(No Model.) 4 Sheets—Sheet 1.

O. SMITH.

WARP STOP MOTION FOR LOOMS.

No. 498,191. Patented May 23, 1893.

Fig: 1.

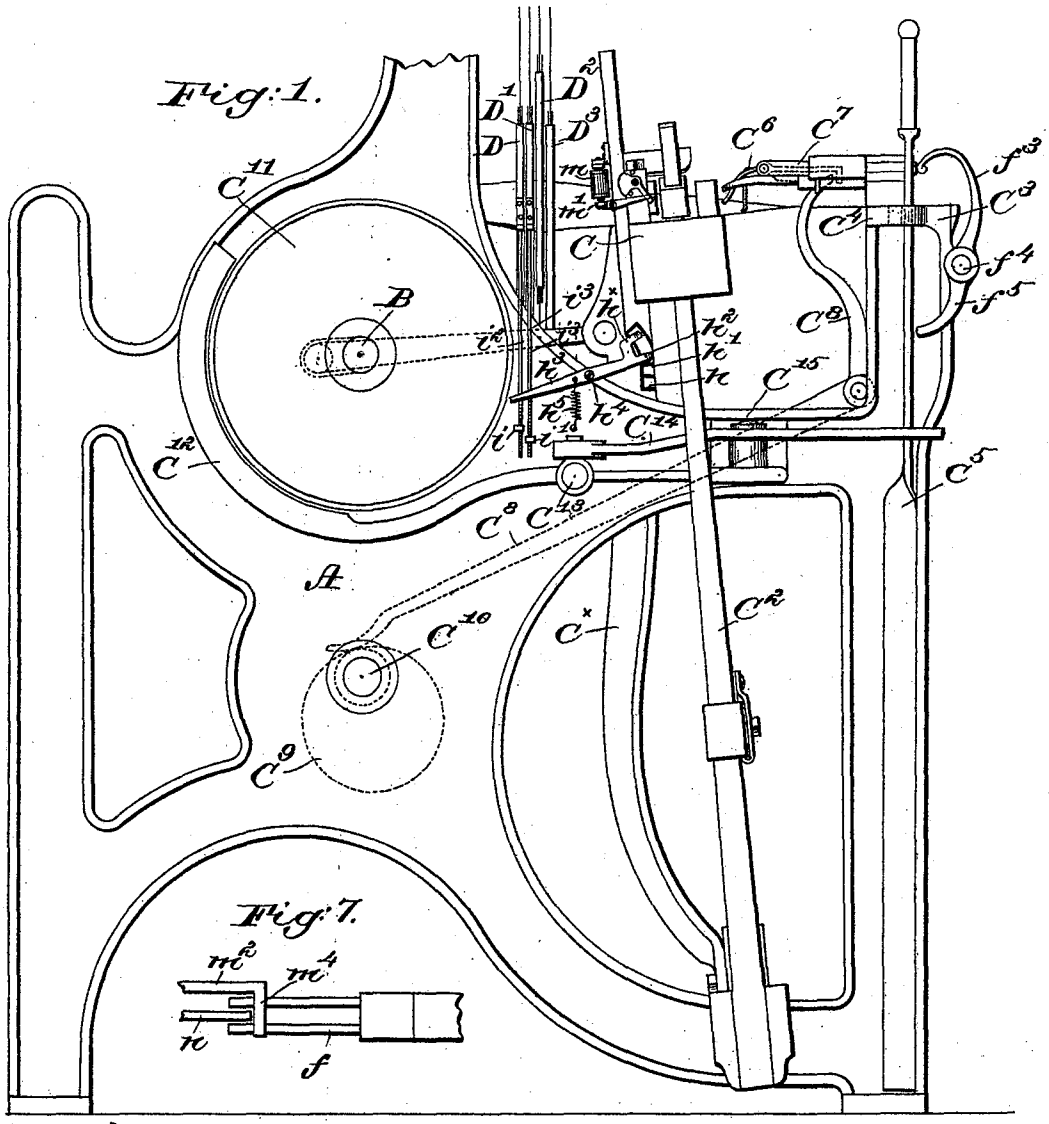


Fig: 7.

Fig: 5.

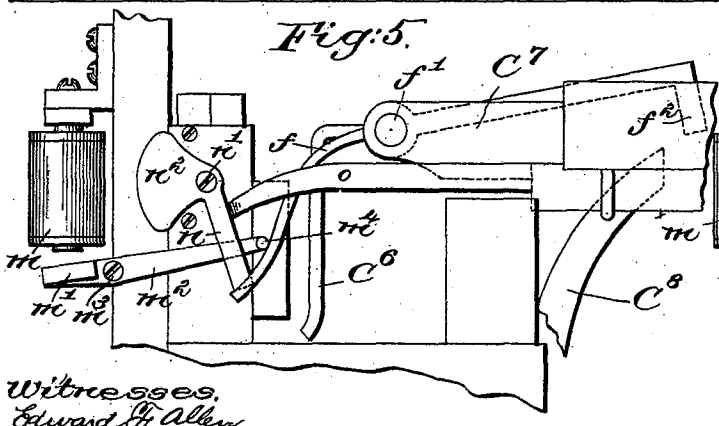
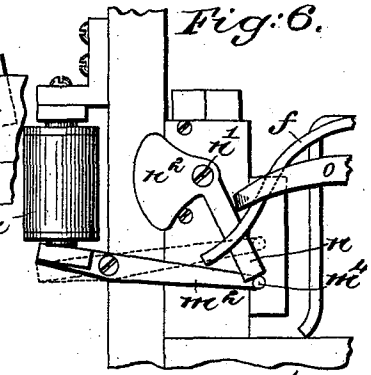


Fig: 6.



Witnesses.
Edward G. Allen.
Louis M. Gowell

Inventor.
Oberlin Smith.
by Crosby & Gregory
Attys.

(No Model.) 4 Sheets—Sheet 2.

O. SMITH.

WARP STOP MOTION FOR LOOMS.

No. 498,191. Patented May 23, 1893.

Fig: 3.

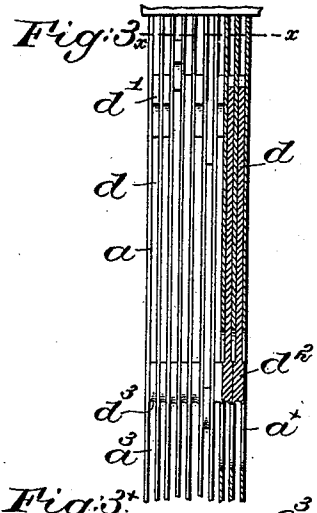


Fig: 3*.

