(No Model.)

5 Sheets—Sheet 1.

O. SMITH.

WARP STOP MOTION FOR LOOMS.

No. 550,567. Patented Nov. 26, 1895.

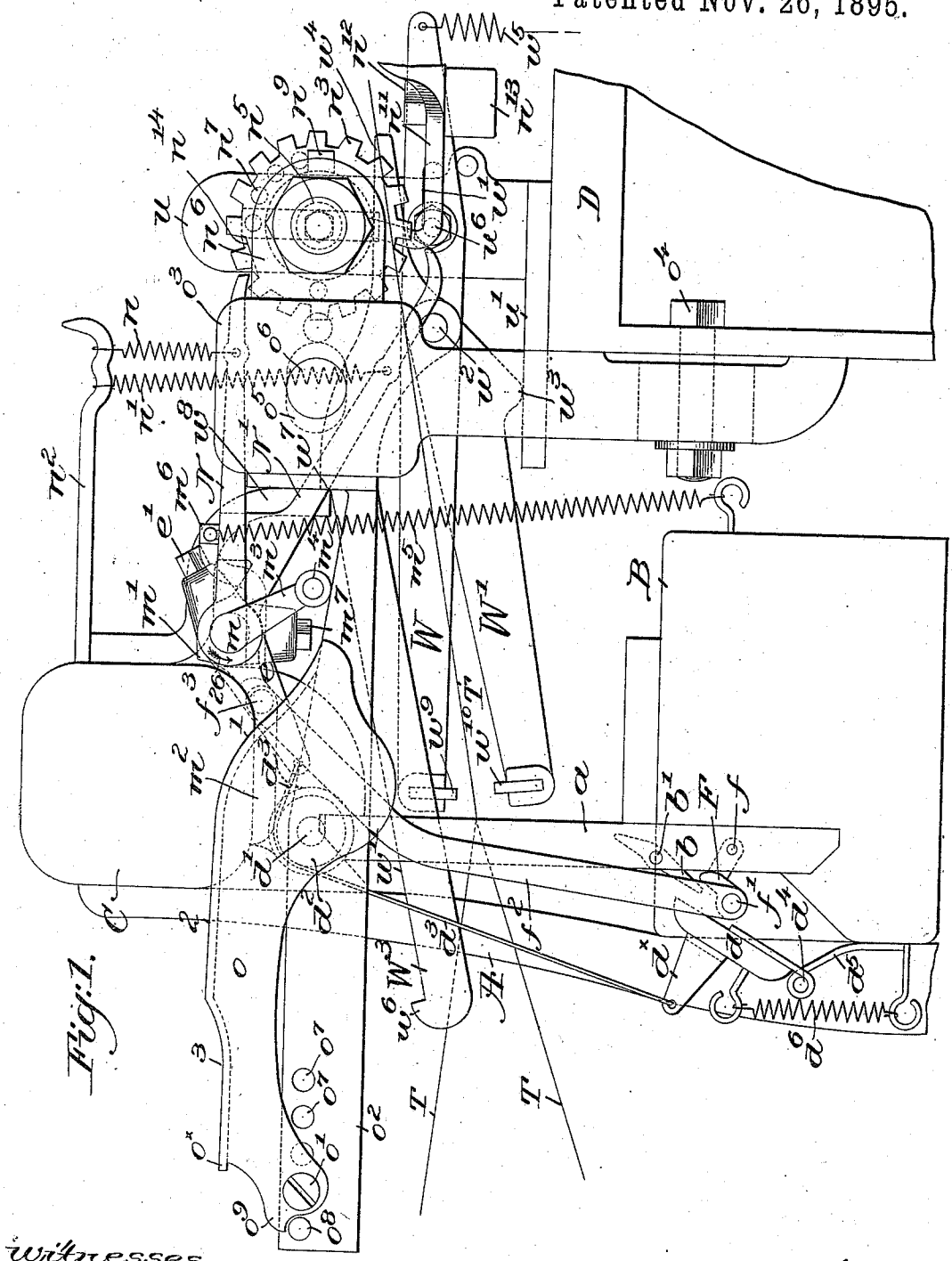


Fig. 1.

Witnesses.
Fred. S. Grundof.
Edward F. Allen.

Inventor:
Oberlin Smith.
by Crosby & Gregory
Attys.

(No Model.) 5 Sheets—Sheet 2.

O. SMITH.

WARP STOP MOTION FOR LOOMS.

No. 550,567. Patented Nov. 26, 1895.

