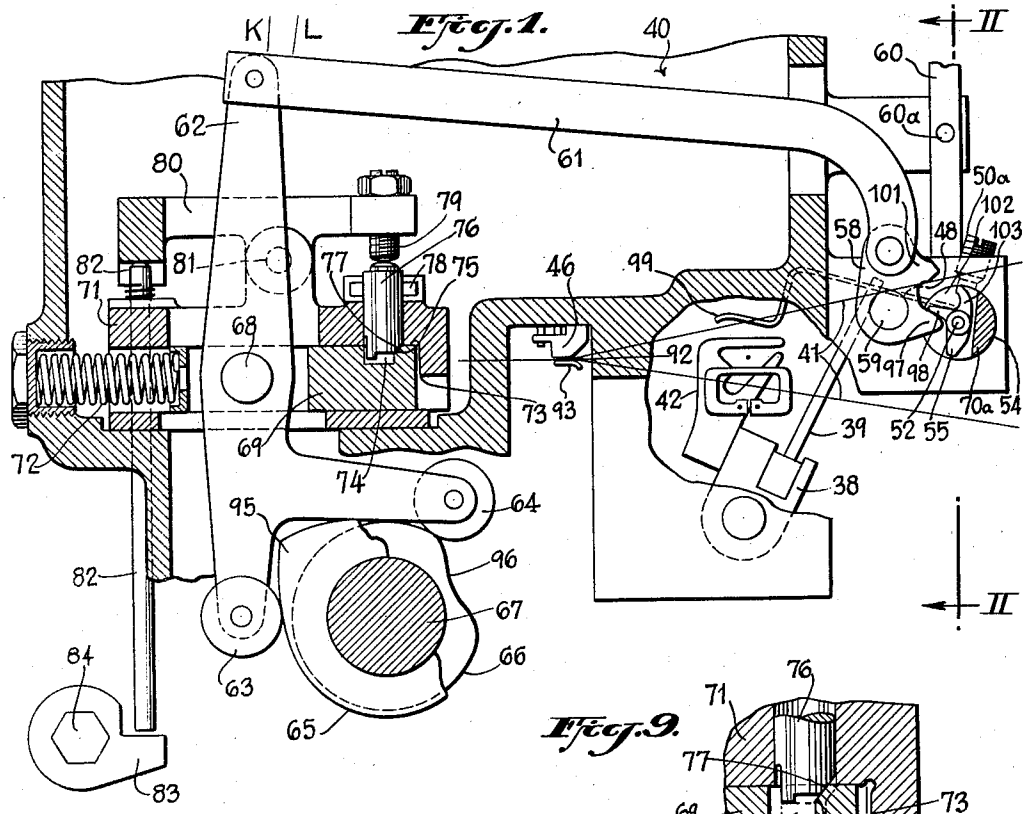
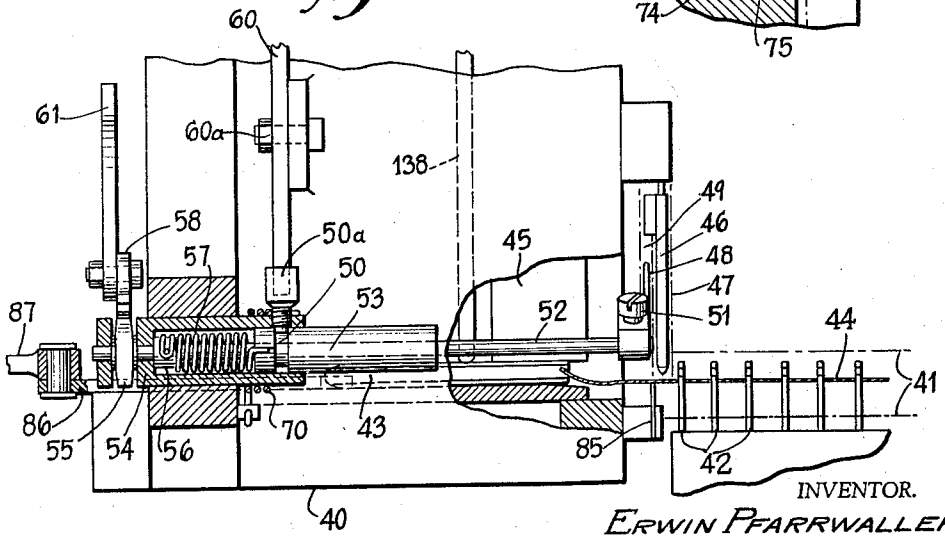


Fig. 3.

Fig. 2.



INVENTOR.
ERWIN PFARRWALLER.
BY K. A. Mayr
ATTORNEY.

Dec. 29, 1959 E. PFARRWALLER 2,918,946

FILLING OR WEFT THREAD DETECTION IN WEAVING MACHINES

Filed Dec. 20, 1956 4 Sheets-Sheet 2

Fig. 7.

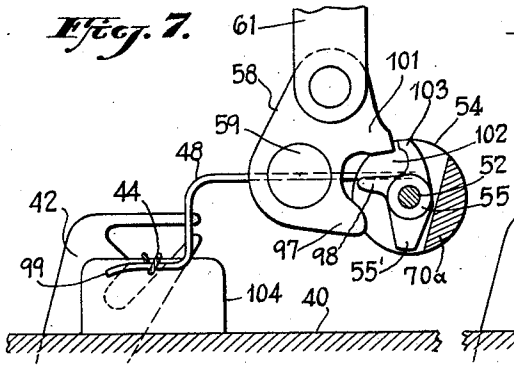


Fig. 8.

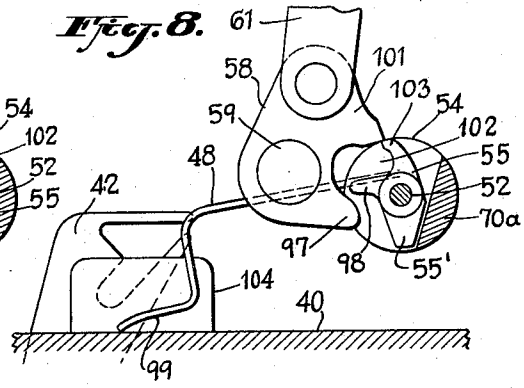


Fig. 4

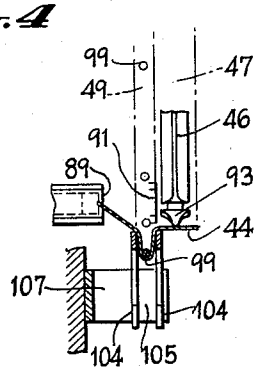


Fig. 3.

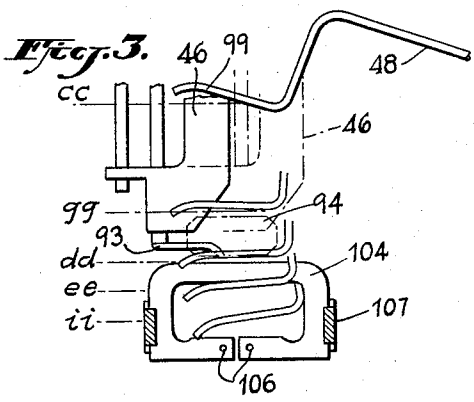


Fig. 11.

