(No Model.) 6 Sheets—Sheet 1.

J. D. BUTLER.

SHUTTLE BOX OPERATING MECHANISM FOR LOOMS.

No. 456,550. Patented July 28, 1891.

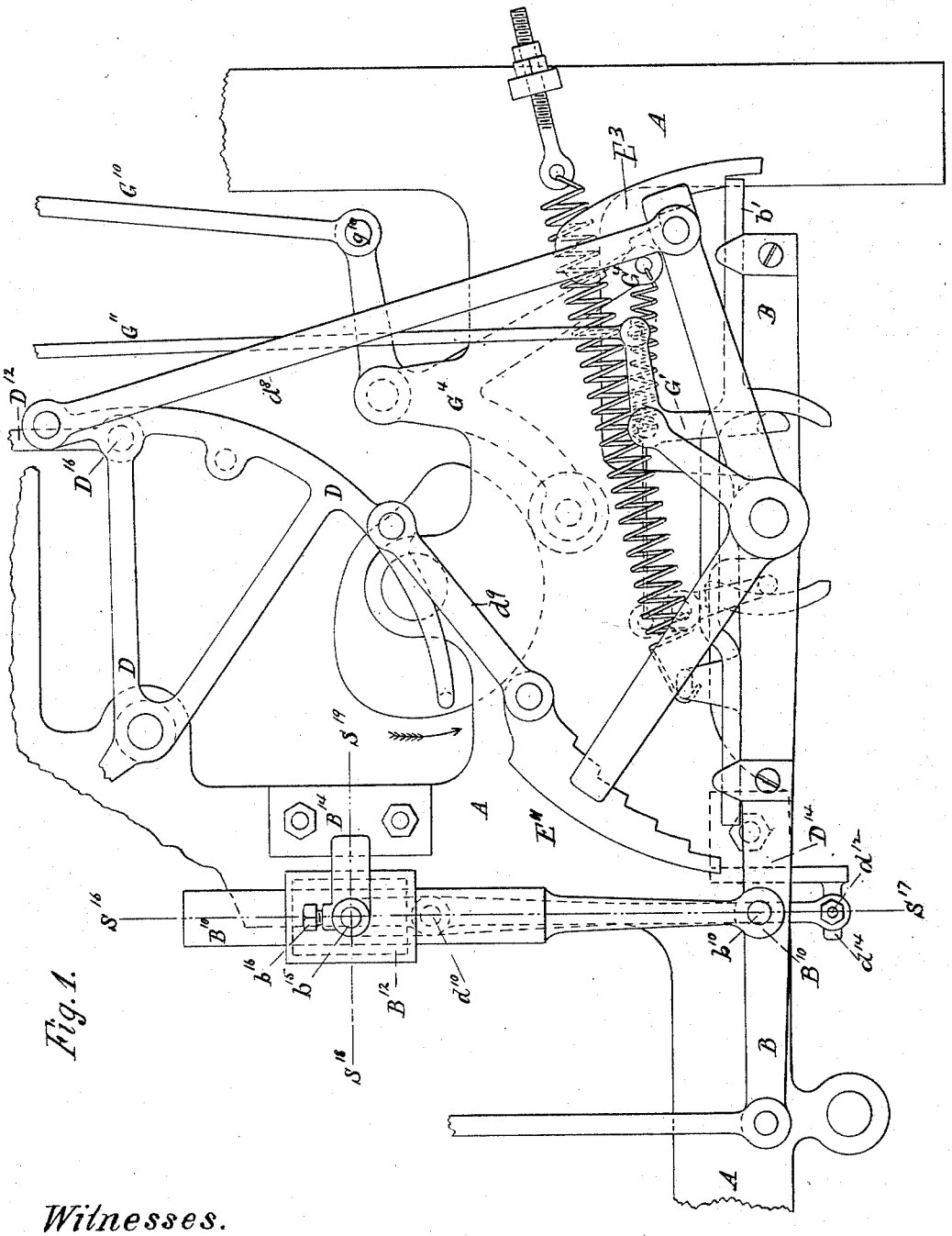


Fig. 1.