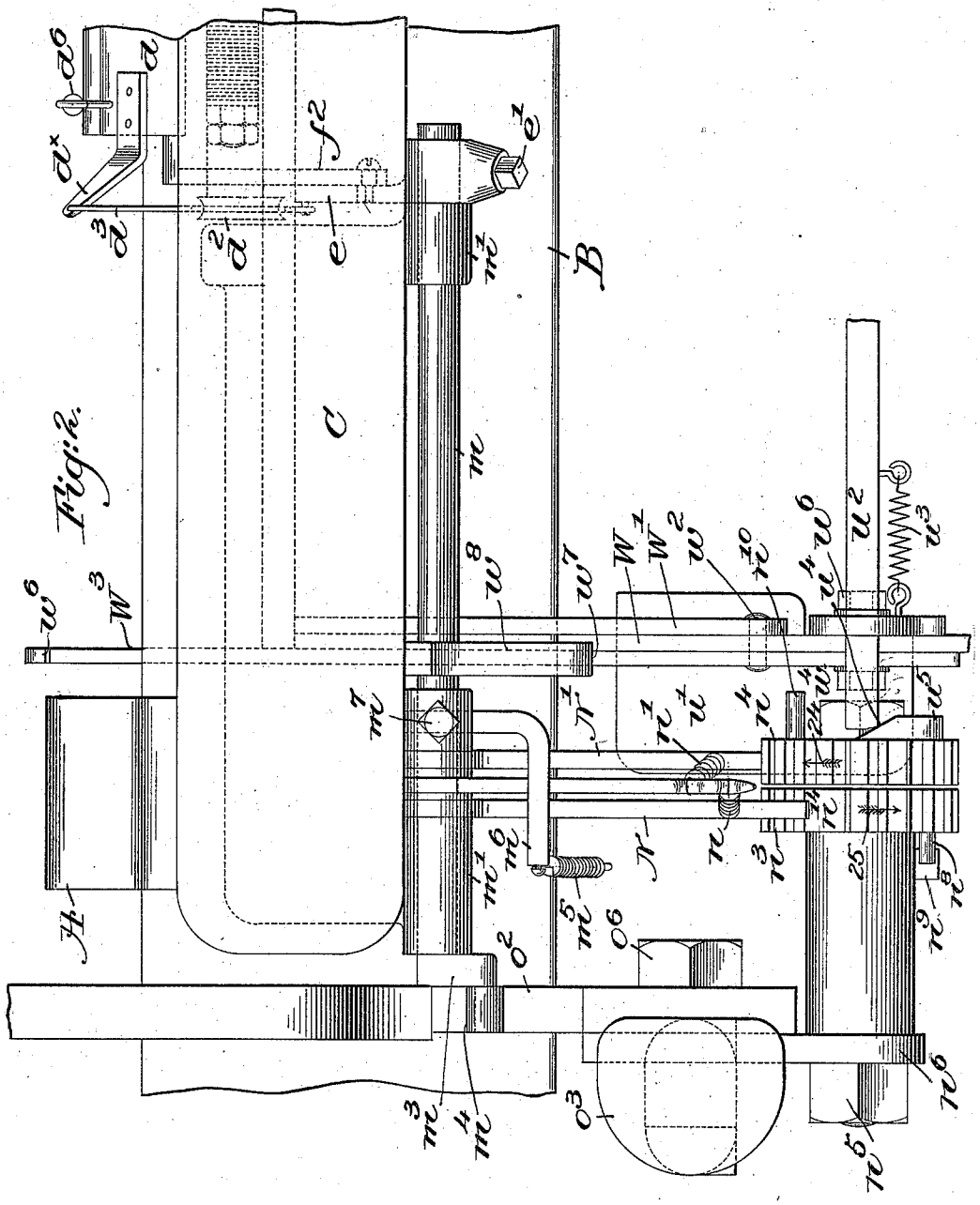


Fig. 2.

Witnesses.
Fred S. Gunnaf.
Edward F. Allen.

Inventor.
Oberlin Smith.
by Crosby & Gregory
Attys

(No Model.) 5 Sheets—Sheet 3.

O. SMITH.

WARP STOP MOTION FOR LOOMS.

No. 550,567. Patented Nov. 26, 1895.

Fig. 3.

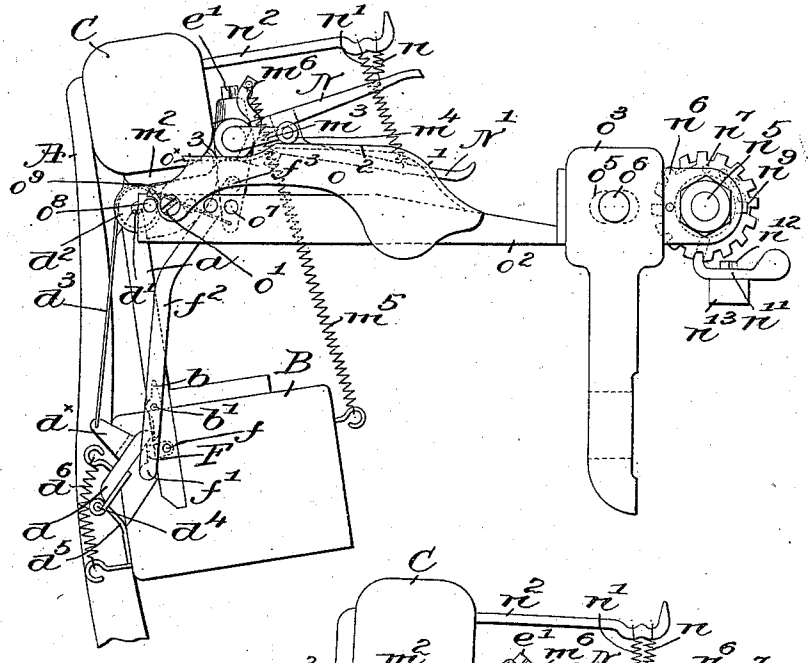
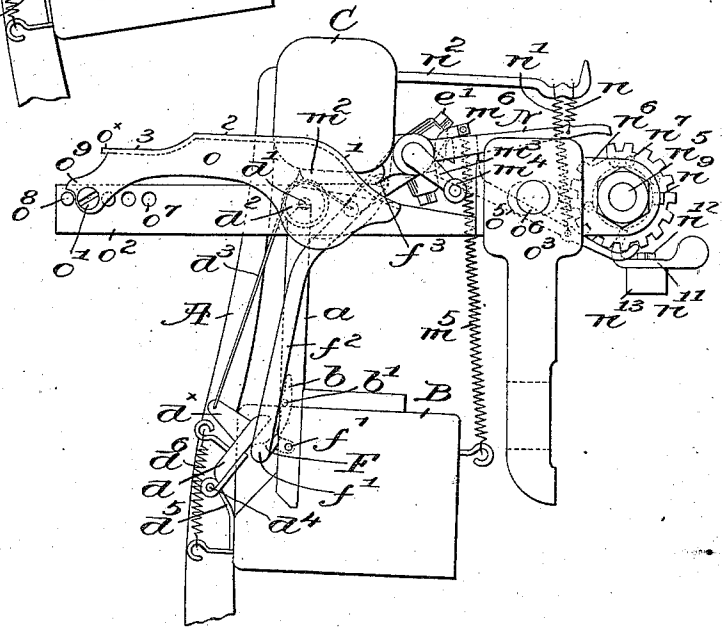


Fig. 4.



Witnesses.
Fred S. Grundy.
Edward F. Allen.

Inventor:
Oberlin Smith.
by Crosby & Gregory
Attys.

(No Model.) 5 Sheets—Sheet 4.

O. SMITH.

WARP STOP MOTION FOR LOOMS.

No. 550,567. Patented Nov. 26, 1895.

Fig: 5.

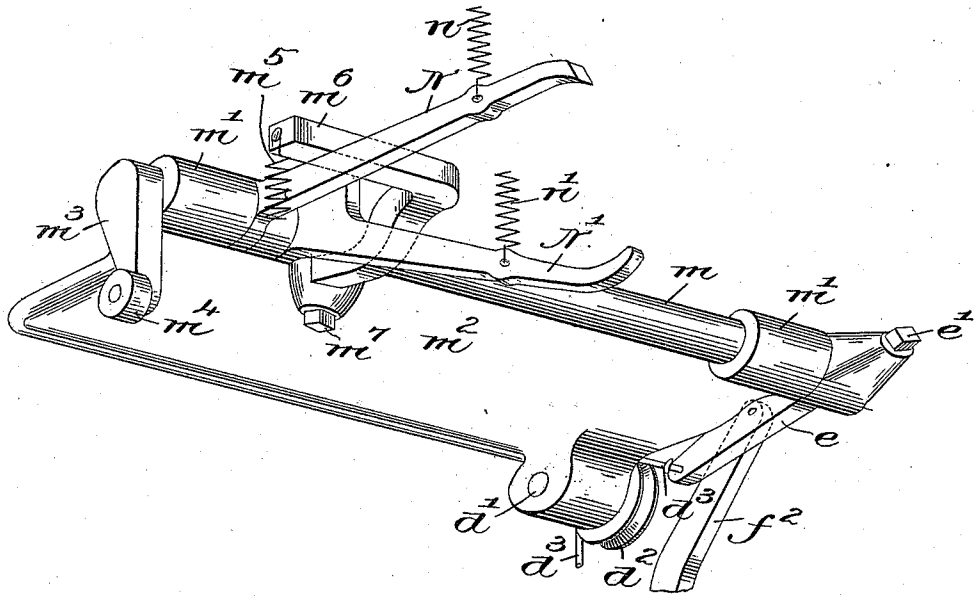
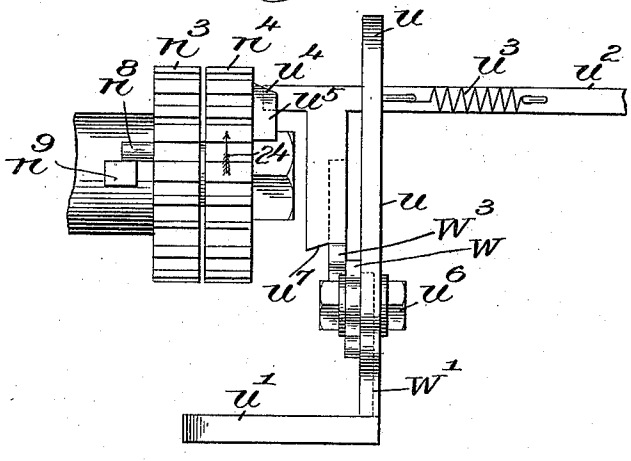


Fig: 6.