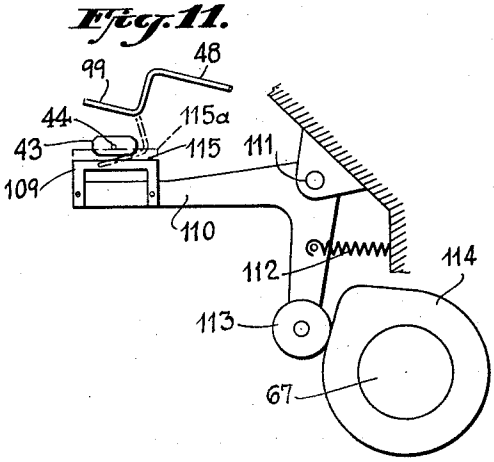
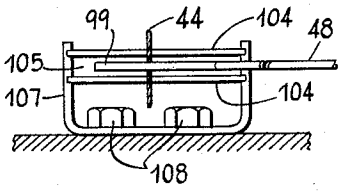


Fig. 5.



INVENTOR.
ERWIN PFARRWALLER.
BY K. B. Mayo
ATTORNEY.

Dec. 29, 1959 E. PFARRWALLER 2,918,946

FILLING OR WEFT THREAD DETECTION IN WEAVING MACHINES

Filed Dec. 20, 1956 4 Sheets-Sheet 3

Fig. 6.

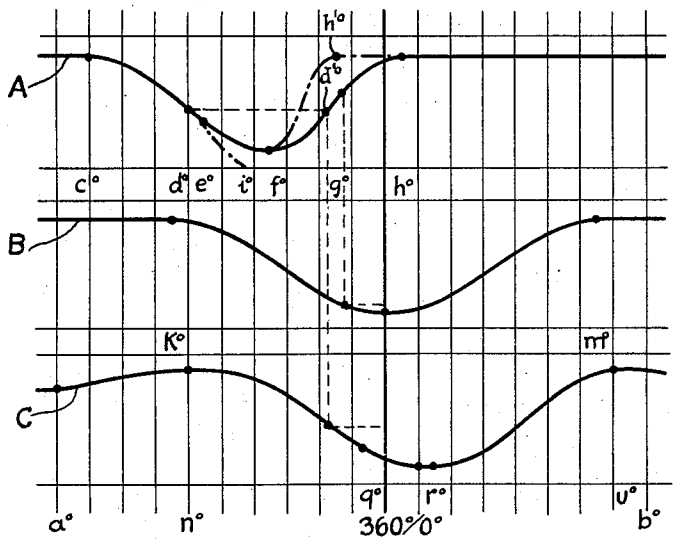


Fig. 10.

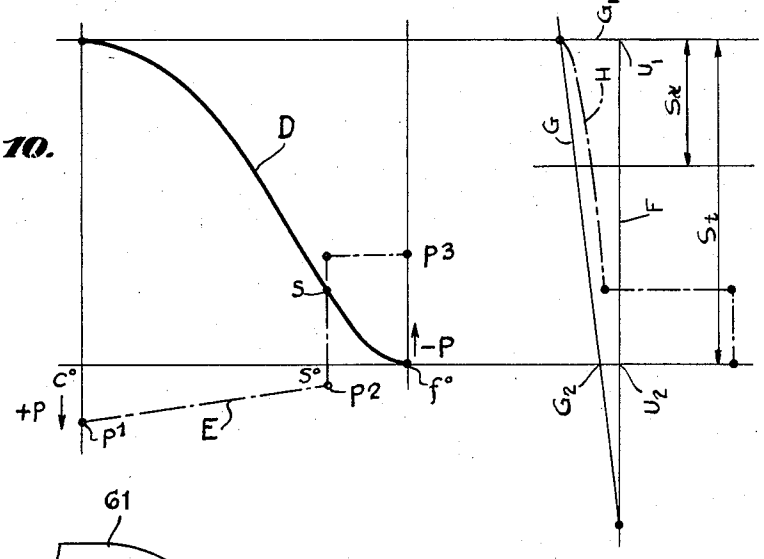


Fig. 12.

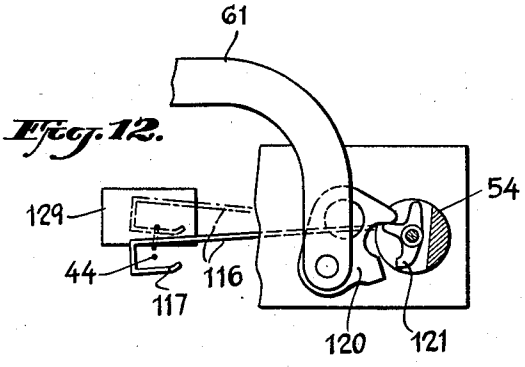
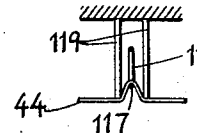


Fig. 13.



INVENTOR.
ERWIN PFARRWALLER.
BY
W. B. Leaf
ATTORNEY.

Dec. 29, 1959 E. PFARRWALLER 2,918,946

FILLING OR WEFT THREAD DETECTION IN WEAVING MACHINES

Filed Dec. 20, 1956 4 Sheets-Sheet 4

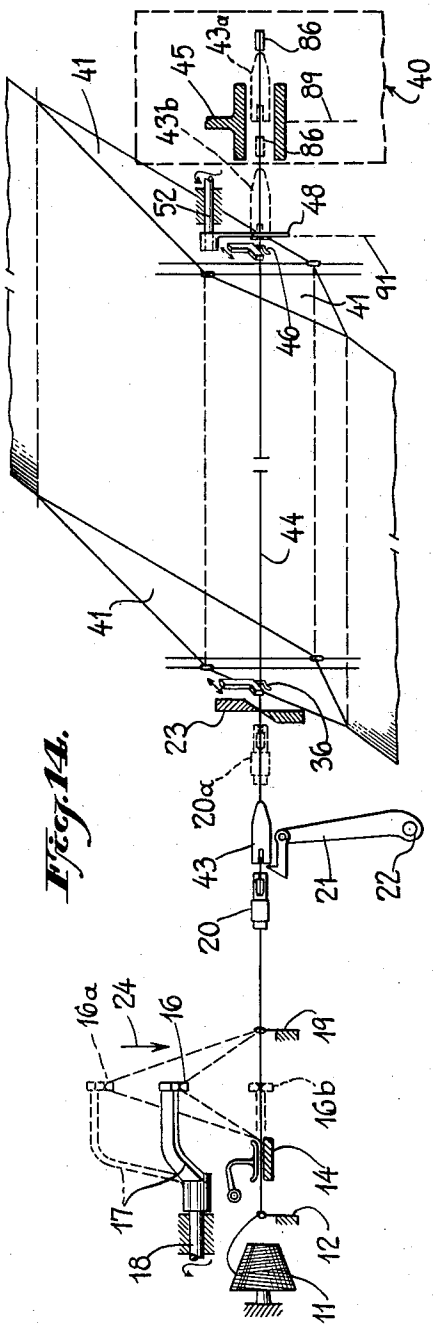


Fig. 14.