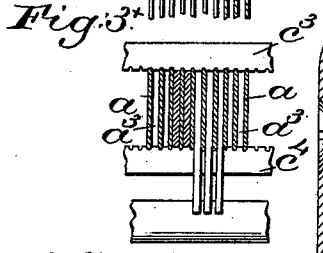


Fig: 12.

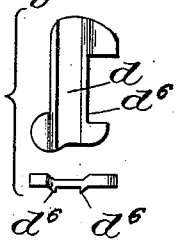


Fig: 4.

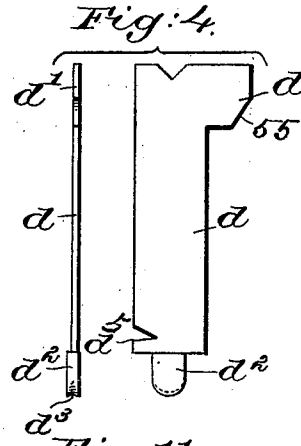


Fig: 11.

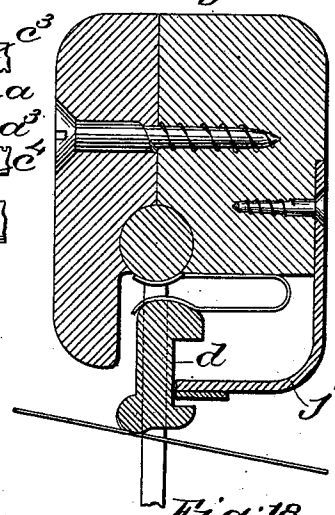


Fig: 18.

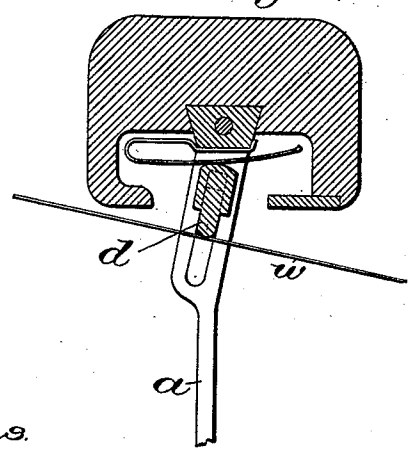
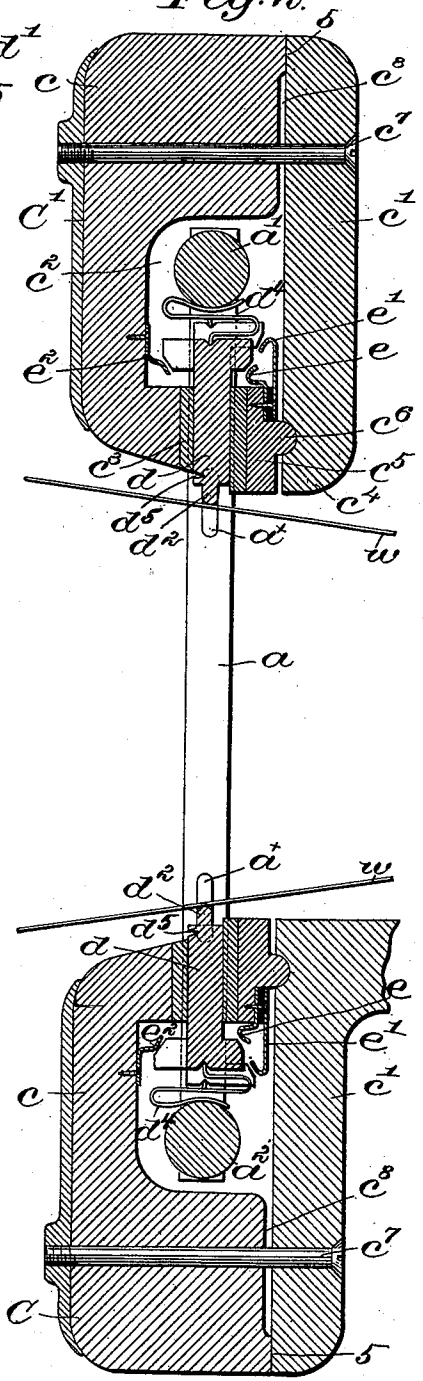


Fig: 2.



Witnesses.
Edward F. Allen.
Louis McSwell

Inventor.
Oberlin Smith.
by Crosby & Gregory
Attys.

(No Model.) 4 Sheets—Sheet 3.

O. SMITH.

WARP STOP MOTION FOR LOOMS.

No. 498,191. Patented May 23, 1893.

Fig: 13.

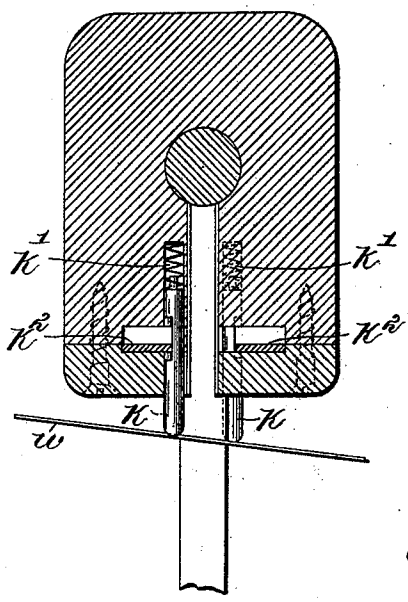


Fig: 14.

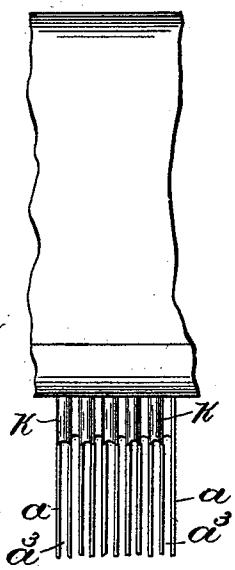


Fig: 15.

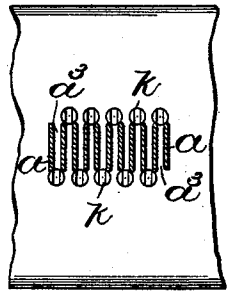


Fig: 10.

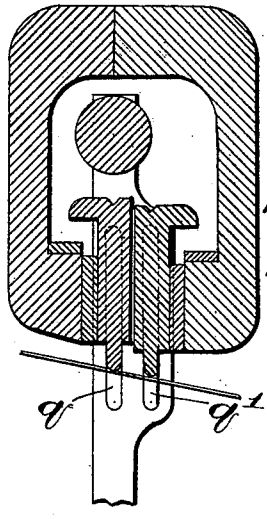


Fig: 9.