Witnesses.

Wm. P. Canning.

Fay H. Martin

Inventor.

James D. Butler.

(No Model.) 6 Sheets—Sheet 2.

J. D. BUTLER.

SHUTTLE BOX OPERATING MECHANISM FOR LOOMS.

No. 456,550. Patented July 28, 1891.

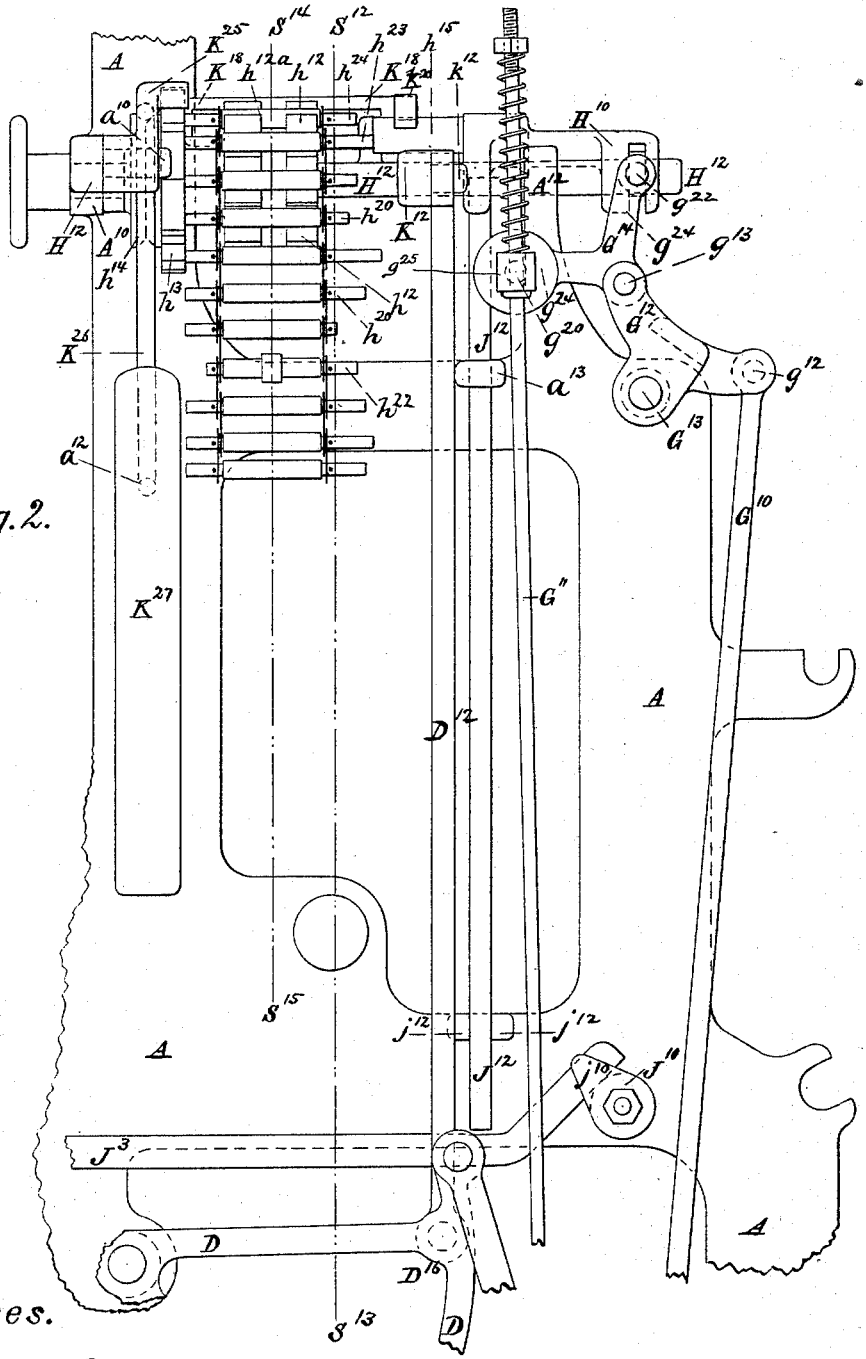


Fig. 2.