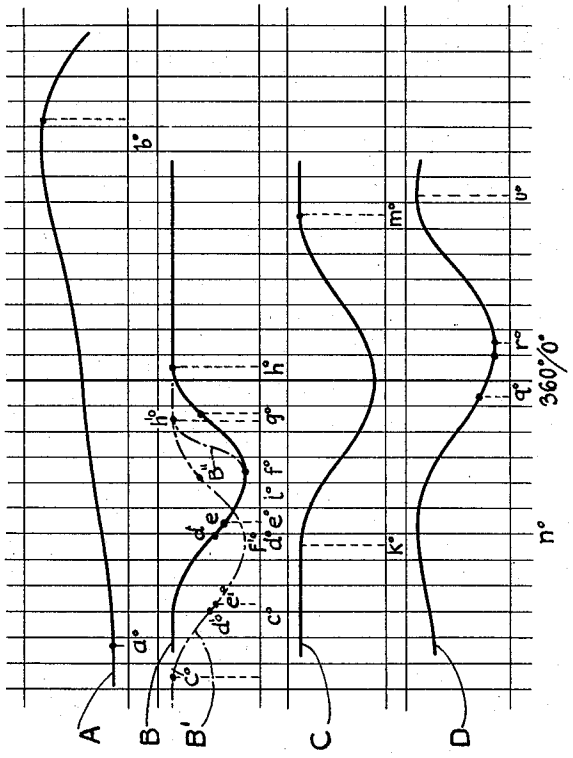


Fig. 15.

INVENTOR.
ERWIN PFARRWALLER.
BY
K. A. Mayr.
ATTORNEY.

United States Patent Office 2,918,946
Patented Dec. 29, 1959

2,918,946

FILLING OR WEFT THREAD DETECTION IN WEAVING MACHINES

Erwin Pfarrwaller, Winterthur, Switzerland, assignor to Sulzer Freres, S.A., Winterthur, Switzerland, a corporation of Switzerland

Application December 20, 1956, Serial No. 629,533

Claims priority, application Switzerland December 29, 1955

18 Claims. (Cl. 139—126)

The present invention relates to methods and devices for checking the filling or weft thread in weaving machines in which the weft thread is inserted by means of elements which are provided with thread grippers, a thread clamp for holding the weft thread until the weft thread is beaten up being provided at least adjacent to the edge of the fabric at the shuttle receiving box side of the machine.

Checking of the correct insertion of the weft threads in the shed is essential. It is conventional to provide a weft thread feeler at the entry side or at the exit side of the shed in weaving machines in which the weft threads are inserted by means of gripper shuttles. In the conventional arrangements it is checked, for example, by means of a thread feeler positioned between the edge of the fabric and the thread clamp thereat, whether sufficient thread is available for forming a selvage by tucking the end of the inserted weft thread into the shed after the shed is changed.

According to the present invention a weft thread feeler or detector is provided at the exit side of the shed which feeler moves in a space which is beyond the space in which the thread clamp moves which is adjacent to the shed, i.e., the thread clamp is proximal to the shed and the thread feeler is distal of the shed.

This arrangement is of advantage not only because the tucking-in space is narrow, the thread clamp seizing the weft thread end adjacent to the fabric, but also because the feeler needle can feel the weft thread independently of the gripping of the weft thread by the thread clamp so that at a faulty insertion the weft thread is not yet beaten up and can, therefore, be easily removed.

The invention is applicable to weaving machines in which the inserted weft thread is pulled back to a predetermined extent. In this case presence of a weft thread is checked at the exit side of the shed after pulling back of the weft thread has begun.

The noval features which are considered characteristic of the invention are set forth with particularity in the appended claims. The invention itself however and additional objects and advantages thereof will best be understood from the following description of embodiments thereof when read in connection with the accompanying drawing in which:

Fig. 1 is a cross sectional view of the shuttle receiving mechanism at the exit side of the shed;

Fig. 2 is a section of the shuttle receiving mechanism along line II—II of Fig. 1;

Figs. 3, 4, and 5 show a portion of the mechanism according to Figs. 1 and 2, illustrating a thread feeler, a support therefor and a thread clamp in different operating positions;

Fig. 6 is a diagram showing the relative movements of the thread feeler, of a shuttle push back slide and of the thread clamp;

Figs. 7 and 8 illustrate a portion of the mechanism according to Figs. 1 and 2, showing different positions of a latch and lever actuating the latch;

Fig. 9 is an enlarged view of a detail of the mechanism shown in Figs. 1 and 2;

Fig. 10 is a diagram illustrating the movement and acceleration of the thread feeler;

Fig. 11 illustrates a modified thread feeler mechanism;

Fig. 12 is a side view and Fig. 13 is an end view of a further modification of a thread feeler mechanism;

Fig. 14 is a diagrammatic illustration of a shed and of mechanisms which are active during the insertion of a weft thread;

Fig. 15 is a diagram showing the movements of the weft thread pull back device, of the thread feeler, of the shuttle push back slide and of the thread clamp at the edge of the fabric.

Like parts are designated by like numerals in different figures of the drawing.

Referring more particularly to Figs. 1 and 2, a shuttle receiving mechanism **40**, which is placed at the exit side of the shed **41**, is adjacent to the end of a shuttle guide formed by guide elements **42** mounted on a lay **38** including a reed **39**. The shuttle **43** has inserted a weft thread **44** into the shed **41**, the thread being connected with the shuttle by means of a clamp located in the interior of the shuttle. The shuttle has arrived in the receiving mechanism and has been braked by a brake **45**, for example, as disclosed in Patent No. 2,538,798. At the right end of the shuttle receiving mechanism **40**, as seen in Fig. 2, a thread clamp **46**, for example, as shown in Patent Nos. 2,519,274 and 2,602,472 is arranged the cross section of whose operating space is indicated by a dash-dot line **47**. At the left of the thread clamp **46** is a feeler needle **48** moving within a space **49**. The needle **48** is made fast on a shaft **52** by means of a screw **51**. The shaft **52** is rotatable in a sleeve **53** extending into a sleeve **54**. A feeler latch **55** and an adjusting ring **56** are mounted on the left end of the shaft **52**, the left end of a torsion spring **57** being connected with the ring **56**. The spring **57** whose right end is fixed to the sleeve **53** tends to rotate the shaft **52** and parts connected therewith in the direction in which the thread feeler **48** moves toward the weft thread. By rotating the sleeve **53** in the sleeve **54** a desired initial tension can be applied to the spring **57**. The sleeve **53** is fixed to the sleeve **54** in the axial and in the desired relative angular position by means of a set screw **50***a* which is screwed into the sleeve **54** and extends into an annular groove **50** in the sleeve **53**.