Witnesses.
Fred S. Gruenbaf.
Louis N. Gourell.

Inventor
Oberlin Smith.
by Crosby & Gregory
Attys.

(No Model.)

5 Sheets—Sheet 5.

O. SMITH.

WARP STOP MOTION FOR LOOMS.

No. 550,567. Patented Nov. 26, 1895.

Fig: 7.

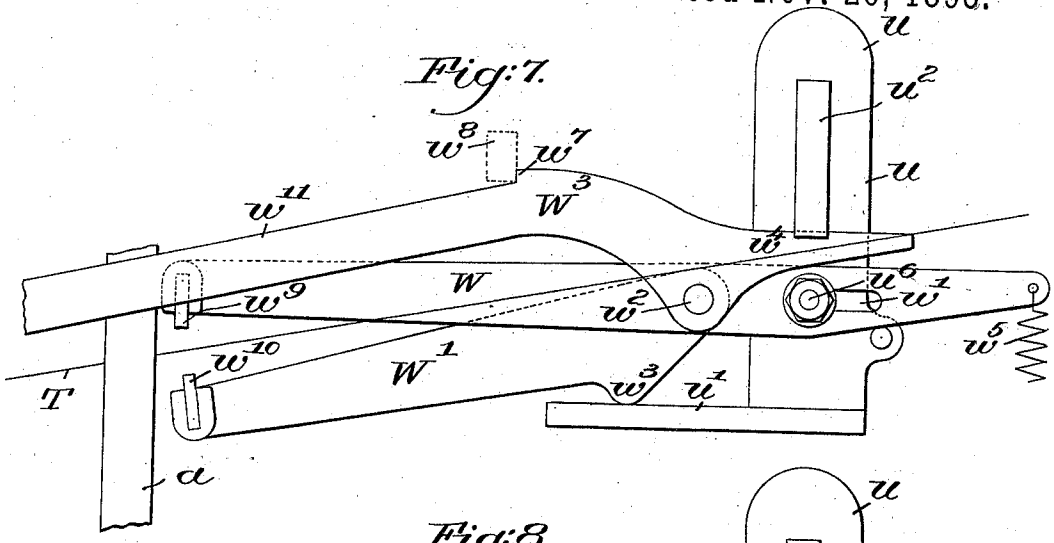


Fig: 8.

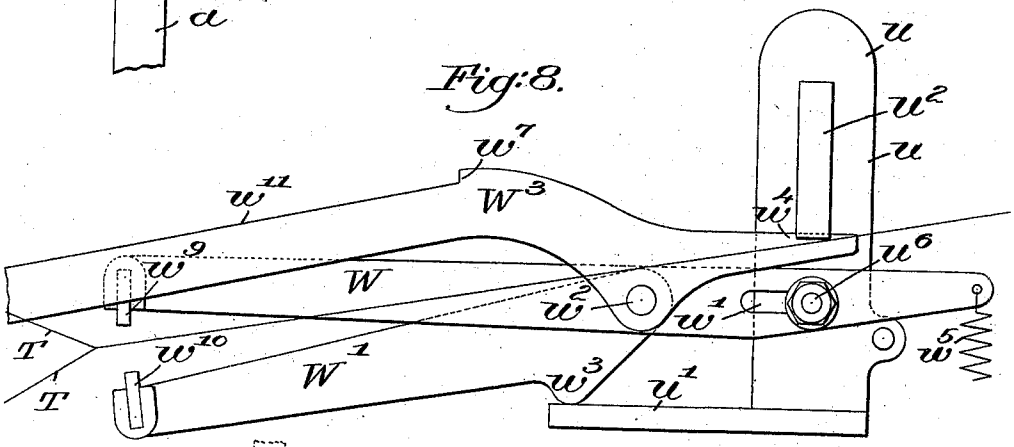
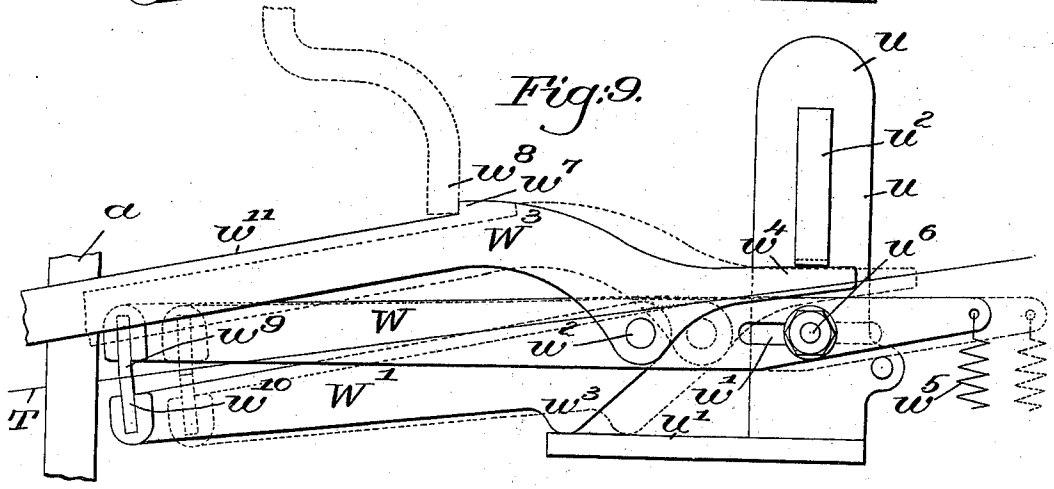


Fig: 9.



Witnesses.
Fred S. Grumbach.
Louis W. Gowell.

Inventor.
Oberlin Smith.
by Crosby & Gregory
Attys.

UNITED STATES PATENT OFFICE.

OBERLIN SMITH, OF BRIDGETON, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE NORTHROP LOOM COMPANY, OF HOPEDALE, MASSACHUSETTS.

WARP STOP-MOTION FOR LOOMS.

SPECIFICATION forming part of Letters Patent No. 550,567, dated November 26, 1895.

Application filed November 16, 1893. Serial No. 491,146. (No model.)