Witnesses.

Wm. P. Canning.

Fay H. Martin

Inventor.

James D. Butler.

(No Model.) 6 Sheets—Sheet 3.

J. D. BUTLER.

SHUTTLE BOX OPERATING MECHANISM FOR LOOMS.

No. 456,550. Patented July 28, 1891.

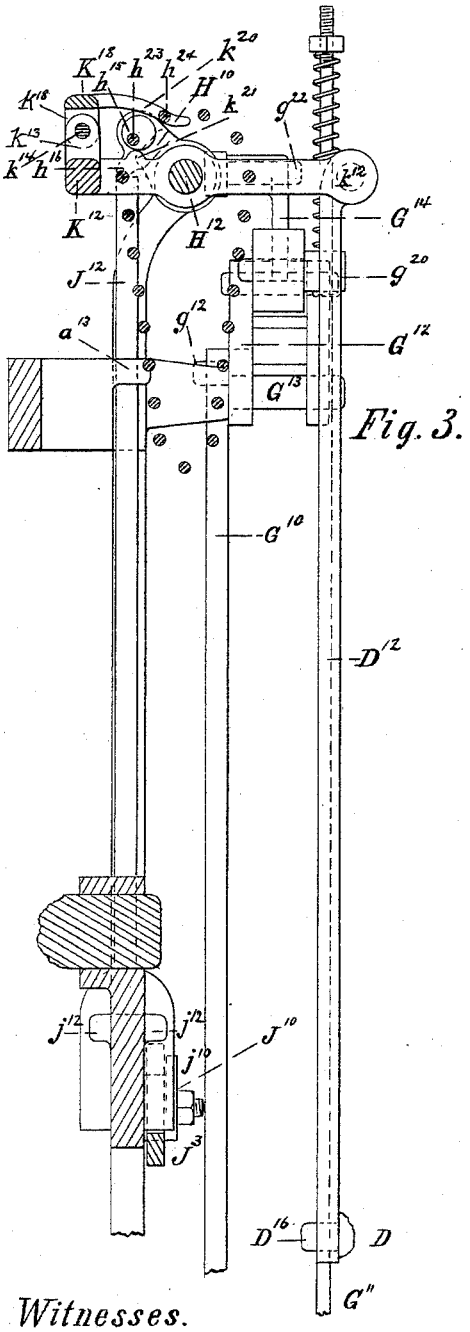


Fig. 3.

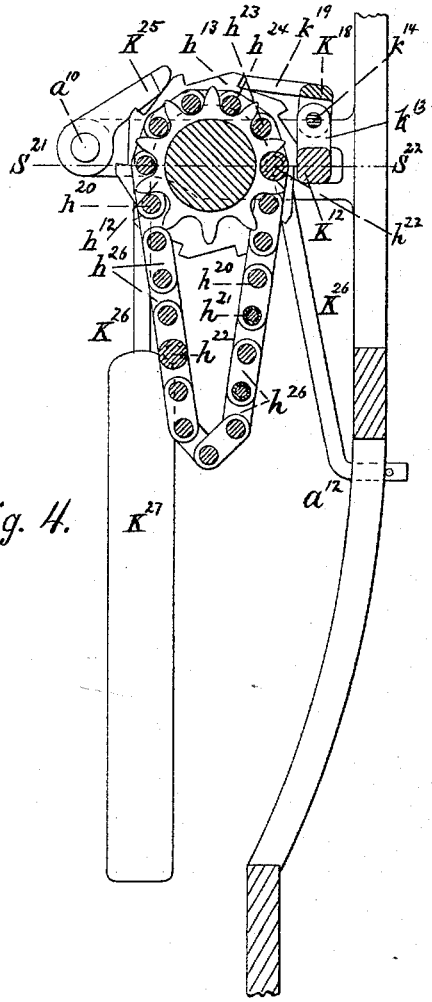


Fig. 4.

Witnesses.

Wm. P. Canning.

Fay H. Martin

Inventor.

James D. Butler.

(No Model.) 6 Sheets—Sheet 4.