The latch **55** is controlled by a lever **58** which swings on a pin **59** connected with a housing for the shuttle receiving mechanism **40**. The lever **58** is actuated by a link **61** pivoted to the upper arm of a lever **62** which has two lower arms provided with cam follower rollers **63** and **64** which engage the surfaces of cams **65** and **66**, respectively, mounted on a shaft **67** which is operatively connected with and rotates in synchronism with the main drive shaft, not shown, of the weaving machine.

The lever **62** rocks on a pin **68** supported by a slide block **69** which is horizontally movable in a guideway **71** and urged by a spring **72** against an abutment **73**. The upper side of the slide block **69** is provided with a recess **74** having an inclined surface portion **75**. A pin **76** is receivable in the recess **74** and is provided with an inclined surface **77** corresponding to and engaging the inclined surface **75**. Pins **78** radially projecting from the pin **76** and placed in a slot of the upper part of the guideway **71** prevent rotation of the pin **76** so that the surfaces **75, 77** remain engaged. The top of the pin **76** is engaged by a bolt **79** adjustably screwed into one end of a lever **80** rocking on a stationary fulcrum **81**. The other end of the lever **80** rests on a vertically movable plunger **82** which rests on an arm **83** extending from a master stop rod **84**, actuating a mechanism, not shown, for stopping

the weaving machine. This mechanism is shown in Patent No. 2,639,732.

The mechanism according to the invention operates as follows:

When the shuttle 43 enters the shuttle receiving mechanism 40, the weft thread rests on a support 85. The feeler needle 48 is then lowered from its upper or rest position. The shuttle 43 is moved back toward the shed 41 by a shuttle push back element 86, which is operatively connected with and actuated by the main drive shaft, not shown, of the loom as is described in my Patent No. 2,538,798, from the position 89 (Fig. 4) in which it is halted by the brake element 45 and which is not always the same, into a definitely predetermined position 91 in which the weft thread 44 is disconnected from the shuttle by opening the shuttle thread clamp as is described, for example, in Patent Nos. 2,702,054 and 2,759,496. The position 91 is defined by the length of the end of the weft thread 44 which is desired to project from the shed 41.

The brake position 89 of the shuttle depends, inter alia, on the gauge and the material of the weft thread. The push back element 86 which is actuated by a lever 87 forming part of the mechanism connecting the element 86 with the main drive shaft of the loom returns the shuttle into the predetermined position 91 which is always exactly the same as is essential, for example, for producing an accurate selvage. A conventional tensioning device as, for example, shown in my Patent No. 2,589,429 is provided on the side of the shed 41 where the shuttle picking mechanism is located. This device pulls the inserted weft thread 44 back so that it remains tensioned when the shuttle 43 is pushed back into the thread release position 91.

At the same time the thread clamp 46, with the jaw 93 in open position is moved from the apex 92 of the shed toward the path of the shuttle by a suitable mechanism as, for example, described in Patent No. 2,602,472. The clamp 46 does not seize the weft thread 44 until the end 99 of the feeler 48 has left the space 94 through which the shuttle 43 travels and until the shuttle has been moved into the weft thread release position 91.

The positions of the individual elements at different moments are shown in Figs. 3 and 4. Their positions at various angular positions of the main drive shaft of the loom by which they are driven are shown in the diagram, Fig. 6. The main drive shaft of the weaving machine rotates from an angular position $a°$ to an angular position $b°$. The curve A represents the movement of the feeler 48 which begins its downward movement at the angular position $c°$ (Fig. 6) from the rest position *cc* shown in Fig. 3. At the angular position $c°$ the roller 63 is moved to the left by the cam 95 (Fig. 1). The roller 64 enters a recess 96 so that the lever 62 swings in clockwise direction, the link 61 moving the latch control lever 58 also in clockwise direction.

Due to the aforesaid motion a holding tooth 97 of the lever 58 moves downward. A tooth 98 of the latch 55 which is pressed against the tooth 97 by the action of the spring 57, moves downward with the tooth 97 so that the shaft 52 rotates counterclockwise, as seen in Fig. 1, and causes lowering of the feeler end 99 of the feeler 48. In the position *dd* (Fig. 3) the end 99 engages the weft thread resting on a support 104 and is arrested by the thread 44 which now forms a loop in the position *ee* (Fig. 4).

The position *dd* of the feeler 48 (Fig. 3) corresponds to the angular position $d°$ of the main loom shaft in Fig. 6. In this position the feeler 48 begins to contact the weft thread 44. The position *ee* of the feeler in Fig. 3 corresponds to the angular position $e°$ and the position *ii* and *gg* correspond to the angular positions $i°$ and $g°$, respectively, as applied to the curve A in Fig. 6.

Engagement of the thread by the thread feeler causes separation of the tooth 97 of the lever 58 from the latch

tooth 98. A little later, a checking tooth 101 of the latch control lever 58 enters a gap 102 of the latch 55 (Fig. 7). This movement is completed at the angular position $f°$ of the main loom shaft (Fig. 6) whereupon the movement of the lever 58 is reversed and the tooth 97 engaging the underside of the tooth 98 moves the latch 55 clockwise and moves the feeler end 99 upward until it reaches the rest position *cc* at the angular position $h°$ of the loom drive shaft.

If the weft thread release position of the shuttle 43 is so far to the right in Fig. 2 that the right end of the shuttle 43 extends into the space 49 in which the feeler 48 moves, the movements of the shuttle push back member 86 and of the feeler 48 must be coordinated with such angular positions of the loom drive shaft that, at the position *gg* (Fig. 3) and at the angular position $g°$ (Fig. 6) the needle end 99 is at least so far lifted that it has left the space 94 in which the shuttle 43 moves.

The curve B in Fig. 6 represents the movement of the shuttle return member 86 which is moved to the right in Fig. 2 at the angular position $k°$ of the loom drive shaft until, after about a full revolution of the drive shaft, the rear end of the shuttle 43 is in the thread release position 91 (Fig. 4) whereupon the member 86 at the angular position $m°$ of the drive shaft reaches again its initial or rest position.

The curve C in Fig. 6 represents the movement of the thread clamp 46. At the angular position $n°$ the clamp 46 begins its movement toward the shuttle path for gripping the weft thread 44. The jaw 93 is closed by spring action (Patent No. 2,602,472) after the drive shaft has reached the angular position $r°$, gripping the weft thread. At the angular position $u°$ of the drive shaft the clamp 46 is at the edge of the fabric where it holds the weft thread 44 until the thread is beaten up and tucking-in of the weft thread end begins.

When comparing the curves A and B it will be apparent that at the angular position $g°$ the push back member 86 has returned the shuttle 43 to the right side of the operating space 49 of the feeler 48 (Fig. 4). However, at the angular position $g°$ (Fig. 6), i.e. at the position *gg* (Fig. 3), the feeler 48 has just left the space 94 in which the shuttle 43 moves so that the shuttle 43 can be moved, without stopping, by the push-back member 86 beyond the operating space 49 into the thread release position 91.