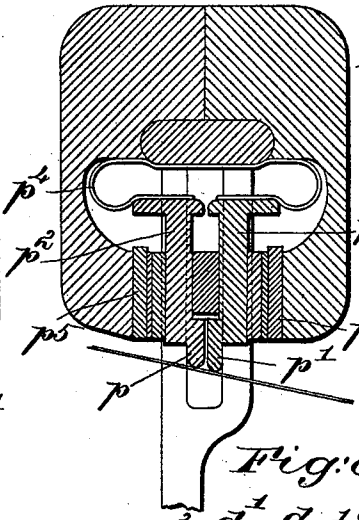


Fig: 16.

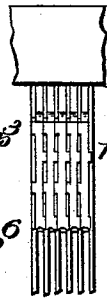


Fig: 17.

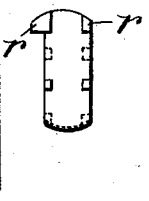
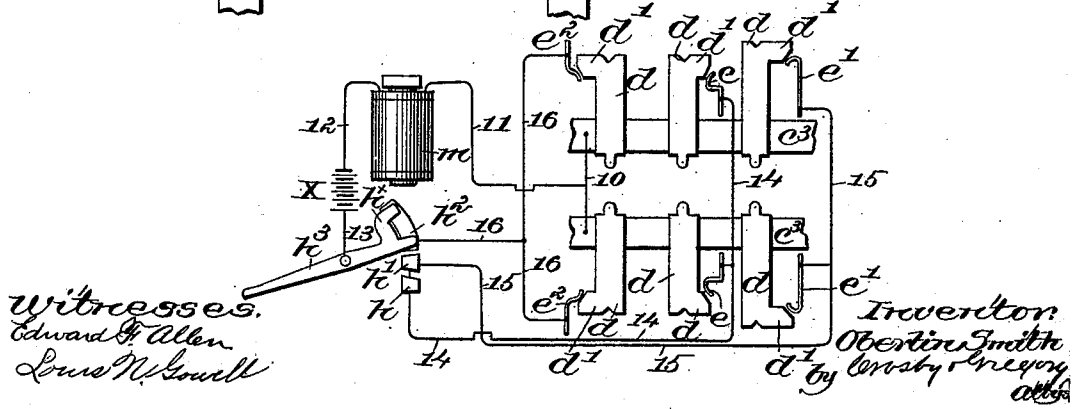


Fig: 8.



Witnesses.
Edward F. Allen
Louis N. Gould

Inventor:
Oberlin Smith
by Crosby & Gregory
attys

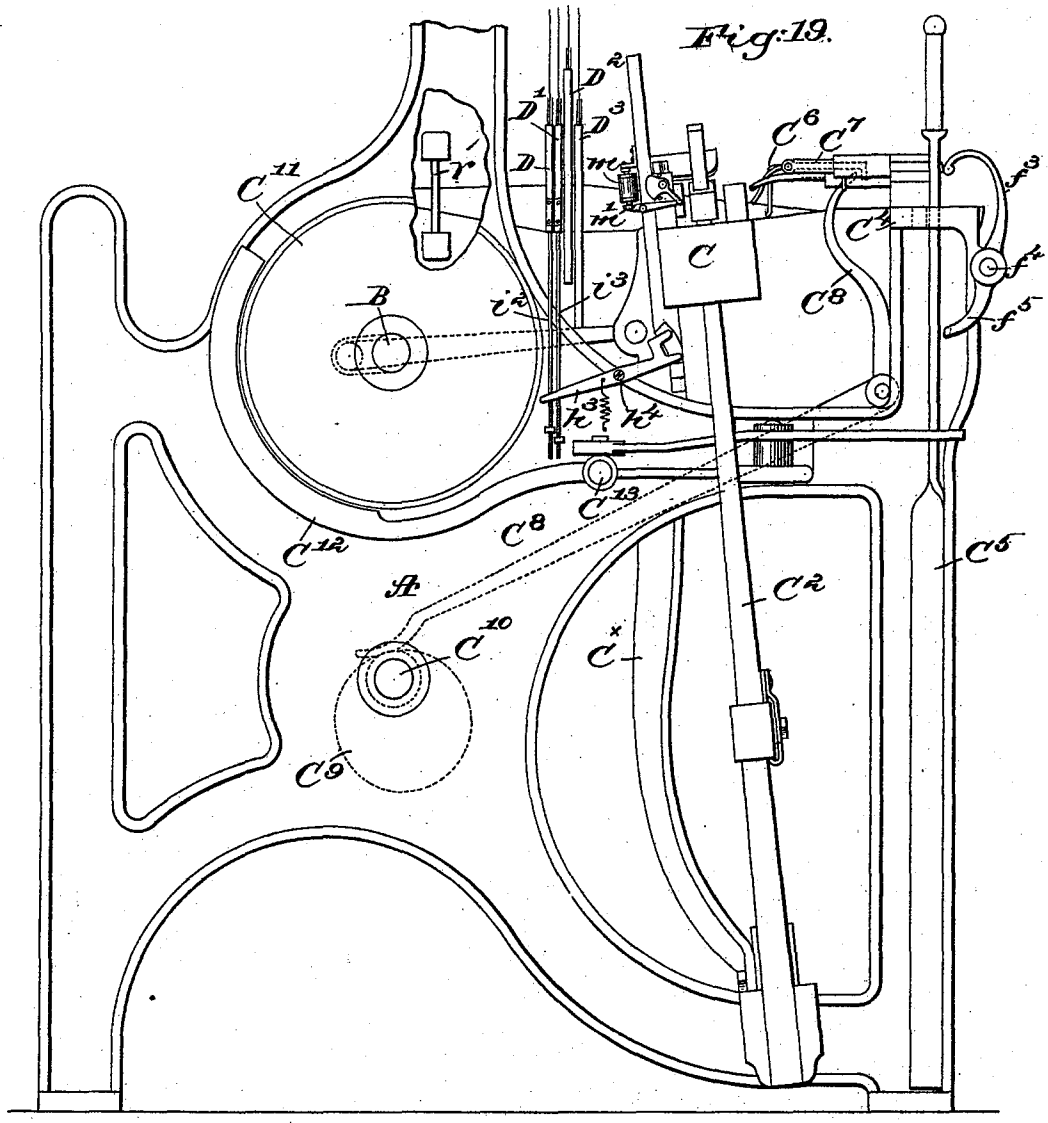
(No Model.) 4 Sheets—Sheet 4.

O. SMITH.

WARP STOP MOTION FOR LOOMS.

No. 498,191. Patented May 23, 1893.