To all whom it may concern:

Be it known that I, OBERLIN SMITH, of Bridgeton, county of Cumberland, State of New Jersey, have invented an Improvement in Warp Stop-Motions for Looms, of which the following description, in connection with the accompanying drawings, is a specification, like letters and figures on the drawings representing like parts.

This invention relates to warp stop-motions of the class shown and described in United States Patent No. 491,139, dated February 7, 1893.

In warp stop-motions of the class represented by the patent referred to a series of so-called "catches," or, as I shall hereinafter denominate them, "warp-detectors," are arranged to be acted upon and moved from their normal into their abnormal positions by the unbroken warp-threads as the latter are opened in shedding, any detector or detectors at such times remaining unmoved by reason of one or more of the warp-threads being broken operating through suitable mechanism to stop the loom. It frequently happens that one or more of the warp-threads, though not broken, become for some reason quite slack or loose, and because of their slackness or looseness are not drawn tightly by the harness-motion in shedding, such loose or slack threads at such times failing to act upon and move their respective detectors, precisely as though said threads had been broken, the loom being thereby stopped, when really the threads are not broken, but simply slack. I have found, however, that if the loom can be continued in operation for several picks the slackness in threads referred to will be taken up or woven into the fabric and the threads be thereafter as tight as any of the threads. I have therefore conducted experiments in order to devise a warp stop-motion which shall stop the loom only for broken threads and for threads which are so slack that the slackness cannot be taken up or woven into the fabric. This I have accomplished by means of what I term a "retarding device" or mechanism interposed between the warp-detectors and the stopping mechanism whereby the loom is stopped only after any warp detector or detectors are found unmoved in their normal positions during several successive picks of the loom. The retarding device does not stop the loom until a sufficient number of picks have been made to weave into the fabric any amount of slackness which would not prove injurious to the fabric; but if at the end of such predetermined number of picks, which may be greater or less, according to the character of the weaving, the detector or detectors are still found unmoved, showing that the slackness, if any, has not been taken up, the loom is then stopped.

In order to further guard against false stopping of the loom by loose or slack warp-threads, I have devised a pair of wipers, which are arranged to act upon the warp-threads from opposite sides as the latter are opened in shedding and wipe or pull the said threads toward the fell of the fabric, to thereby draw any slackness toward the fell, that it may be woven into the same, and at the same time tighten the loosened or slack threads, that they may properly act upon and move their respective detectors, and thereby prevent stopping of the loom.

One part of this invention therefore consists in a warp stop-motion for looms containing the following instrumentalities, viz: a lay, a series of reed-dents, warp-detectors arranged to be acted upon and moved from their normal into their abnormal positions by the unbroken tight warp-threads, a stopping mechanism for the loom, and a retarding device interposed between said warp-detectors and stopping mechanism and to effect the release of the latter, and means for moving said retarding device a predetermined distance at each beat of the lay when a warp-detector is unmoved by reason of a broken or loose thread, whereby two or more beats of the lay necessarily intervene between the breakage of the warp thread or threads and stopping of the loom, substantially as will be described; also, in a warp stop-motion for looms, the following instrumentalities, viz: a lay, a series of reed-dents, warp-detectors arranged to be acted upon and moved from their normal into their abnormal positions by the unbroken tight warp-threads, a stopping

mechanism for the loom, and wipers movable toward the fell of the fabric and adapted to act upon the warp-threads to draw any slackness from the said threads, and thereby tighten the latter, substantially as and for the purpose specified.

In the drawings, Figure 1 represents in end view a sufficient portion of a loom to enable this invention to be understood; Fig. 2, a top or plan view of the parts shown in Fig. 1, one end of the loom only being shown; Fig. 3, a view similar to Fig. 1, but on a smaller scale, showing the parts in a different position; Fig. 4, another similar view with the parts in still another position; Fig. 5, a perspective view of the bracket m^2 and the parts carried thereby; Fig. 6, a detail looking from the right, Fig. 1, showing the toothed wheels n^3 n^4, the slide-bar u^2, and the cam and spring to actuate it; and Figs. 7, 8, and 9 diagram views showing the wipers in different positions.

Referring to the drawings, A represents the lay-sword, carrying the usual lay B and hand-rail C, between which are mounted in usual manner the reed-dents a, separated to leave suitable reed-spaces, between which the warp-threads are passed.

In the construction shown the warp-detectors are shown at b, arranged between the dents of the reed and pivoted at b' upon a pivot-rod extending lengthwise the reed through the several dents thereof, the said detectors during the backward movement of the lay being acted upon by the unbroken tight threads and moved into their positions Fig. 1 in a manner well understood.

F represents the feeler, pivoted at f and adapted to swing toward and from the lower tail ends of the detectors, said feeler having jointed to it at f' one end of a connecting-rod f^2, jointed at f^3 at its upper end to the arm e, secured by means of a set-screw e' to the shaft m, the said shaft m being journaled in suitable lugs m' on and forming a part of a plate-like bracket m^2, (shown in dotted lines, Figs. 1 and 2, and in Fig. 5,) said bracket being bolted to the under side of the hand-rail and in an undercut portion thereof, as shown. The arm e is prolonged beyond the point f^3 at which the connecting-rod f^2 is jointed and has connected to its outer end a flexible connection d^3, preferably a cord, the same being shown as passed over a pulley d^2, pivoted at d' to one end of the bracket m^2, (see Fig. 5,) said connection at its lower end being attached to an arm $d^\times$ on the depressor d, (see Fig. 1,) pivoted at d^4 in suitable brackets d^5, secured to the lay B, a spring d^6 acting to retain the said depressor normally in its elevated retracted position, as shown in Fig. 1.

The shaft m at its outer end is provided with a depending arm m^3, carrying at its free end a roller or other stud m^4, which during the reciprocating movements of the lay co-operates with a cam o, pivoted at o' to an arm o^2, bolted or otherwise secured to an upright o^3, attached to the frame D, as best shown in Fig. 1, the said upright o^3 having a slot, (shown in dotted lines,) through which the clamping-bolt o^4 is passed to thereby furnish means for adjusting the vertical position of the upright and the cam o. The horizontal arm o^2 is also adjustably connected with the upright o^3 by means of the slot o^5 and bolt o^6, (see Fig. 1,) whereby the said arm and cam may be adjusted horizontally in order to properly time the movements of the mechanism, as will be hereinafter described.

The cam o consists of a vertical plate having its upper edge turned over at right angles to form a lip $o^\times$, which constitutes the working face of the cam, the said face being shaped to present a gradually-rising portion 1, terminating in a horizontal portion 2, the latter extending rearwardly to a slight depression 3, which latter terminates abruply at the end of the cam.

It will be seen that the horizontal arm o^2 is provided with a series of holes o^7 for the reception of the pivot-screw o', the said holes being also fitted to receive a stop-pin o^8, which co-operates with a stop-lug o^9 on the cam, said pin o^8 limiting the rotary upward movement of the cam about its pivot, the cam at its free end normally resting with its lip upon the arm o^2, which constitutes a continuation of the cam. The position of the cam on the horizontal arm may be varied by screwing the pivoted screw o' into one or another of the holes o^7, the stop-pin o^8 being likewise transferred into the proper hole to bring it into position to co-operate with the stop o^9 in its adjusted position, the range of adjustment furnished by the series of holes o^7, taken in connection with the finer adjustment provided by the pin-and-slot connection o^6 o^5, permitting the finest possible adjustment of the cam for the purpose of properly timing the movements of the mechanism.