A comparison of the curves A and C shows that the clamp 46 is moved for seizing the weft thread simultaneously with the lowering of the feeler 48; the latter, however, is lifted at the angular position $d'°$ (Fig. 6) from the thread 44 which is again straightened before the clamp 46 reaches its left position (Fig. 3) at the picking path. In this position the weft thread enters the open clamp 46 at the angular position $q°$ of the loom drive shaft. Thereupon the clamp is closed for gripping and holding the weft thread at the position $r°$.

The dotted lines in Fig. 6 illustrate the aforedescribed interrelations between the curves A, B and C.

If there is no weft thread at the exit side of the shed 41 or if the weft thread breaks within the shed, nothing on the exit side of the shed can be pulled back by the thread pull back device during the time the shuttle is moved toward the shed and a severed thread portion becomes loose even if the point of breakage is close to the picking side of the shed.

The descending feeler 48 is now not retarded because there is no or only a loose thread so that the latch 55 revolves counterclockwise beyond the position shown in Fig. 7 until it reaches the position shown in Fig. 8 whereby the end portion of the needle moves beyond the position *ee* into the position *ii* (Fig. 3), in Figure 6 in curve A the angular position $i°$. The checking tooth 101 cannot enter into the gap 102 upon continued rotation of the lever 58 because in the position of the device shown in Fig. 8 a locking tooth 103 of the latch 55 blocks the

checking tooth **101** and prevents further movement of the lever **58** which cannot reach the position shown in Fig. 7.

Movement of the lever **62** is stopped because of the engagement of the teeth **101** and **103**. The upper end of the lever **62** remains in the position K (Fig. 1) and cannot reach its normal right end position L. This causes movement of the slide block **69** to the left against the action of the spring **72**. The inclined surface **75** presses the bolt **76** whose inclined surface **77** is engaged by the inclined surface **75** upward into the position shown in solid lines in Fig. 9. The lever **80** is rocked counterclockwise and presses the plunger **82** downward, causing clockwise rotation of the master stop rod **84** and stopping of the weaving machine.

In order to return the feeler to normal operating position the upper end of a lever **60** is manually pulled to the left in Fig. 1. The lever **60** swings on a pivot **60***a* mounted on the casing of the shuttle receiving mechanism **40**, the lower end of the lever **60** pressing against the previously described screw **50***a* and turning the sleeve **54** clockwise against the action of a torsion spring **70** (Fig. 2). When the feeler **48** is in the position *ii* the lower arm **55'** of the latch **55** abuts against a web **70***a* of the sleeve **54** so that, upon clockwise rotation of the sleeve **54** by means of the lever **60**, the latch is also rotated and the locking tooth **103** is moved away from the checking tooth **101**. The latter can now be received in the gap **102** and the spring **72** can return the slide block **69** into the normal position so that the upper end of the lever **62** moves into the position L. The lever **80** simultaneously rocks clockwise and ceases to hold the master stop rod **84** in loom stopping position.

The angular range between $f°$ and $h°$ during which the thread feeler **48** returns to rest position must be so great that the shaft **67** of the weaving machine rotates between the moment of starting of the loom stopping operation and the moment at which the main drive shaft of the loom comes to a standstill so far that the feeler **48** has reached the rest position *cc* (Fig. 3) at the angular position $h°$ of the main drive shaft. If this is so, a correcting pick can be made after removal of the faulty weft thread without manual lifting of the feeler **48** and the feeler is protected against damage.

When working with thin weft threads, two spaced thread supports **104**, as shown in Fig. 5, must be provided, the space **105** between the two supports being somewhat greater than the thickness of the end portion **99** of the thread feeler **48** plus twice the diameter of the thread. A thin weft thread is too pliable for retarding the feeling movement of the feeler **48** produced by the spring **57**, if only one support is provided. In spite of the presence of a weft thread **44** the end of the feeler would be so far lowered that the locking tooth **103** would prevent continued movement of the checking tooth **101** (Fig. 8) and the loom would be stopped.

The side of the end portion **99** of the feeler **48** facing the weft thread **44** is concave for preventing pushing aside of the weft thread along the upper edge of the support **104**.

When the weaving machine operates at high speed and when the stroke of the end portion **99** of the thread feeler is relatively great, a considerable acceleration is needed so that the feeler needle can perform the feeling stroke within the limited time available for this operation. The power of the spring **57** must be so great that the feeler **48** is sufficiently accelerated. The force of the spring diminishes during the expansion, i.e., during the feeling movement of the feeler. When the feeler moves toward the weft thread the latch **55** follows the latch control lever **58** and the tooth **98** may be separated from the tooth **97**, if the movement of the latch is too slow. This can be prevented by greater pretension of the spring **57** or by providing a stronger spring.

As long as the feeler end **99** does not engage the weft thread **44** the greatness of the acceleration is of no consequence. If, however, the feeler end engages thin or very flexible weft thread material the force of the spring **57** needed for producing the required acceleration may produce such a great loop of the weft thread, even if two thread supports **104** are provided, that the locking tooth **103** blocks the checking tooth **101** so that the loom is stopped, although a thread **44** is present.

Reduction of the acceleration of the feeler **48** due to diminishing of the force of the spring **57** is not disadvantageous. It is only necessary that the acceleration of the control lever **58** with its tooth **97** is conformed to the acceleration of the tooth **98** of the latch member **55**. This is illustrated in the diagram Fig. 10. The curve D represents the path of the feeler end portion **99** between the angular positions $c°$ and $f°$ of the main drive shaft of the weaving machine. The line E represents the acceleration and deceleration. The acceleration diminishes from p_1 to p_2 up to the point S of the curve D where the feeler end **99** engages the weft thread. The feeler **48** is retarded after engaging the weft thread **44**. The acceleration is negative from the angular position S° and has the value p_3 which is a multiple of p_1 and p_2. The decrease of the acceleration from p_1 to p_2 is chosen according to the characteristic G of the spring **57**. The force G of the spring **57** is plotted above a line F which which represents the path or stroke of the feeler end **99** between U_1 and U_2. The line G shows the decrease of the spring force from G_1 to G_2 corresponding to the path U_1 to U_2 traveled by the end **99**, G_2 representing the spring tension when the feeler end **99** is in the lower position. Line H which is substantially parallel to and spaced from the line G indicates the force needed for moving the feeler **48** having the mass M.

The line G is straight. Considering a certain pretension of the spring **57** at U_2 the force G at a distance S_x from G_1 can be calculated as follows:

$$G = G_1\left(1 - \frac{S_x}{1.5 \cdot S_t}\right)$$

wherein S_t is the total path between U_1 and U_2. The force H which moves the feeler **48** and the member **55** and the reduction of this force corresponding to the decreasing acceleration of these parts can be calculated by using the aforesaid formula. If H is somewhat smaller than G, the member **55** rests on the lever **58** during the feeler movement.

From the line H the first part of the acceleration curve E can be calculated. The minimal value of the acceleration p_2 depends on the thickness of and on the material of which the weft thread **44** is made and must be sufficient to ensure engagement of the weft thread **44** by the thread feeler. The acceleration p_1 at the beginning of the feeler movement depends on the shape of the lines H and G.