Fig. 19.



Witnesses.
Fred. S. Greene of
Louis N. Goswell

Inventor.
Oberlin Smith
by Crosby & Gregory
Attys.

UNITED STATES PATENT OFFICE.

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

WARP STOP-MOTION FOR LOOMS.

SPECIFICATION forming part of Letters Patent No. 498,191, dated May 23, 1893.

Application filed February 13, 1892. Serial No. 421,388. (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 has for its object to provide a stop-motion for looms which will act to stop the loom upon the breakage of one or more warp threads.

The invention consists essentially of a series of warp detectors, each of which is moved into an abnormal position by a warp thread forming part of a shed, provided such warp thread is perfect and unbroken; but should a warp thread be broken it will fail to properly move its co-operating detector from its normal into its abnormal position, and any single detector left in its normal position will act through suitable mechanism to stop the loom, as will be more fully hereinafter described.

My invention is capable of being carried out practically in many different ways and by devices differing materially in construction; so I have selected for the present embodiment of my invention forms of detectors adapted to slide freely or substantially so between or on and adapted to be guided preferably by the dents of the reed, there being a detector for each reed space, so that as the warp thread or threads in any particular reed space is or are moved in the formation of a shed, such threads, if unbroken, will move the detectors into their abnormal positions, but should any warp thread in any reed space be broken, so that it fails to properly come into one side or half of the open shed, the detector which should be moved by it, if unbroken, will not be moved as described, but will be left in its normal position to effect the stopping of the loom. The stopping of the loom by the failure of a warp thread to move a detector may be effected in a number of different ways; but in this present embodiment of my invention the movement of a detector by a warp thread from its normal into its abnormal position operates to break an electric circuit, which circuit, if permitted to remain unbroken or closed by the failure of a detector to be moved, will act through suitable mechanical devices, preferably electrically actuated, to stop the loom.

One part of this invention therefore comprehends a loom containing the following instrumentalities, viz:—a series of sliding detectors each of which is adapted to be moved from its normal into its abnormal position by a warp thread, provided such warp thread is unbroken; a carrier for said series of detectors; and a stopping mechanism adapted to be actuated by any one of said detectors when in its normal position, substantially as described.

Another part of this invention consists in the combination with a loom, of a series of warp detectors adapted to be moved from their normal into their abnormal positions by the warp threads selected to form a shed, provided said warp threads are unbroken; and electrically-actuated stopping mechanism for the said loom controlled by the position of a detector, substantially as will be described: also in the combination with a loom containing a lay, and a reed carried by said lay, of a series of detectors arranged to slide between and be guided by the dents of the said reed, and acted upon by the warp threads passing through the said reed, substantially as will be described: also in the combination with a loom containing a lay, a series of warp detectors, an electro-magnet, the circuit of which is controlled by said detectors, and a stopping mechanism actuated by said detectors, of means actuated by movement of the lay to interrupt the circuit of said electro-magnet periodically, substantially as will be described.

Other features of this invention will be hereinafter described and pointed out in the claims.

Figure 1 is a left-hand end elevation of a sufficient portion of a loom to enable this invention to be understood, only that part of the shed-forming mechanism which directly receives and guides the warp threads to sepa-

rate them in the formation of sheds being shown; Fig. 2, an enlarged section of the lay cap and reed, said figure showing one form of detector capable of being held in abnormal position by the warp threads, shown as opened as in the formation of a shed; Fig. 3, a partial front view of the reed, showing the detectors held between the reed dents, some of which are in section, one of the detectors being in its normal position; Fig. $3^{\times}$, a section on the dotted line x—x, Fig. 3; Fig. 4, side and end elevations respectively of one of the warp detectors; Fig. 5, a detail on an enlarged scale, showing a portion of the electrically-actuated stopping mechanism, the parts being in the positions which they will occupy when all the detectors are moved into their abnormal positions by the warp threads; Fig. 6, a similar view illustrating the positions of the parts when one of the detectors has been left in its normal position by the breakage of a warp thread or the failure of a warp thread to move it; Fig. 7, a detail of a weft fork to be referred to; Fig. 8, a diagrammatical view, illustrating the electrical connections of the stop motion. Fig. 9 represents a modified construction, wherein two detectors are arranged in each end of each reed space. Fig. 10 represents another construction, wherein two detectors are arranged at each end of each reed space, each detector, however, in this latter construction being guided by or through a separate slot in a reed dent. Fig. 11 is a sectional detail of a reed cap and a portion of a reed, illustrating yet another form of detector with its co-operating parts. Fig. 12 shows a side and a top view of one of the detectors shown in Fig. 11, Figs. 13, 14, 15 respectively, a section, a partial side view, and a partial under side view illustrating yet another modified form of my invention. Figs. 16 and 17 illustrate still another modification to be referred to; Fig. 18, a construction wherein the reed dents at their upper ends are inclined so that the detectors may move in a direction at right angles to the upper plane of the shed; and Fig. 19, a modification to be described.

Referring to the drawings, A represents a portion of the side frame of a loom; B the lay or crank-shaft; C the lay; $C^{\times}$ the lay sword operated from said shaft; C^2 the picker stick; C^3 the breast-beam; C^4 a holding plate having a slot for the shipper C^5 to move in, and a notch to hold the same in position; C^6 a weft fork; C^7 a weft slide-bar; C^8 a weft hammer; C^9 a cam on the shaft C^{10} to actuate the said weft hammer; C^{11} a driving pulley on the shaft B; C^{12} a belt-controller mounted to slide on the rod C^{13} and actuated by a lever C^{14}, pivoted at C^{15}, and having its outer end in engagement with the shipper C^5; and D, D′, D^2, D^3 heddle frames, all of which are and may be of well-known or desired construction and arrangement and which may be actuated in usual manner, so need not therefore be herein further described.

Any devices commonly used to actuate harness frames in looms may be used in a loom containing detectors embodying my invention; and it will also be obvious that the particular kind of harness, whether of metal or thread, or whether outside of a harness frame as in a Jacquard loom, is immaterial to my invention.