During the backward movement of the lay the roller-stud m^4 on the arm m^3 slides upon the cam-surface $o^\times$, and at the end of said movement drops from the rear end of said surface upon the arm o^2, said stud during the return or forward movement of the lay passing along said arm beneath the lip or cam-surface $o^\times$, the free end of the cam rising to permit the said roller-stud to pass from under as the lay nears the end of its forward or beating-in movement.

The roller-stud m^4 is normally retained in working contact with the surface of the cam by means of a spiral spring m^5, attached at its lower end to the lay B and at its upper end to an arm m^6, made fast on the shaft m by a set-screw m^7, said arm m^6 also constituting a stop for the pawls of the retarding device, to be hereinafter described.

N N' represent two pawls loosely journaled upon the shaft m and normally held against the stop-arm m^6 by suitable springs n and n', connected with an arm n^2, standing out from the front of the hand-rail, said springs n and n' being, however, of less strength than the

spring m^5, which latter pulls the stop, pawls, shaft, and roller-stud m^4 all into their lowest positions, with the roller-stud in contact with the cam-surface at all times.

The pawl N has a slightly-downturned end, while the pawl N′ has a slightly-upturned end, the said pawls being positioned and adapted to engage, respectively, two toothed wheels n^3 n^4, loosely pivoted upon the bolt n^5, carried by a bracket n^6, slotted and attached to the upright arm o^3 by the same bolt o^6 that secures the arm o^2 to said bracket. (See Fig. 1.) The toothed wheel n^4 is provided at its inner face adjacent the wheel n^3 with a series of holes n^7 (shown in dotted lines, Fig. 1) to receive the end of a dowel-pin n^8, inserted through the wheel n^3, (see Fig. 2,) the relative positions of the two wheels being varied by inserting the said pin n^8 in one or another of the holes n^7 in the wheel n^4, the said pin n^8 also co-operating with a lug n^9 on the bracket n^6 to prevent retrograde movement of the toothed wheels, as will be described.

The toothed wheel n^4 is provided with a laterally-extended pin n^{10}, which when the wheel is rotated a sufficient distance in the direction of the arrow 24, Fig. 2, is adapted to strike the upturned end of the actuator n^{11}, pivoted at n^{12} to the knock-off n^{13}, adapted, when moved, to knock off or release the usual shipper-lever connected with the stopping mechanism of the loom, which stopping mechanism may be of any suitable or desired construction and need not be herein shown, as it forms no essential part of this invention beyond the actuator and knock-off referred to.

By referring to Fig. 1 it will be seen that with the parts in the position there shown the pawl N is in a position to engage the toothed wheel n^3, while the pawl N′ is dropped below its wheel n^4 and out of engagement with the teeth of the same. It will be seen, however, that a tooth is removed from the wheel n^3, leaving a blank space n^{14}, in which the end of the pawl N works back and forth without moving the wheel during the normal operation of the loom.

In the drawings, Fig. 1, the lay is shown as on its backward movement, having proceeded a short distance only, and with the parts in this position the operation of the mechanism is as follows, viz: As the lay continues its backward movement the roller-stud m^4 will ride upon the cam-surface $o^\times$ of the cam o, and thereby rotate the shaft m in the direction of the arrow 26, such movement of the shaft turning the arm e down into its position Fig. 3, thereby acting, through the connecting-rod f^2, to drop the feeler F below and out of the range of movement of the warp-detectors b, such movement of the arm e also exerting a pull upon the cord d^3, to thereby throw the depressor d to the right, Fig. 1, into its position Fig. 3 against the tails of the warp-detectors to positively move the latter into their normal dotted-line position, Fig. 3, in readiness to be acted upon by the unbroken tight warp-threads, as will be described. When the roller-stud m^4 in the backward movement of the lay reaches and follows down into the depression 3 in the cam-surface $o^\times$, the shaft m is partially returned to its normal position, raising the arm e sufficiently to permit the depressor to be drawn back by its spring d^6 away from the warp-detectors which it has pressed into their normal positions. Immediately or soon after the depressor is withdrawn from contact with the warp-detectors, as just described, the detectors thus moved into their normal positions come in contact with the warp-threads T moved in the lower plane of the shed, and by the opening of the shed and by the friction of the detectors sliding upon the warp-threads, due to the backward movement of the lay, the detectors which are acted upon by the unbroken tight warp-threads are moved to the right into their abnormal positions, Fig. 1, with their tails standing out from the reed. Just as the lay reaches the end of its backward movement the roller-stud m^4 drops from the end of the cam-surface $o^\times$ down upon the top of the horizontal arm o^2, thereby permitting the spring m^5 to return the shaft m to its normal position, further removing the depressor from the detectors, and at the same time acting, through the connecting-rod f^2, to raise the feeler F toward the ends of the tails of the detectors, said feeler passing beneath the said tails, between the same and the reed, as shown in Fig. 1, thereby permitting full movement of the shaft m to its normal position. With the shaft m in its normal position, Fig. 1, the lay begins its forward or beating-in movement, the roller-stud m^4 traveling along the upper edge of the horizontal arm o^2 and raising the free end of the cam in order that it may pass from under the same, the pawl N as it approaches its toothed wheel n^3 entering the blank space n^{14} on the periphery thereof, causing, therefore, no movement of the latter. The movements of the loom continue in this manner so long as all the detectors are moved from their normal into their abnormal positions by the unbroken tight warp-threads, as described, the feeler in each case rising beneath the tails of the detectors, and the depressor at each pick returning the detectors to their normal positions in order that all may be in proper position to be acted upon by the warp-threads, as described.

Should a warp-thread be excessively loose, it will fail to act upon and move its detector from its normal into its abnormal position, the said detector in such case remaining in its position Fig. 4, and when the roller-stud m^4 drops from the end of the cam-surface $o^\times$ at the end of the backward movement of the lay the spring m^5 will be unable to turn the shaft m back to its full normal position and to raise the feeler, for the said feeler will at once be obstructed in its movement by the tail of the unmoved detector, which thereby prevents the return of the shaft m to its full

normal position, the said shaft remaining in its position Fig. 4 during the next succeeding forward movement of the lay.