J. D. BUTLER.

SHUTTLE BOX OPERATING MECHANISM FOR LOOMS.

No. 456,550. Patented July 28, 1891.

Fig. 6.

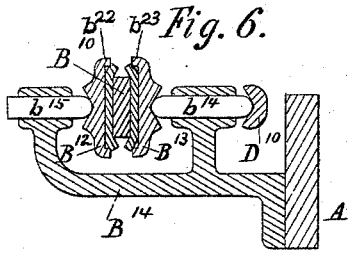


Fig. 7.

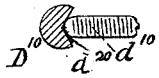


Fig. 10.

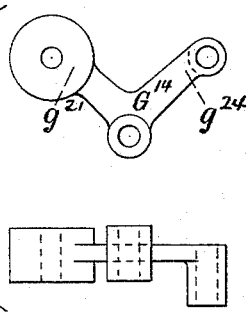
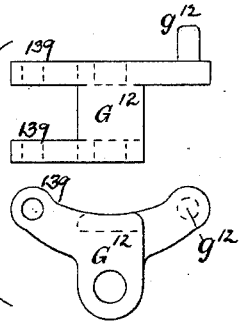


Fig. 8.



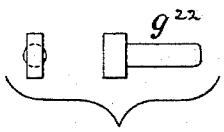


Fig. 11.

Fig. 5.

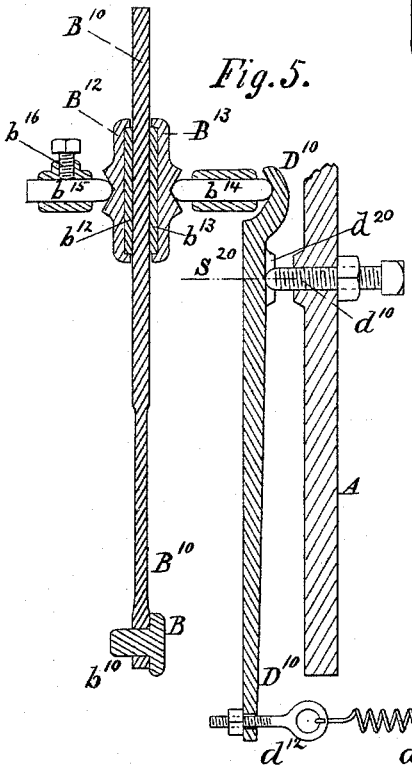
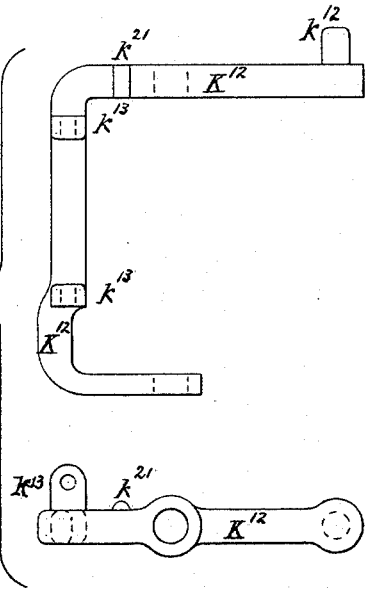


Fig. 17.



Witnesses.

Wm. P. Canning.

Fay H. Martin

Inventor.

James D. Butler.

(No Model.) 6 Sheets—Sheet 5.

J. D. BUTLER.

SHUTTLE BOX OPERATING MECHANISM FOR LOOMS.

No. 456,550. Patented July 28, 1891.

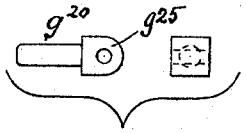


Fig. 9.