Referring to Figs. 2 to 4, the reed consisting of the reed dents a, held in position with relation to each other by the reed heads a', a^2, so as to leave suitable reed spaces a^3, are supposed to be of usual construction; but the lay C and the lay cap C′ as shown are peculiarly constructed to thereby permit ready access to the reed. Both the lay C and the lay cap C′, see Fig. 2, are of similar construction, and therefore one only,—viz., the lay cap, need be herein specifically described, like letters and figures in each representing like parts. The lay cap C′ consists of two members c, c', the member c having a suitable longitudinal groove or recess c^2 to receive the upper reed head a', and having its inner face below said groove fitted with a guide or clamping plate c^3. The reed is held between this guide plate c^3 and a similar guide plate c^4, carried by a strip c^5 having a bead or bearing surface c^6 at its outer face adapted to co-operate with a longitudinal groove in the member c' of the lay cap, the two members c, c' being drawn together to thereby clamp the reed dents between the guide plates by means of bolts or screws c^7, a portion of the member c being removed, as at c^8, above the groove c^2, so that the two members will contact at two points only, viz.,—the point 5 along the upper edges and the bead or surface c^6 along the bottom edges, thus permitting the two members of the cap to twist or warp it may be slightly without affecting in any manner the reed and the other parts supported thereby. In practice the reed dents a will preferably be recessed slightly into the guide plates c^3, c^4, as indicated in Fig. $3^{\times}$, to prevent the dents from spreading and thus releasing the warp detectors from between them. The reed spaces a^3 contain in the present instance both at top and bottom warp detectors d, each of which is formed substantially as represented in Figs. 2 and 4, wherein the body of the detector is of proper size and shape to fit between adjacent sides of the reed dents and the guide plates c^3, c^4, the latter, together with the reed dents, forming a metallic box or guide in which the detectors may slide vertically.

The series of detectors d above the guide plates c^3, c^4, are provided with heads d', the heads of some of the detectors being formed to make electrical contact with a contact strip e carried by the strip c^5; others of the detectors have their heads d' higher than the heads of the detectors referred to and are adapted to make electrical contact with a contact strip e', also carried by the strip c^5 but insulated from the contact strip e; while yet others of the detectors have their heads d' turned in an opposite direction and are adapt-

ed to make electrical contact with a contact strip e^2, the faces of the heads of all of the detectors being preferably beveled, as at 55, so that a rubbing engagement between each head and its contact strip is provided to insure a perfect contact. The heads d' of the detectors thus constitute movable electric contacts which are actuated by the warp thread, the contact strips e, e', e^2 constituting co-operating fixed contacts therefor.

The detectors for the best results may be provided at their lower ends with bearing lugs d^2, as in Fig. 4, which constitute the thread supports for the detectors, the said thread supports being grooved preferably as at d^3 to bear upon the warp threads w in the reed spaces in which the detectors are arranged, the said lugs being extended into suitable slots or spaces $a^\times$ in the reed dents to thus prevent the warp threads from being caught and drawn between the detectors and the reed dents at either side, the said warp threads acting to move the detectors from their lower normal positions in contact with their respective contact strips into their abnormal elevated positions, as represented in the drawings, suitable springs d^4 being preferably interposed between the detectors and the upper and lower reed heads to press the said detectors upon the warp threads; although such springs may, if desired, be omitted in the lay cap and gravity relied upon to hold the detectors down; but when the detectors are employed in the lay, the springs or some equivalent devices should be employed.

The detector may be provided with niches d^5 in which to insert the point of a sharp instrument for the purpose of moving the detectors in their respective reed spaces, in case they should become clogged with lint or other substance.

Referring to Figs. 1, 5, 6, and 7, the lay C of the loom carries an electro-magnet m, having its armature m' fast on one end of an armature-carrier m^3, pivoted at m^3, and in the present instance having its outer end turned at right angles, as at m^4, to form a hook in line with and adapted to strike against the end of a warp fork f, see Fig. 7, shown as pivoted at f' in the slide-bar C^7 in which the weft fork C^6 is also pivoted, said warp fork f having its outer end provided with a hook f^2, adapted to be acted upon by the weft hammer C^8 in precisely the same manner as the weft fork C^6 is acted upon by the said hammer.

Believing myself to be the first person to use a warp fork, my invention is not limited to the exact shape or construction of the warp fork or its actuating devices.

The weight of the armature m', when unattracted by its magnet m, is normally sufficient to maintain the armature in its retracted position with the hook m^4 of the armature-carrier in its elevated position, as shown in Figs. 1 and 5, although a spring may be provided if necessary to hold the armature in its retracted position; but when the armature m' is attracted, the said armature-carrier is moved to its abnormal position, Fig. 6, and is caught and retained in such abnormal position by a locking device, herein shown as a pawl n, pivoted at n' and normally retained in its position Fig. 6 by a counterweight n^2.

When the armature m' of the magnet m is in its retracted position, Fig. 5, the hook m^4 of the armature-carrier, during the forward movement of the lay when beating in the weft, will strike against the warp fork, as in Figs. 5 and 7, and turn the same on its pivot, Fig. 7, into the position shown in Fig. 5, so that its hook f^2 will be raised out of the path of movement of the weft hammer C^8. But should the said armature be attracted by its magnet, the hook m^4 of the armature-carrier will be caught and retained in its abnormal full-line position, Fig. 6, so that it will pass under the end of the warp fork f without engaging and turning the same on its pivot, so that the weft hammer C^8 in its subsequent forward movement will engage the hook f^2 of the fork and move the same and its slide C^7 in a direction to act upon a suitable arm f^3 on the shaft f^4 to turn the said shaft, thus causing the arm f^5 on the said shaft to strike against the shipper C^5 and move the same sufficiently to disengage it from the usual notch in the holding plate C^4, and permit the shipper to be moved to effect the stopping of the loom precisely as though the loom had been stopped by failure of the weft thread to turn the weft fork C^6 on its pivot.

It will be understood that my invention may be applied to a loom having any usual driving mechanism having fast and loose pulleys, from one or the other of which a belt will be passed when it is desired to stop the loom, or the driving pulleys may be of the variety known as clutch or friction pulleys.

Whatever form of driving pulley or pulleys is or are used for the loom, will be under the control of its own proper form of device or devices to effect the stopping of the crank shaft at the proper time as required; but with all varieties of pulleys there must be some sort of a shipper handle under the control of the operator to stop the loom, and co-operating with this handle, which I have designated by the letter "C^5" and have denominated the shipper, there will be the usual proper devices, according to the character of the pulley used.