The pawls N and N′ are always drawn upwardly against the stop m^6 by the springs n and n'; but, the spring m^5 being the stronger, whenever the shaft m is permitted to return to its original normal position the stop m^6 holds the two pawls down in their normal positions, Fig. 1, so that pawl N at the completion of the forward or beating-in movement of the lay will enter the blank space in its toothed wheel n^3. When, however, the shaft m is prevented from making its full return movement on account of an unmoved detector, as described, the stop m^6 is held in its raised position, Fig. 4, so that the pawls, always held in contact with this stop, occupy a more elevated position than they would had the shaft m been permitted to return to its full normal position, and as the lay approaches the end of its forward or beating-in movement the pawl N, which during the previous operation of the loom had entered the blank space in its wheel n^3, now passes clear above the said wheel, while the pawl N′, which during the previous operation of the lay had passed below its toothed wheel n^4, now engages the said wheel and pushes the same around, in the present instance two teeth, in the direction of the arrow 24, Fig. 2, rotation of the wheel n^4 acting, through the dowel-pin n^8, to also rotate the wheel n^3 in the same direction. As the lay begins its next return movement, as before, the depressor moves forward to press the detectors into their normal positions, the warp-threads are shifted by the harness-motion to carry a new series of threads down into the lower plane of the shed, and the unbroken threads of the new series of threads act upon the detectors to move the latter into their abnormal positions, the feeler being raised, as before, to determine whether or not all the detectors have been moved. If the warp-threads in this new series of threads are unbroken, then all the detectors will be moved and the feeler will be permitted to have its full movement beneath the tails of the detectors, to thereby give full return movement to the shaft m, such full movement of the said shaft carrying the stop m^6, and thereby the pawls N and N′, again into their lowermost positions, Fig. 1, so that the pawl N′ will pass below and out of engagement with its wheel n^4, while the pawl N will engage its wheel n^3 and push the same and the wheel n^4 back again one tooth toward their normal positions, thus leaving the said wheels advanced in the direction of the arrow 24 only one tooth instead of two teeth, as they were pushed by the pawl N′. The lay now begins another return movement and the warp-threads are again shifted to bring the first series of threads—*i. e.*, the series which contained the slack thread—again into the lower plane of the shed, and if the slackness in such thread has in the meantime been taken up or woven into the fabric said thread will, with the other tight threads, act upon and properly move its detector, so that the feeler can have full movement to again drop the pawls into their normal or lowest positions, enabling the pawl N to once more engage its wheel n^3 and move the same and wheel n^4 yet another tooth toward and this time fully into its normal position, so that the said pawl N may thereafter work in the blank space in the said wheel n^3. If, however, at this last-mentioned pick of the loom the slack thread which originally caused the movement of the wheels n^3 n^4 two teeth in the direction of arrow 24 still remained slack, it would again fail to move its detector and would act in the manner first described to cause the pawl N′ to move the wheels n^3 n^4 again two teeth in the direction of the arrow 24—*i. e.*, three teeth from its normal position—carrying the pin n^{10} farther around toward the actuator n^{11}. This operation—viz., the pushing of the wheels two teeth in the direction of the arrow 24 at each alternate pick when a slack warp-thread appears in the lower plane of the shed and returning the said wheels one tooth at each alternate pick when another series of threads containing no slack ones appears in the lower plane of the shed—continues so long as the slackness in the thread remains, until the wheels n^3 n^4 by successive pushes—herein four in number, representing eight beats of the lay—have been moved into position with the pin n^{10} directly back of the actuator, whereupon the next push by the pawl N′ causes the said pin to move the said actuator and knock-off to stop the loom. If the slackness in the warp-thread should at any time before the pin n^{10} reaches and moves the actuator be taken up, then the pawl N′ will thereafter be prevented from moving the wheels n^3 n^4 and the pawl N′ will, by successive beats of the lay, gradually return the said wheels to their normal positions, so that the loom may continue its operation; but if the slackness is so great that it cannot be taken up before the said pin reaches said actuator, or should the thread be a broken instead of a slack thread, then the loom will at the end of the predetermined number of picks, regulated by the pins, be stopped.

The operation of the retarding device and stop-motion, as above explained, is the operation of the motion when applied to a simple loom in which two alternating and different sheds only are used, the shed being shifted at each beat of the lay, it having been assumed that the slack thread or threads was in one series of threads only, that series appearing in the plane of the shed at which the detectors are located at each alternate pick only because each series appears in the lower plane at each alternate pick only. Because each series of threads appears in the plane of the shed adjacent to the detectors at each alternate pick only it is necessary that the pawl N′ should move the wheels n^3 n^4 two teeth and the pawl N move them in an opposite direction one

tooth, for otherwise were, the back and forth motions of the wheels equal, they would balance each other and no progress would be made by the wheels in a direction toward stopping the loom. By having the pawl N′ move the wheels two teeth and the pawl N move them in an opposite direction one tooth there is a real advance of one tooth at each push of the pawl N′ toward stopping the loom. As shown in the drawings, this unequal effect is obtained simply by allowing the forward end of the pawls N N′ to be so related to the axis of the toothed wheels that N′ will move far enough to take up two teeth, while N takes up but one. If there should be a slack thread in both sheds, then there would be no counteracting or return pushing movement by the pawl N, but the pawl N′ would be permitted to engage its wheel n^4 at each successive beat of the lay, moving the said wheel and the wheel n^3 two teeth at each push, the result being that the loom will be stopped in half the time. Of course this excess of movement of the pawl N′ over that of the pawl N may be varied according to the number of sheds employed, so as to leave no opportunity for the wheels n^3 n^4, moved by a broken or loose thread in one shed, to be fully returned again to their normal positions by the intervening sheds having no loose or broken threads. A thread may remain slack for two or three beats and on the fourth beat be tightened sufficiently to restore its former tension, whereupon the pawls will immediately be returned to their proper positions and the toothed wheels restored to their original positions without stopping the loom. The number of beats of the lay which intervenes between the time when a detector is first found unmoved in its normal position and the time at which the loom is stopped may be varied by means of dowel-pin n^8, which may be inserted in one or another of the holes in the toothed wheel n^4, to thereby bring the pin n^{10} nearer to or farther from the actuator n^{11} when the loom is in normal operation, with the pawl N working in the blank space n^{14}.

In order to further guard against false stopping of the loom by reason of slack threads, which could just as well be woven into and taken up in the fabric, I have devised what I term "wipers," to be used in connection with a warp stop-motion, for the purpose of rendering the latter more reliable in its operation.

Referring particularly to Figs. 1 and 2 and 7 to 9, u is an upright standing from and forming a part of a plate u', secured to the frame D, there being one of these uprights at each end of the loom; but as they are alike in construction it is deemed unnecessary to show more than one. A longitudinally-movable slide-bar u^2 is fitted to slide in the uprights u as guides, the said slide-bar being acted upon by a spring u^3, Fig. 2, which draws the slide-bar always toward the left of the loom, when facing the latter, with its end pressed against or immediately in front of the inclined surface u^4 of a ring-like cam-surface u^5 on the face of the toothed wheel n^4, so that whenever the said wheel is rotated in the direction of arrow 24, due to a detector remaining unmoved in its normal position, the said cam-surface u^4 will move the slide-bar to the right against the action of the said spring. A fixed bolt or stud u^6 is carried by the upright u', said stud passing through a slot w' in the wiper-lever W, the latter having pivoted to it at w^2 the lower wiper-lever W′, the latter having a lug w^3, which normally rests upon the plate u', as shown in Figs. 7 to 9.