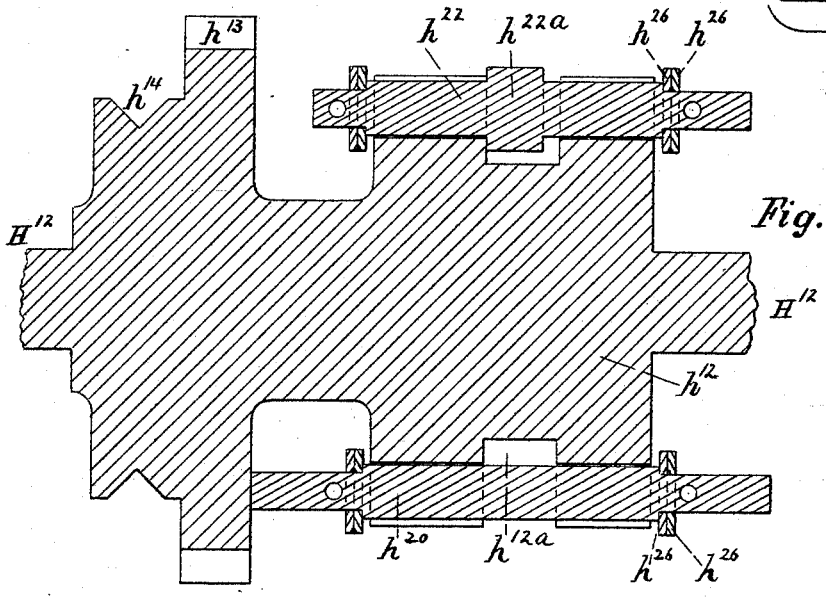


Fig. 13.

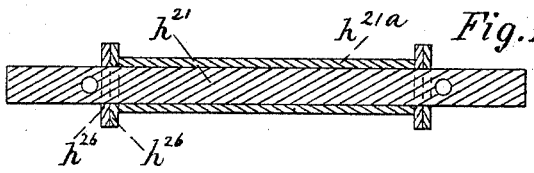


Fig. 14.

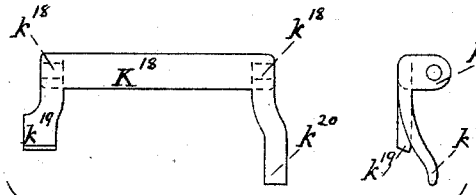


Fig. 15.

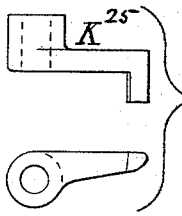
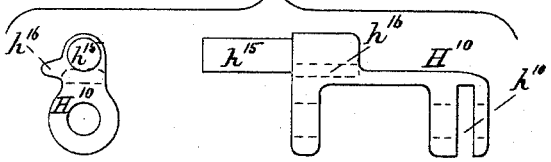


Fig. 16.

Fig. 12.



Witnesses.

Wm. P. Cuming.

Fay H. Martin

Inventor.

James D. Butler

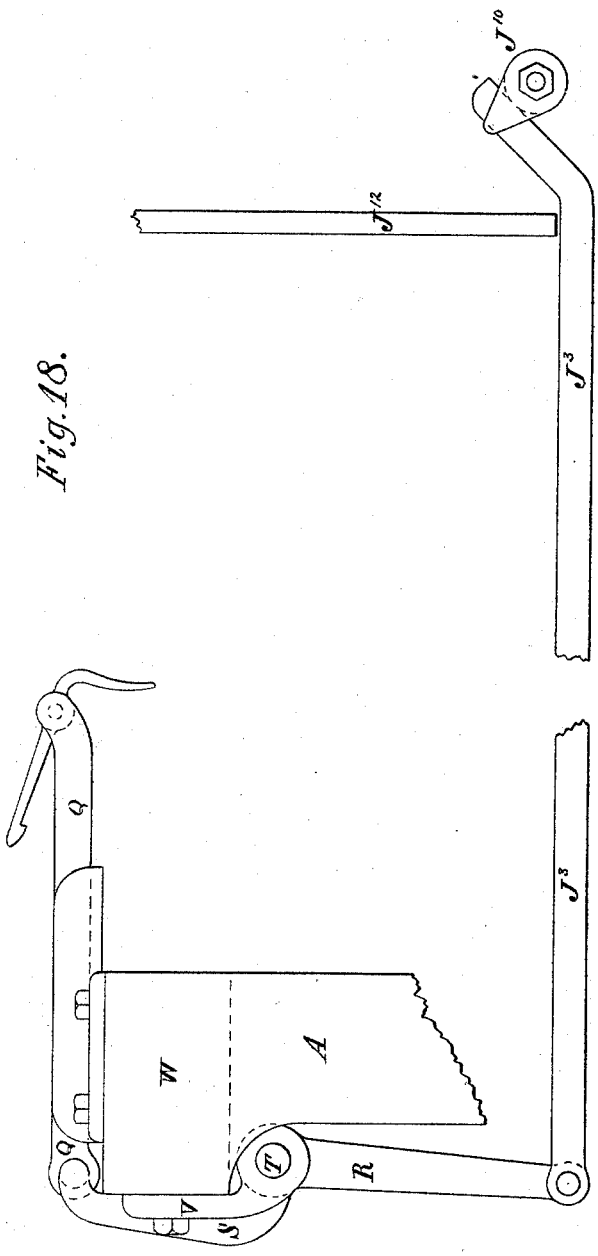
(No Model.) 6 Sheets—Sheet 6.