I have shown usual actuating devices between the slide-bar C^7 and the shipper C^5; but this invention is not limited to the particular devices shown, and the same may be variously made or formed or any known or suitable equivalent devices substituted therefor without departing from my invention. The circuits of the contact strips e, e', e^2 are controlled by a switch of suitable construction and preferably actuated by the lay at each stroke, the said switch, as herein shown, having three contact plates h, h', h^2 on the lay sword $C^\times$, see Fig. 1, but insulated therefrom and

from each other, said contact plates being connected respectively in circuit with the contact strips e, e' and e^2. The co-operating selecting member of the switch consists of the lever h^3 pivoted at h^4 on the frame A of the loom, and normally acted upon by a spring h^5 and retained in its elevated position as represented in Fig. 1, where it will engage the contact plate h^2 as the latter is moved beneath it at each backward movement of the lay. But the said selecting lever is moved from its position Fig. 1 into proper position to engage, as the lay is moved backward, either of the contacts h or h' by means of nuts i, i', threaded respectively on rods i^2, i^3, secured to and movable with the harness frames D, D', the harness frame D' when it is raised to move certain of the warp threads into the upper plane of the shed, acting through the rod i^3 and nut i' to move the lever h^3 into position to engage the contact h'; while the harness frame D, when raised to bring certain other of the warp threads into the upper plane of the shed, will act through the rod i^2 and nut i to move the said lever into position to engage the other contact h, the arm $h^\times$ on the said lever, however, moving upon the contact h^2 when the lever h^3 is moved therefrom to either of the contacts h or h', so that the said contact h^2 and the contact strip and detectors which co-operate therewith are always in circuit with the electro-magnet m whether the detectors controlled by the contacts h and h' are placed in circuit or not. The switch therefore which consists of the contacts h, h' and h^2, and the selecting lever h^3, is actuated by the lay which moves the contacts toward and from the selecting lever h^3 to make and break the circuit. The various parts may be arranged in circuit as indicated in Fig. 8, wherein the guide plate c^3 on the lay and the guide plate c^3 on the lay cap are represented as connected in circuit by a wire 10, although in practice such wire would not be necessary because the said plates would be electrically connected by the metallic reed dents clamped against them, the wire 10 being indicated on the drawings for the sake of clearness, said plates being connected through this wire or the reed dents with the electro-magnet m by means of a wire 11, the magnet m being in turn connected by a wire 12 with one pole of the battery or generator X, the opposite pole of which is connected by wire 13 with the selecting lever h^3.

In the loom illustrated and described, the reed spaces through which those warp threads which are controlled by the harness frames D^2, D^3 are passed will each contain two or it may be more warp threads, each controlled by its own proper frame, said frames being moved at each pick of the loom so that the threads may be made to cross each other in their respective reed spaces in the formation of each shed. Those warp threads which are controlled by the frames D, D', however, in the present instance will pass through separate reed spaces and the frames controlling them, will be moved only occasionally for the introduction into the face of the fabric of the particular threads which they control.

Referring to Figs. 1 and 2, the operation of the stop motion is as follows:—As the lay is moved into its rearmost position, Fig. 1, the frames D^2, D^3, will be moved to form a shed of their threads in usual manner, the switch lever h^3 being now in its position Fig. 1 to engage the contact h^2 as the lay reaches its rearmost position. If the threads which are moved into the upper or lower planes of the shed are perfect and unbroken they will act upon the detectors in the respective reed spaces and move the said detectors into the positions represented in Fig. 2, the heads d' of the detectors or movable contacts being thereby removed from engagement with their contact strips e^2, and at this time the circuit is closed by the selecting lever h^3 through the contact h^2; but as all of the detectors which co-operate with the contact strip e^2 are removed from engagement with such contact strip by the warp threads as the latter are moved to form the shed, the circuit will remain broken and the lay will begin its forward movement for the purpose of beating in the weft thread, with the armature m' of the magnet m in its retracted position, and the hook m^4 of the armature-carrier will engage the warp fork f and turn the same on its pivot so that its hook f^2 will not be engaged by the weft hammer C^8 as the latter is moved forward; and provided the weft fork C^6 is also turned on its pivot by the weft thread in usual manner, the said weft hammer will move forward without carrying with it the slide C^7. But if any of the warp threads which should have moved the detectors which co-operate with the contact strip e^2 into their abnormal positions out of engagement with said contact strip as described, should become broken, such thread would fail to move its detector and would permit it to assume its normal position with the beveled face 5 of its movable contact head in engagement with the contact strip e^2, closing the circuit at that point, so that as the lay is moved into its rearmost position, as indicated in Fig. 1, and the circuit is closed through the selecting lever h^3 as described, the electro-magnet m will be energized, the circuit being traced from the battery, Fig. 8, through the selecting lever h^3, contact h^2, wire 16, contact strip e^2, contact d, guide plate c^3, reed dent, wire 10, wire 11, through the electro-magnet m, and wire 12 back to the battery. The magnet m being energized as the circuit is closed by the engagement of the selecting lever h^3 with the contact h^2, the armature m' will be attracted and the hook m^4 on the outer end of the armature-carrier will be caught and held in its lowermost full-line position, Fig. 6, by the locking device n, so that upon the next forward movement of the lay to beat in the weft thread the hook m^4 will pass beneath the warp fork f, failing to turn the same upon its

pivot, and the weft hammer C^8 in its next forward movement will engage the hook f^2 on the said fork and move the slide-bar C^7 forward or to the right, Fig. 1, and act through the arm f^3 to turn the shaft f^4 and cause its arm f^5 to release the shipper C^5 from the notch in the holding plate C^4, and permit the said shipper to move and stop the loom in usual manner. As the lay is moved forward to beat in the weft thread, the locking device n, which still holds the armature-carrier m^2 in its lowermost position, Fig. 6, will strike against a fixed abutment o and be pushed back to release said armature-carrier and permit the same to resume its normal full-line position, Fig. 5, so that when the broken warp thread is mended and the loom again started the armature-carrier m^2 will be in proper position to operate as previously described to stop the loom if necessary upon the breakage of another of the warp threads. When, during the process of weaving, either of the harness frames D or D′, is raised for the introduction into the face of the fabric of the warp threads controlled thereby, the detectors in the reed spaces through which such warp threads pass will be raised in the manner described, provided the threads are not broken; but should one of them be broken it will fail to lift its detector, but will permit the same to close the circuit at that point through its contact strip, the same movement of the harness frame which raised the warp threads to the upper plane of the shed also moving the selecting lever h^3 into position to engage either the contact h or h^2, according as the frame D or D′ has been moved, to thus place the contact strip e or e' in circuit with the magnet m to stop the loom, said contact strips and their co-operating detectors at all other times remaining cut out of circuit. The arm $h^\times$ on the lever h^3, however, still maintains the contact strip e^2 in circuit with the magnet to detect a broken warp thread controlled by either of the frames D^2, D^3.