The retardation p_3 is not dependent on the power of the spring **57** because it is effected by the deceleration of the movement of the tooth **97**. The drive of the lever **58**, i.e., the configuration of the cams **65** and **66** is based on the line E. This has the advantage that, even in a weaving machine operating at a great number of picks per minute, the latch **55** cannot stay behind the lever **58**, also when the feeler **48** is in its lowest position, so that the angular movement of the main drive shaft of the weaving machine for effecting the thread feeling operation can be made small.

Due to the positive drive of the latch **55** and of the feeler **48** during the return of the feeler to rest position the angular movement of the loom drive shaft from $f°$ to $h°$ can be smaller, for example, one half or less of the angular movement from $c°$ to $f°$ as shown by the dash-dot line A in Fig. 6. The feeler has returned to the rest position *cc* in Fig. 3 when the loom shaft has reached the angular position $h'°$.

Figs. 3 to 5 show removable and interchangeable thread supports 104. These are in the form of frame members made of resilient material and having a transversely split lower portion. A U-shaped holder 107 is fixed to the casing of the shuttle receiving mechanism by bolts 108. By inserting the prongs of pliers into bores 106 in the neighboring ends of the split portion of a support 104 the latter can be compressed and inserted into the holder 107.

In order to prevent too much deflection of the weft thread 44 out of the shuttle path by the thread feeler the thread support designated by numeral 109 in Fig. 11 may be made rockable. To accomplish this the support is mounted on a lever 110 which rocks on a pin 111 and has an arm provided with a cam follower roller 113 engaging a cam 114 mounted on the shaft 67. The arm of the lever 110 provided with the roller 113 is pulled toward the cam 114 by a spring 112. The rotating cam 114 rocks the lever 110 so that a thread supporting edge 115 of the support 109 moves up into the position 115*a* indicated by a dotted line which coincides with the path of the thread pulled by the shuttle 43 out of the shed when the end 99 of the feeler 48 swings toward the thread 44. The extent of the swinging movement of the thread feeler is thereby shortened with the result that the angular movement of the main shaft of the weaving machine needed for the thread feeling motion can be reduced or the acceleration of the end portion 99 of the thread feeler can be reduced.

Instead of moving the thread feeler downward for the feeling operation a mechanism may be provided for moving the thread feeler upward for the feeling operation. This is shown in Figs. 12 and 13. The end 117 of the feeler 116 is bent to form a rectangle through which the shuttle can pass. The lower part of the rectangle is formed by the extreme end of the feeler and is below the thread 44. The feeler moves upward for the thread feeling operation, thread supports 119 being placed above the path of the thread. A latch lever 120 and a latch 121 have the same configuration as the members 58 and 55, respectively, in the embodiment of the invention shown in Figs. 1 and 2. However, they are turned 180° to produce the opposite movement of the feeler.

The mechanism according to the invention may be so arranged that the feeler engages the weft thread after pulling back of the weft thread by the pull back mechanism has begun.

Fig. 14 is a diagrammatic illustration of a shed and of devices for inserting weft threads thereinto as far as they are pertinent to the present invention. The weft thread 44 pulled from a spool 11 passes through an eye 12, through a thread brake 14, and thereupon through an eye 16 of a weft thread pull back device 17 which is rocked by a rocking shaft 18. The thread then passes through a stationary eye 19 to a conventional weft thread presenting device 20 which connects the weft thread with a shuttle 43. The latter is picked through the shed 41 by means of a conventional picker 21 driven by a torsion shaft 22. The rocking shaft 18 and the torsion shaft 22 are actuated by the main drive shaft of the weaving machine so that the pull back device 17 and the picker 21 are operated in a predetermined timed relation. The shuttle, accelerated by the picker 21, passes thread severing shears 23 and a thread clamp 36 at the left side of the shed before entering the shed 41. After leaving the shed the shuttle passes a thread clamp 46, placed at the exit side of the shed, and a thread feeler 48 whereupon the shuttle, now designated 43*b*, moves into a shuttle receiving mechanism 40 where it is braked by a plunger 45 to be halted in the position 43*a*.

The thread brake 14 is in lifted position when the shuttle is picked and the thread pull back device is in the uppermost position 16*a* pulling up a predetermined length of thread. When the picker 21 is actuated for picking the shuttle to which a weft thread is connected by a clamp provided inside the shuttle, the pull back device 17 is lowered, moving in the direction of the arrow 24. During the time the thread is laid in the shed the eye 16 is in the lowermost position 16*b* and remains there until the shuttle approaches the right side of the shed in Fig. 14. Thereupon the weft thread pull back device 17 is lifted and the thread brake engages the thread for braking the thread 44. The upward movement of the pull back device initiated pulling the weft thread in a direction opposite to that in which the weft thread moved into the shed. At this time the feeler 48 is in the position *dd* in Fig. 3 in which it engages the thread.

After the shuttle 43 has been stopped by the brake 45 in a position 89 which is not always the same it is pushed back toward the shed to a predetermined position 91. In this position the weft thread 44 is released from the shuttle by opening the thread clamp in the shuttle. The position 91 determines the desired length of the thread end projecting from the right side of the shed 41. The weft thread remains tensioned during the time the shuttle is pushed back from position 89 to position 91 because the weft thread pull back device 17 is lifted farther during this time.

The feeler 48 is moved from its rest position *cc* (Fig. 3) to engage the weft thread, if any, after the thread has been pulled back. The weft thread clamp 46 which is in open position is simultaneously moved toward the weft thread.

The abscissa of the diagram Fig. 15 represents the rotation angles of the drive shaft of the weaving machine. The curve A represents the movement of the eye 16 of the weft thread pull back device 17. When the main loom shaft is at the angular position *a*° the eye 16 of the thread pull back lever 17 is lifted from its lowermost position 16_b and begins to exert pull on the weft thread.

The curve B represents the movement of the weft thread feeler 48 which begins a downward movement from the rest position *cc* (Fig. 3) at the angular position *c*° of the main loom drive shaft. The tooth 97 (Fig. 7) of the latch lever 58 moves downward permitting the tooth 98 of the latch 55 which is pressed against the tooth 97 by the action of the spring 57 to move downward and causing the shaft 52 to rotate counterclockwise and lowering of the feeler end 99. In the position *dd* (Fig. 3) the feeler end 99 engages the thread 44 and is retarded by the latter and stopped at the position *ee*.

This causes removal of the tooth 97 of the latch lever 58 from the tooth 98. A little later the checking tooth 101 of the latch lever 58 enters the gap 102 of the latch 55 as seen in Fig. 7. This movement comes to an end when the main drive shaft reaches the angular position *f*°. Thereupon the lever 58 swings in the opposite direction causing engagement of the teeth 97 and 98 and clockwise rocking of the shaft 52 and of the feeler 48 until the feeler end 99 is again in the rest position *cc* at the angular position *h*° of the loom drive shaft.

If the weft thread release position 91 of the shuttle 43 is so far to the left in Fig. 14 that the left end of the shuttle is within the operating range 49 of the thread feeler 48 the movements of the shuttle push back device 86 and of the feeler 48 must be effected at such angular positions of the main drive shaft that, at the position *gg* (Fig. 3) of the feeler end 99 at the drive shaft position *g*° in Fig. 15, the feeler 48 is at least so far lifted that the end of the feeler is removed from the space 94 in which the shuttle moves.