W^3 represents the actuating-lever, also pivoted at w^2 to the wipers W and W′, said lever W^3 having a tail portion w^4, which extends forward beneath and normally rests in a cut-away portion or groove u^7 in the under side of the slide-bar u^2, as best shown in Fig. 6, the end of the said groove adjacent the end of the slide-bar being beveled or inclined, as shown, for a purpose to be described. A spring w^5, attached to the loom-frame, acts to pull the front end of the wiper W down, to thereby raise its rear or wiping end, together with the pivot w^2 and the actuating-arm W^3, to maintain the tail w^4 of the latter always in contact with the groove u^7 in the slide-bar. The actuating-lever W^3 is provided near its rear end with a shoulder w^6 (see Fig. 1) and at a point near its pivot w^2 with a second shoulder w^7, an actuating-plate w^8 on the hand-rail C cooperating with these shoulders w^6 and w^7 during movement of the lay to actuate the wipers, as will be described.

The inner rear ends of the wiper-levers W and W′ at opposite ends of the loom carry the wipers w^9 and w^{10}, shown as and preferably in the form of felt, rubber, or other equivalent material, or, in place of the same, brushes or their equivalents may be used, the said wipers in either case extending continuously from one to the other end of the loom, spanning the fabric throughout its entire width.

By reference to Figs. 7 and 8 it will be seen that the spring w^5 normally raises the wiper-lever W and the pivot w^2, and thereby separates the wipers, as shown, the warp-threads T passing between these wipers.

In the normal operation of the loom the devices described occupy the positions Fig. 7, with the tail w^4 of the actuating-lever W^3 resting in the groove u^7 of the slide-bar, which groove permits the said tail to be raised sufficiently to drop the inner end of the lever, so that the shoulder w^6 lies below and out of the path of movement of the actuating-plate w^8 on the hand-rail, the said plate passing above the said shoulder. When, however, a warp-detector is unmoved and remains in its normal position and through the pawl N′ causes rotation of the toothed wheels n^3 n^4 in the direction of arrow 24, Fig. 2, the cam u^4 immediately acts upon the end of the slide-bar u^2 and pushes the same to the right or toward the middle of the loom, Fig. 2, thereby caus-

ing the inclined end of the groove w^7 (see Fig. 6) to act upon and depress the tail w^4 of the actuating-lever, thereby raising the rear end of the said actuating-lever and bringing the shoulder w^6 up into the path of movement of the plate w^8 on the hand-rail, so that as the lay moves back the said plate, by striking said shoulder, moves the wiper-levers backward into the position Fig. 8. As the lay approaches the end of its next return or forward movement the actuating-plate w^8 on the hand-rail rides upon the inclined upper edge w^{11} of the raised actuating-lever W^3 and depresses the same to thereby close the wipers upon the warp, as in full lines, Fig. 9, the end of the slide-bar w^2 acting as a fulcrum. Further forward movement of the lay causes the plate w^8 to strike the shoulder w^7 on the actuating-lever and push the closed wipers bodily before it to the limit of the slot w', as shown in dotted lines, Fig. 9, said wipers thereby acting upon and drawing the warp-threads toward the fell of the fabric to work or wipe forward into the fabric any slackness which may be in any of the warp-threads. Upon the next backward movement of the lay the actuating-plate w^8, following down the inclined edge w^{11} of the actuating-lever W^3, permits the wipers to open, and just before the lay reaches the end of its backward movement said plate strikes the shoulder w^6 and moves the open wipers to the left, as in Fig. 8, preparatory to again wiping forward the threads at the next pick of the loom. Upon the next forward movement of the lay, if the cam-surface w^4 on the toothed wheel n^4 still remains in its former position or has been moved still farther around by movement of the said wheel, the wipers will again be closed upon the warp-threads and moved forward to take up slack, as before, this wiping operation being continued at each beat of the lay so long as the toothed wheels n^3 and n^4 remain moved from their normal positions, owing to any of the detectors remaining unmoved. As soon as any slackness in the warp-threads is taken up and all the detectors are again moved into their abnormal positions at each beat of the lay the pawl N will by successive beats push the toothed wheels n^3 n^4 back into their normal positions, Figs. 1 and 2, thereby restoring the cam w^4 to its normal position and permitting the slide-bar w^2, actuated by its spring w^3, to return to its normal position at the left of the loom, with the groove w^7 above the tail of the actuating-lever W^3, permitting the said tail to rise into the groove and thereby drop the inner end of said lever below and out of the range of movement of the actuating-plate w^8.

From the above it will be understood that whenever a detector remains unmoved in its normal position and the toothed wheels n^3 n^4 begin to be and by successive beats of the lay are moved toward such position as will cause the stopping of the loom the wipers are at the same time automatically thrown into operative action to wipe forward any slackness in the loose thread or threads to enable the same to be woven into the fabric. As soon, however, as the slack has been taken up by the wipers and woven into the fabric the detector is again moved as it should be with the others and the pawl N returns the toothed wheels to their normal positions, thereby automatically throwing out of operation the wipers referred to. The wipers thus operate only when a detector is unmoved, indicating a slack or broken thread.

Of course, when a thread is broken, instead of being simply slack, the operation of the wipers can have no remedial effect, and at the end of the predetermined number of beats of the lay determined by the relative positions of the blank space in the toothed wheel n^3 and the actuating-pin on the toothed wheel n^4 the loom will be stopped.

In practice I have found that from four to five beats of the lay is, as a rule, sufficient to take up any amount of slackness which can be woven into the fabric without causing an obvious and injurious effect in the latter, and that any slackness so excessive that it cannot be taken up during such number of beats of the lay is so great that the loom should be stopped, as for a broken thread, in order that the slack thread may be tightened by the operator.

This invention is not limited to the particular construction or device herein shown, for I consider myself to be the first to interpose a retarding device between the detectors and the knock-off or actuator for the stopping mechanism, and also to employ wipers to wipe forward into the fabric any slackness which is not so excessive as to prevent its being woven into the fabric. I therefore consider myself entitled to claim, broadly, and without reference to constructional details, the retarding device and also the wipers when used in combination with the stopping devices, whether said retarding device and wipers are used independently or together.

It is obvious that this invention is not limited to the particular retarding device shown, for the same may be varied without departing from the scope of the invention.

The term "warp-detectors," employed in the claims, includes any device acted upon and moved from one (its normal) into another (its abnormal) position by a warp thread or threads when the latter is or are unbroken and tight—*i. e.*, under such tension as renders it unnecessary to stop the loom.

I claim—

1. In a warp stop motion for looms, the following instrumentalities, viz;—a lay; a series of reed dents; warp detectors arranged to be acted upon and moved from their normal into their abnormal positions by the unbroken tight warp threads; a stopping mechanism for the loom, and a retarding device interposed between said warp detectors and stopping mechanism to effect release of the latter, and means for moving said retarding device

a predetermined distance during each beat of the lay when a warp detector is unmoved in its normal position by reason of a broken or loose thread, substantially as described.

2. In a warp stop motion for looms, the following instrumentalities, viz;—a lay; a series of warp detectors arranged to be acted upon and moved from their normal into their abnormal positions by the unbroken tight warp threads; a stopping mechanism for the loom and a retarding device interposed between said detectors and stopping mechanism to effect release of the latter at the end of a predetermined number of beats of the lay, substantially as described.