If the stop-motion herein described should be applied to a plain loom wherein all the warp threads are alternately moved at each pick either into the upper or lower planes of the shed, all of the detectors could be arranged to co-operate with a common contact strip, and all of the detectors on the lay cap with another common contact strip, both of which strips would be arranged in circuit with a single contact h, in which case the selecting lever h^3 may be made fast or be nothing more than a fixed spring pin to close the circuit with the contact h on the lay at each backward movement of the lay; but in fancy looms of the open shed order, wherein some of the warp threads remain either in the upper or lower planes of the shed during two or more successive picks, and would therefore remain at one end of the reed spaces during two or more successive picks so that the detectors at the opposite ends of the reed spaces through which such unmoved threads pass would not be moved from engagement with their respective contact strips, but would during such times as said warp threads are not moved, remain in contact or engagement with their contact strip, and would thus act to stop the loom when the circuit is closed by the switch device upon the first backward movement of the lay when perhaps the warp threads which co-operate with said detectors might be unbroken, the failure of said warp threads to move their detectors being due not to the fact that they are broken but rather to the fact that they were not moved into the upper or the lower plane of the shed by the harness motion; hence the necessity of providing a selecting device, as the lever h^3, to cut out such of the detectors as are controlled by those warp threads which are not moved at that shed, such detectors being selected and cut into circuit by said selecting device only when the warp threads which moved them are to be moved by the harness motion. Therefore any failure of the warp threads controlled by the harness frames D or D′ to move their detectors into their abnormal positions out of engagement with their contact strips, will operate to stop the loom through the selecting lever h^3, which is moved at the right time into proper position to engage the contact h or h' which is in circuit with the strip of the particular series of detectors which should be moved.

While I have herein represented only one simple form of fancy loom, it is evident that this principle of employing a selecting device under the control of the harness motion may be used to throw into circuit one or more of any number of series of detectors and for one or more sheds, and thus provide a stop motion which may be adapted to any possible form of loom.

In general, detectors may by this system be divided into various groups, which may individually be switched into action at the proper time. These groups may have their component detectors scattered about among the others in various combinations, as has just been described. Or, a group may be a whole upper set of detectors, while another group may be a lower set. Or, a group may be a forward set, while another group may be a back set. In either of the two latter cases, say with a plain two-harness loom, one plane of the shed may, if desired, be switched into action with one group while the other plane is switched with the other.

In Figs. 1 and 2 but a single detector is shown at top and bottom of each reed space; but it will be expressly understood that, if desirable or necessary, one or both ends of each reed space may be provided with two detectors arranged as shown in Figs. 9 and 10.

Referring to Fig. 9, the slot in the reed dent is made of sufficient size to include the lugs p, p', of two detectors p^2, p^3, which are acted upon in this instance by a common spring p^4 which tends to press the detectors down into

their normal positions to contact with the strip p^6.

In Fig. 10 each reed dent is provided with two slots q, q', each of which receives the lug of a separate detector.

In Figs. 2, 9, and 10 the detectors are shown as provided with lugs which slide in slots in the reed dents; but in lieu of such constructions I may employ a construction such as represented in Figs. 11 and 12, wherein the detectors d are formed with guiding ribs d^6 upon one side, which serve as guides to retain the detectors in proper position and permit them to slide vertically on the reed dents, the circuit in such construction being closed through a contact plate j.

Figs. 13, 14, and 15 represent another modified construction, wherein the detectors are made in the form of pins k, arranged to slide vertically in suitable holes drilled in the lay cap or lay, said pins being acted upon by springs k' which tend to press the pins down into contact with the contact strips k^2, said pins being restrained from such movement by the warp threads w, if unbroken. The pins k are preferably arranged at opposite sides of the reed dents, as best shown in Fig. 15, in order that the pins may be made of sufficient diameter to avoid possibility of the warp threads becoming displaced and thereby failing to lift the pins.

Fig. 16 represents a partial front view of a reed with several detectors in position, and Fig. 17 a side view of one of the detectors, showing a different arrangement of guiding lugs or projections r, which are offset from each other upon opposite sides of the detectors, permitting each detector to have at each side a lug of a height equal to the thickness of a reed dent.

Fig. 18 represents the reed dents as inclined or shaped at their upper ends to permit the detectors to move in lines substantially at right angles to the upper plane of the shed. In this modified construction I have also represented the springs which force the detectors upon the warp threads as prolonged and adapted to close the circuit with the contact strip instead of having the circuit closed by the detector itself, as in other constructions.

The term "warp detectors," as employed in the claims, is intended to embrace any device which is moved into or retained in one position, which I term abnormal, by a warp thread, if the latter is unbroken, but which will fail to be retained in or moved into its abnormal position if the warp thread is broken.

In the present embodiment of this invention I have seen fit to arrange the detectors upon the lay of the loom, and to utilize a portion thereof and the reed as a carrier for and to guide the detectors in their movements; but it is not intended however to limit this invention to the particular carrier shown.

The armature-carrier m^2 constitutes a warp fork-actuator.

It will be obvious from the foregoing description that the dents which serve as guides for the detectors would operate equally well were the frame carrying the dents fixed in the loom frame at the rear of the usual lay and its reed as represented at r' Fig. 19; so this invention is not in all instances to be limited to detectors movable on or with relation to dents carried by a lay, the dents in addition to their function of guiding the detectors also serving the purpose of beating the weft into the fell; or, in other words, the detectors are claimed broadly, irrespective of the particular dents and irrespective of the dents forming part of a moving lay.

A warp stop motion embodying this invention may be readily applied to any existing loom without altering the same materially, and in practice the warp threads do not have to be poked through any additional openings or manipulated in any way different from the ordinary.

I claim—

1. A loom containing the following instrumentalities, viz:—a series of reed dents, a series of detectors working between the same each of which is adapted to be moved from its normal into its abnormal position by a warp thread, provided such warp thread is unbroken; a carrier for said series of detectors fixed and movable electrical contacts, the latter moved by the detectors; and an electrically-actuated stopping mechanism for the loom controlled by said fixed and movable contacts, substantially as described.

2. A loom containing the following instrumentalities, viz:—a lay; a series of reed dents carried thereby; warp detectors having thread supports, said thread supports being located between the said reed dents, and a stopping mechanism for the loom adapted to be actuated by a detector left in its normal position, substantially as described.

3. The combination, in a warp stop-motion for looms, of a lay; a series of reed dents carried thereby; sliding warp detectors arranged between the said reed dents; and independent guide plates to guide said detectors, substantially as described.

4. In a warp stop-motion for looms, the combination with a lay, of a series of reed dents carried thereby; guide plates c^3, c^4, crossing the reed dents near the reed head into which said reed dents are recessed; and a series of warp detectors arranged between the said reed dents, substantially as described.

5. In a warp stop-motion for looms, a lay; a series of reed dents carried thereby, and provided with slots; and warp detectors arranged between and having lugs to enter the slots in the said reed dents, substantially as described.