The curve C in Fig. 15 represents the movement of the shuttle push back slide 86 which is moved to the left from its rest position at the angular position *k*° of the loom drive shaft until the rear end of the shuttle 43 is in the thread release position 91 when the drive shaft is in the position 360° whereupon the push back slide 86 is returned to its rest position which is reached when the drive shaft assumes the angular position *m*°.

The movement of the thread clamp **46** is represented by the curve D. At the angular position $n°$ of the drive shaft, the clamp is moved toward the thread picking path in order to grip the weft thread **44**. The clamp **93** is closed when the drive shaft reaches the angular position $r°$. At the angular position $u°$ of the drive shaft the clamp **46** is adjacent to the edge of the fabric and holds the thread until the thread is beaten up and the selvage is formed.

When comparing the curves A and B in Fig. 15 the following is observed: Tensioning of the weft thread begins at the angular position $a°$ whereas the feeler **48** begins its movement not before the drive shaft has reached the position $c°$, i.e., after it has passed the position $a°$. The thread is not engaged by the feeler until the drive shaft reaches the position $d°$, i.e., after pulling back of the weft thread has begun. This is also the case, if the feeling movement is advanced according to the dash-dot line B'. Although the feeler begins the feeling movement at the angular position $c'°$ ahead of the position $a°$ of the drive shaft, the thread is engaged between the position $d'°$ and $e'°$ at a later movement than the position $a°$ at which the thread pull back device begins to act. To advance the thread feeling operation according to curve B' has the advantage that the thread feeler is out of the way of the shuttle when the latter is pushed back into the operating range of the thread feeler. If the shuttle is pushed back so far that the thread release position **91** is within the operating range of the thread feeler, the selvage on the fabric need not be made broader to provide room for the thread feeler. Instead of advancing the whole thread feeling operation according to line B' the lifting of the thread feeler **48** may be so accelerated that it is completed at the angular position $h'°$ instead of h° and the lifting of the thread feeler takes place along line B''. During the time the shuttle push back slide pushes the shuttle **43** back the weft thread remains tensioned because of continued lifting of the eye **16** of the thread pull back device, unless the thread is broken within or outside of the shed, or unless the thread is pulled out of the shuttle clamp.

A comparison of the curves B, B' and C shows that pushing back of the shuttle is initiated in advance of the beginning of the feeling operation at the angular position $d°$ when the feeler moves according to curve B but not if the feeling movement is advanced according to the curve B' to the angular position $d'°$.

At the angular position $g°$ the push back slide **86** has moved the shuttle **43** back to the operating range of the feeler **48**. The latter, however, has left the space through which the shuttle passes and the shuttle can be pushed back to the weft thread release position **91**.

A comparison of the curves B and D reveals that the thread clamp **46** is moved toward the weft thread while the thread feeler **48** is lowered. The latter, however, is lifted away from the thread **44** and the thread is stretched before the clamp **46** arrives at the path of the shuttles and of the weft thread (solid line showing in Fig. 3) and before the weft thread is received by the open clamp at the angular position $q°$ of the main drive shaft of the weaving machine. The clamp jaw **93** is not closed and the weft thread is not seized before the drive shaft reaches the angular position $r°$.

If there is no weft thread **44** at the exit side of the shed **41** or if the thread is broken, the broken part is not tensioned by the pull back device **17** and is loose even if the thread is broken near the picking side of the shed, because the end of the broken thread portion which is connected with the shuttle is pushed back toward the shed when the shuttle is pushed back by the slide **86**.

The thread feeler is, therefore, not retarded when the feeler end is lowered and the feeler actuating mechanism operates and effects stopping of the weaving machine in the previously described manner.

I claim:

1. In a weaving machine in which the weft thread is inserted into the shed by an element to which the weft thread is attached by means of a thread gripper, a weft thread feeler positioned at the exit side of the shed, and a thread clamp for seizing and holding the weft thread until it is beaten up, said clamp being positioned adjacent to the exit side of the shed and between the latter and said thread feeler.

2. In a weaving machine as defined in claim 1, return means for pushing the weft thread inserting element after it has inserted a weft thread back toward the shed into a predetermined position, and means for moving said feeler toward and from the weft thread in timed relation to the movement of said return means and moving said feeler during its travel from the weft thread out of the path of said inserting element before completion of the push back movement of said return means.

3. In a weaving machine as defined in claim 1, a drive shaft, spring means urging said feeler toward the weft thread, and means operatively interconnecting said drive shaft and said feeler for moving said feeler away from the weft thread against the action of said spring means.

4. In a weaving machine as defined in claim 1, an actuating mechanism for said thread feeler, said actuating mechanism including a rocking shaft on which said feeler is mounted, a spring connected with said shaft for rocking said shaft to move said feeler toward the weft thread, a latch mounted on said shaft, a latch control member adapted to engage said latch, a drive shaft rotating in timed relation to the operation of the weaving machine, cam means mounted on said shaft, a lever including cam follower means engaged by said cam means, and means interconnecting said lever and said latch control member for periodically engaging the latter with said latch for rocking said rocking shaft against the acting of said spring.

5. In a weaving machine according to claim 4, a cam associated with said control member, said cam being adapted to engage said latch and having such configuration as to rock said latch and said rocking shaft at a gradually changing speed according to the gradually changing force produced by said spring.

6. In a weaving machine according to claim 4, said cam means being so formed that the rocking motion of said rocking shaft and of said feeler connected therewith from the extreme idle position to the position in which said feeler engages the weft thread occurs during at least twice the angular movement of said drive shaft which effects movement of said feeler away from the weft thread.

7. In a weaving machine of the gripper shuttle type and having a shed formed by warp threads, a shuttle picking mechanism at one side of the shed, a shuttle receiving mechanism at the other side of the shed, a thread clamp positioned between the shed and said receiving mechanism and adjacent to the shed for seizing and holding a weft thread until it is beaten up, said shuttle receiving mechanism including return means for pushing a shuttle back toward said thread clamp into a predetermined position after the shuttle has laid a weft thread into the shed, a weft or filling thread detecting mechanism including a weft thread feeler interposed between said shuttle receiving mechanism and said thread clamp and adapted to be periodically moved into the shuttle path for engaging a weft thread, and a mechanism interconnecting said return means and said weft thread detecting mechanism for operating said return means and said mechanism in timed relation and moving said thread feeler out of the shuttle path before a pushed back shuttle enters the space in which said thread feeler moves.

8. In a weaving machine of the gripper shuttle type and having a shed formed by warp threads, a shuttle picking mechanism positioned at one side of the shed, a shuttle receiving mechanism positioned at the other side

of the shed, a weft thread clamp positioned between said shuttle receiving mechanism and the shed and adjacent to the latter for seizing and holding a weft thread which has been pulled through the shed by a shuttle until the weft thread is beaten up, a weft or filling thread detecting mechanism including a weft thread feeler interposed between said shuttle receiving mechanism and said thread clamp and adapted to be periodically moved toward a weft thread after it has been laid into the shed by a shuttle, and a weft thread support means positioned adjacent to said feeler.