3. In a warp stop motion for looms, the following instrumentalities, viz;—a lay; a series of reed dents; warp detectors arranged to be acted upon and moved from their normal into their abnormal positions by the unbroken tight warp threads; a stopping mechanism for the loom; a retarding device interposed between said stopping mechanism and warp detectors, and adapted when moved in one direction to effect the stopping of the loom; two pawls adapted to move said retarding device in opposite directions, and means to move said pawls; and mechanism between said warp detectors and pawls whereby the position of the said detectors determines which of the two pawls shall act upon and move said retarding device, substantially as described.

4. In a warp stop motion for looms, the following instrumentalities, viz;—a lay; a series of reed dents; warp detectors between the same and adapted to be moved from their normal into their abnormal positions by the unbroken tight warp threads; a feeler co-operating with said detectors, and actuating mechanism therefor; a retarding device, and a stopping mechanism for the loom actuated thereby; two pawls on said lay adapted to move said retarding device in opposite directions, and connections between said feeler and pawls whereby the position of the former determines which pawl shall move said retarding device and control the stopping of the loom, substantially as described.

5. In a warp stop motion for looms, the following instrumentalities, viz;—a lay; a series of reed dents; warp detectors arranged between the same and adapted to be moved from their normal into their abnormal positions by the unbroken tight warp threads; a depressor; a feeler, and mechanism to actuate the same; a stopping mechanism for the loom, and a retarding device to effect operation of the said stopping mechanism and interposed between the same and said feeler and controlled as to its operation by the position of the latter, whereby two or more beats of the lay necessarily intervene between the breakage or loosening of a warp thread and the stopping of the loom, substantially as described.

6. In a warp stop motion for looms, the following instrumentalities, viz;—a frame; a lay; a reed thereon; warp detectors arranged between the dents thereof and adapted to be moved from their normal into their abnormal positions by the unbroken tight warp threads; a feeler also carried by said lay; a movable cam on the loom frame; a co-operating feeler actuator on the lay adapted to ride over and under said cam during each complete movement of the lay; and a stopping mechanism for the loom controlled by said feeler, substantially as described.

7. In a warp stop motion for looms, the following instrumentalities, viz;—a frame; a lay; a reed thereon; warp detectors arranged between the dents thereof and adapted to be moved from their normal into their abnormal positions by the unbroken tight warp threads; a feeler also carried by said lay; a movable cam on the loom frame; a co-operating feeler actuator on the lay adapted to ride over and under said cam during each complete movement of the lay; and a stopping mechanism for the loom controlled by said feeler, the depressor also actuated from said feeler actuator, substantially as described.

8. In a warp stop motion for looms, the following instrumentalities, viz;—a frame; a lay; a reed carried thereby, and a series of warp detectors arranged between the dents thereof and adapted to be moved from their normal into their abnormal positions by the unbroken tight threads; a stopping mechanism for the loom; a retarding device to effect operation of the same; two pawls on the lay to move said retarding device in opposite directions respectively; a feeler; a feeler actuator; a cam to move the same in one direction, and a spring to move the same in an opposite direction; a stop for said pawls movable with said feeler actuator; and springs to retain said pawls normally against said stop, whereby the position of the feeler actuator and stop determines which of the said pawls shall act upon and move the said retarding device, substantially as described.

9. In a warp stop motion for looms, the following instrumentalities, viz;—a frame; a lay; a reed carried thereby; a series of warp detectors arranged between the dents thereof and adapted to be acted upon and moved from their normal into their abnormal positions by the unbroken tight warp threads; a stopping mechanism for the loom; an actuator therefor, a two-part retarding device, and pawls on the lay adapted to engage respectively the two parts of said retarding device to move the latter in one or the other direction according as one or the other part is acted upon by its pawl; a feeler, and mechanism controlled thereby to determine which of the said pawls shall act upon and move said retarding device, substantially as described.

10. In a warp stop motion for looms, the following instrumentalities, viz;—a frame; a lay; a reed carried thereby; a series of warp detectors arranged between the dents thereof

and adapted to be acted upon and moved from their normal into their abnormal positions by the unbroken tight warp threads; a stopping mechanism for the loom; an actuator therefor; a retarding device comprising two toothed members; adjusting and connecting devices to vary the relative positions of the same; a lug on one of said toothed members to move the same; and a blank space on the other of said members; two pawls on the lay, one adapted to engage the toothed member provided with the actuator lug referred to, but normally out of engagement with said member, and the other normally working in the blank space in the other of said toothed members referred to; a feeler co-operating with said warp detectors and adapted when it encounters a detector in its abnormal position to cause the pawl normally out of engagement to engage and move the toothed member of the retarding device having the actuating lug, the other of said pawls when acting upon its toothed member returning said retarding device to its normal position, all substantially as described.

11. In a warp stop motion for looms, the following instrumentalities, viz;—a frame; a lay; a reed carried thereby; a series of warp detectors arranged between the dents thereof, and adapted to be acted upon and moved from their normal into their abnormal positions by the unbroken tight warp threads; a stopping mechanism for the loom; an actuator therefor; a two-part retarding device, and pawls on the lay adapted to engage respectively and alternately the two parts of said retarding device to move the same in opposite directions; a stop to determine the positions of said pawls, a feeler, and connections between the same and said stop, whereby the position of the latter is controlled by the former, substantially as described.

12. A warp stop motion for looms, containing the following instrumentalities, viz;—a series of detectors adapted to be moved from their normal into their abnormal positions by the unbroken warp threads; a stopping mechanism actuated by one of said detectors permitted to remain unmoved in its normal position; and a wiping device to act upon and wipe the warp threads toward the fell of the fabric, substantially as and for the purposes set forth.

13. A warp stop motion for looms, containing the following instrumentalities, viz;—a series of detectors adapted to be moved from their normal into their abnormal positions by the unbroken warp threads; a stopping mechanism actuated by one of said detectors permitted to remain unmoved in its normal position; two or more normally inoperative wipers, and means controlled by the positions of the detectors to close the said wipers upon and to wipe forward the warp threads, substantially as and for the purposes set forth.

14. A warp stop motion for looms, containing the following instrumentalities, viz;—a lay; a series of detectors adapted to be moved from their normal into their abnormal positions by the unbroken warp threads; a stopping mechanism actuated by one of said detectors permitted to remain unmoved in its normal position; two or more normally separated wipers, means controlled by the position of said detectors to close the same upon the warp threads; and connections between said wipers, when closed, and the lay, whereby the latter moves the wipers toward the fell of the fabric to wipe forward any slackness in said threads, substantially as described.

15. In a warp stop motion for looms the combination with the stopping mechanism for the loom, and means to operate the same actuated by a broken or slack warp thread, of a warp tightening wiping device to act upon and wipe the warp threads toward the fell of the fabric to thereby tighten the same, for co-operation with the said stopping mechanism, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

OBERLIN SMITH.

Witnesses:
LIDA M. BROOMALL,
ENOS PAULLIN.