6. In a warp stop-motion for looms, a lay; reed-dents carried thereby; and warp detectors arranged between said reed-dents and having laterally extended side lugs crossing the vertical planes of the adjacent reed-dents, between the outer edges thereof whereby said reed-dents lying at opposite sides of said lugs

act to prevent lateral displacement of the threads from said detectors, substantially as described.

7. In a warp stop-motion for looms, stopping devices, a lay; and a series of reed dents carried thereby; combined with a sliding warp detector; and a co-operating fixed contact therefor in electrical connection with the stopping devices of the loom, to operate substantially as described.

8. A lay; a series of warp detectors carried thereby; a warp fork; and devices intermediate said detectors and warp fork controlled as to their positions by the detectors and adapted to actuate the warp fork; combined with a stopping mechanism controlled as to its operation by the said warp fork, substantially as described.

9. A warp stop-motion for looms containing a lay; a warp fork; and a stopping mechanism controlled by the warp fork; combined with a series of warp detectors; a co-operating fixed contact; an electro-magnet in circuit therewith; and an armature to determine by its movement the operation of the warp fork, substantially as described.

10. A loom containing the following instrumentalities, viz:—a lay; a warp fork; a stopping mechanism controlled by the same; a series of warp detectors; a co-operating fixed contact therefor; an electro-magnet on the lay in circuit with said fixed contact, and its armature adapted by movement of the lay to effect movement of the said warp fork when said armature is in one position, and not to effect movement of said warp fork when the armature is in another position, substantially as described.

11. A loom containing the following instrumentalities, viz:—a lay; a series of warp detectors; an electrically-actuated stopping mechanism controlled by said detectors and including a switch adapted to be actuated by the lay, to operate substantially as described.

12. A loom containing the following instrumentalities, viz:—a lay; a series of warp detectors; an electro-magnet, the circuit of which is controlled by said detectors; a stopping mechanism actuated through said electro-magnet; and means actuated by movement of the lay to break the circuit of said electro-magnet periodically, substantially as described.

13. A loom containing the following instrumentalities, viz:—a lay; a warp fork; a stopping mechanism controlled thereby; a series of warp detectors; and a co-operating fixed contact therefor; an electro-magnet on the lay, its armature, an armature-carrier therefor adapted to engage said warp fork and by movement of the lay move the fork, substantially as described.

14. A loom containing the following instrumentalities, viz:—a lay; a warp fork; a stopping mechanism controlled thereby; a series of warp detectors; a co-operating fixed contact therefor; an electro-magnet on the lay, its armature, an armature-carrier therefor adapted to engage said warp fork and by movement of the lay move the fork; and a locking device to hold the said armature-carrier in position to avoid moving the fork, substantially as described.

15. A loom containing the following instrumentalities, viz:—a lay; a series of warp detectors; an electro-magnet; its armature and a carrier therefor; a stopping mechanism for the loom controlled by the position of said armature-carrier; devices actuated by movement of the lay to periodically interrupt the circuit of the magnet; and a locking device to hold the armature-carrier in position while the circuit is thus interrupted, substantially as described.

16. A loom containing the following instrumentalities, a lay; a warp fork; and a stopping mechanism controlled thereby; a series of warp detectors; a co-operating fixed contact therefor; an electro-magnet on the lay, its armature, an armature-carrier therefor adapted to engage said fork and by movement of the lay to move the same; a locking device to hold said armature-carrier in position to avoid moving the fork; and a stationary abutment to release said armature-carrier from said locking device, substantially as described.

17. In a warp stop-motion for looms, a lay; a harness motion; two or more series of warp detectors; an electro-magnet its armature; and a switch controlled by said harness motion adapted by its position to place detectors of certain series in electrical connection with and to control said magnet, and a stopping mechanism for the loom controlled through said electro-magnet, substantially as described.

18. A loom containing the following instrumentalities, a lay; two or more series of warp detectors, stopping mechanism controlled thereby; a harness motion; a switch lever to determine by its position which of the series of detectors shall control the stopping mechanism; and devices intermediate said switch lever and harness motion to move the former by the latter, substantially as described.

19. In a warp stop-motion for looms, a shed-forming mechanism; a lay; and a series of reed dents carried thereby leaving reed spaces between them; and warp detectors located at or near each end of the said reed spaces to detect a broken warp thread either in the upper or lower plane of the shed, substantially as described.

20. A loom containing the following instrumentalities, a lay, and a lay cap, each having two guide plates; a series of reed dents clamped at each end between the said guide plates; and a series of warp detectors arranged between the said reed dents, at each end of the reed spaces substantially as described.

21. A loom containing the following instrumentalities, a lay, and a lay cap, each having two guide plates; a series of reed dents clamped at each end between the said guide plates and a series of sliding warp detectors

arranged between said reed dents and guided by said guide plates, substantially as described.

22. In a loom, the reed holding part thereof comprising two members contacting with each other at or near their opposite edges only; a series of reed dents clamped between said members; and a series of warp detectors arranged between the said reed dents, and clamping devices to effect the clamping of the reed dents between the said members substantially as described.

23. A loom containing a lay comprising two members *c*, *c'*; a strip c^5 having a bearing c^6; a series of reed dents clamped between the said strip and the member *c*; and a series of warp detectors arranged between the said reed dents, substantially as described.

24. A loom containing the following instrumentalities, a lay; a series of reed dents carried thereby; a series of sliding warp detectors arranged between said reed dents and provided with heads; a fixed contact to cooperate with heads on the said detectors; and electrically-actuated stopping mechanism controlled by the electrical engagement of said heads with said contact, substantially as described.

25. A loom containing the following instrumentalities, a lay; a series of reed dents carried thereby; a series of sliding warp detectors arranged between the said reed dents and having heads *d'* provided with beveled faces adapted to make electrical engagement with a fixed contact; and an electrically-actuated stopping mechanism controlled by said electrical engagement, substantially as described.

26. A loom containing the following instrumentalities, viz:—a lay; a series of reed dents carried thereby; a series of sliding warp detectors arranged between the said reed dents and acted upon and moved by the warp threads; springs to oppose such movement; and a stopping mechanism controlled by said detectors, substantially as described.

27. A loom containing the following instrumentalities, viz:—a lay; a series of reed dents carried thereby; a series of sliding warp detectors arranged between the said reed dents; and niches in the said detectors by which they may be moved, substantially as described.

28. In a warp stop motion for looms, a stopping mechanism, a series of warp detectors divided into groups, and mechanism, whereby one or more of the groups may be thrown into operative connection with the stopping mechanism, to operate, substantially as described.

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

OBERLIN SMITH.

Witnesses:
JAMES J. REEVES,
HUGH L. REEVES.