9. In a weaving machine as defined in claim 8, said weft thread support means being positioned between said clamp and said feeler.

10. In a weaving machine as defined in claim 8, said weft thread support means including two spaced support members positioned to permit movement of said feeler therebetween, the space between said members being at least equal to the thickness of said feeler plus twice the thickness of the thickest weft threads used in the machine.

11. In a weaving machine of the gripper shuttle type and having a shed formed by warp threads, a shuttle picking mechanism positioned at one side of the shed, a shuttle receiving mechanism positioned at the other side of the shed, a weft thread clamp positioned between said shuttle receiving mechanism and the shed and adjacent to the latter for seizing and holding a weft thread which has been pulled through the shed by a shuttle until the weft thread is beaten up, and a weft or filling thread detecting mechanism including a weft thread feeler interposed between said shuttle receiving mechanism and said thread clamp and adapted to be periodically moved toward a weft thread after it has been laid into the shed by a shuttle, said feeler having an end portion adapted to engage a weft thread and having a concave surface facing the weft thread.

12. The method of operating a weaving machine of the gripper shuttle type and having a shed formed by warp threads, a shuttle picking mechanism positioned at one side of the shed, a shuttle receiving mechanism positioned at the other side of the shed, a weft thread clamp positioned between said shuttle receiving mechanism and the shed and adjacent to the latter for seizing and holding a weft thread which has been pulled through the shed by a shuttle until the weft thread is beaten up, and a weft or filling thread detecting mechanism including a weft thread feeler interposed between said shuttle receiving mechanism and said thread clamp and adapted to be periodically moved toward a weft thread after it has been laid into the shed by a shuttle, including the step of removing the weft thread feeler from a weft thread after it has engaged the weft thread and before the weft thread clamp receives the weft thread.

13. In a weaving machine of the gripper shuttle type and having a shed formed by warp threads, a shuttle picking mechanism positioned at one side of the shed, a shuttle receiving mechanism positioned at the other side of the shed, a weft thread clamp positioned between said shuttle receiving mechanism and the shed and adjacent to the latter for seizing and holding a weft thread which has been pulled through the shed by a shuttle until the weft thread is beaten up, a weft or filling thread detecting mechanism including a weft thread feeler interposed between said shuttle receiving mechanism and said thread clamp and adapted to be periodically moved toward a weft thread after it has been laid into the shed by a shuttle, and a weft thread support means positioned adjacent to said feeler, said weft thread support means including a resilient frame member having a transversely split portion affording compression of said frame member, and a holder adapted to receive said frame member when said frame member is compressed.

14. In a weaving machine of the gripper shuttle type and having a shed formed by warp threads, a shuttle picking mechanism positioned at one side of the shed, a shuttle receiving mechanism positioned at the other side of the shed, a weft thread clamp positioned between said shuttle receiving mechanism and the shed and adjacent to the latter for seizing and holding a weft thread which has been pulled through the shed by a shuttle until the weft thread is beaten up, a weft or filling thread detecting mechanism including a weft thread feeler interposed between said shuttle receiving mechanism and said thread clamp and adapted to be periodically moved toward a weft thread after it has been laid into the shed by a shuttle, a weft thread support means, an actuating mechanism for said support means, said actuating mechanism being adapted to move said support means toward and from a weft thread, and means interconnecting said weft thread detecting mechanism and said actuating mechanism for moving said feeler and said support means simultaneously toward a weft thread.

15. A weaving machine having a shed formed by warp threads, oblong gripper shuttles of a substantially rectangular cross-sectional configuration, the broad sides of said shuttles being in horizontal position when the shuttles move through the shed, a mechanism for picking the shuttles through the shed located on one side of the shed, a shuttle receiving mechanism positioned at the other side of the shed, a weft thread clamp positioned between said shuttle receiving mechanism and the shed and adjacent to the latter for seizing and holding a weft thread which has been pulled through the shed by a shuttle until the weft thread is beaten up, and a weft or filling thread detecting mechanism including a weft thread feeler interposed between said shuttle receiving mechanism and said thread clamp and adapted to be periodically moved toward a weft thread after it has been laid into the shed by a shuttle, said feeler moving in direction toward and from the broad side of said shuttles.

16. A method for operating a weaving machine having gripper shuttles, a shed formed by warp threads, a picking mechanism positioned at one side of the shed for picking the shuttles with a weft thread attached thereto through the shed, a shuttle receiving mechanism positioned at the other side of the shed, a weft thread pull back mechanism positioned at the picking side of the shed for pulling back a length of a weft thread after it has been laid in the shed by a shuttle, and a weft or filling thread detecting mechanism including a weft thread feeler interposed between said shuttle receiving mechanism and the shed and adapted to be periodically moved toward a weft thread after it has been laid into the shed by a shuttle, including the step of moving said feeler toward the weft thread after pulling back of the weft thread by said pull back mechanism has begun.

17. A method for operating a weaving machine having gripper shuttles, a shed formed by warp threads, a picking mechanism positioned at one side of the shed for picking the shuttles with a weft thread attached thereto through the shed, a shuttle receiving mechanism positioned at the other side of the shed, a weft thread pull back mechanism positioned at the picking side of the shed for pulling back a length of a weft thread after it has been laid in the shed by a shuttle, shuttle push back means for pushing a shuttle back toward the shed into a predetermined position after the shuttle has arrived in the receiving mechanism, and a weft or filling thread detecting mechanism including a weft thread feeler interposed between said shuttle receiving mechanism and the shed and adapted to be periodically moved toward a weft thread after it has been laid into the shed by a shuttle, including the step of moving said feeler toward the weft thread after pushing back by said push back mechanism of the shuttle which carried the weft thread through the shed has begun.

18. A method for operating a weaving machine having gripper shuttles, a shed formed by warp threads, a picking mechanism positioned at one side of the shed for

picking the shuttles with a weft thread attached thereto through the shed, a shuttle receiving mechanism positioned at the other side of the shed, a weft thread pull back mechanism positioned at the picking side of the shed for pulling back a length of a weft thread after it has been laid in the shed by a shuttle, shuttle push back means for pushing a shuttle back toward the shed into a predetermined position after the shuttle has arrived in the receiving mechanism, and a weft or filling thread detecting mechanism including a weft thread feeler interposed between said shuttle receiving mechanism and the shed and adapted to be periodically moved toward a weft thread after it has been laid into the shed by a shuttle, including the step of moving said feeler toward the weft thread before pushing back by said push back mechanism of the shuttle which carried the weft thread through the shed has been completed.

References Cited in the file of this patent

UNITED STATES PATENTS

2,538,798	Pfarrwaller	Jan. 23, 1951
2,744,545	Taylor et al.	May 8, 1956
2,774,388	Frentzel	Dec. 18, 1956

OTHER REFERENCES

Curtis, M. S.: "Warner and Swasey's New Weaving Machine." Canadian Textile Journal, July 23, 1948, page 42.