J. D. BUTLER.

SHUTTLE BOX OPERATING MECHANISM FOR LOOMS.

No. 456,550. Patented July 28, 1891.

Fig. 18.



Witnesses:
Percy R. Kenway.
Channing Whittaker.

Inventor.
James D. Butler.

UNITED STATES PATENT OFFICE.

JAMES D. BUTLER, OF LOWELL, MASSACHUSETTS.

SHUTTLE-BOX-OPERATING MECHANISM FOR LOOMS.

SPECIFICATION forming part of Letters Patent No. 456,550, dated July 28, 1891.

Application filed May 8, 1885. Serial No. 164,846. (No model.)

To all whom it may concern:

Be it known that I, JAMES D. BUTLER, of Lowell, in the county of Middlesex and State of Massachusetts, have invented an Improvement in Shuttle-Box-Operating Mechanisms for Looms, of which the following description, in connection with the accompanying drawings, is a specification.

My invention is an improvement on the class of loom shown in the United States Letters Patent granted to me August 19, 1884, and the parts herein used and also found in the loom described in the said patent will not be herein particularly described.

My invention consists, in part, in an improvement in the brake for the shuttle-box-shifting lever, and also includes the combination, in a loom, of a pattern-chain having bars of different lengths, and means controlled by the said bars to effect the engagement of devices by which to actuate the shuttle-box-shifting lever to place it in different positions, according as one or another of the shuttles is to be thrown, as will be hereinafter described.

Figure 1 is an elevation of a part of the side of the loom with a portion of my improvements applied thereto; and Fig. 2, an elevation of another part of the loom side above that represented in Fig. 1, showing the additional parts of my invention, there not being room on a sheet to show the whole side in one drawing. Fig. 3 is a section through line S^{12} S^{13} of Fig. 2 as seen from the left of Fig. 2; Fig. 4, a section through line S^{14} S^{15} of Fig. 2 as seen from the right of Fig. 2; Fig. 5, a section through line S^{16} S^{17} of Fig. 1 as seen from the right of Fig. 1, and Fig. 6 a section through line S^{18} S^{19} of Fig. 1 as seen from the top of Fig. 1. Fig. 7 is a partial section through S^{20} of Fig. 5. For the sake of clearness the pins and bolts are not shown in section like the other pieces in Figs. 5, 6, and 7. Fig. 8 is a plan and elevation of a double-armed lever; Fig. 9, a plan and an end view of a pin; Fig. 10, a plan and elevation of a lever; Fig. 11, a side and an end elevation of a pin; Fig. 12, a plan and an end view of the sliding and rocking frame to be described, having the pattern-feeling stud upon it; Fig. 13, a partial section through line S^{21} S^{22} of Fig. 4 as seen from the top of Fig. 4, and Fig. 14 a section through a pattern-chain bar. The scale to which Figs. 13 and 14 are drawn is three times as great as that of the other figures, for the sake of securing especial clearness. Fig. 15 is a plan and an end view of a frame having at one end a pawl for a ratchet-wheel; Fig. 16, a plan and elevation of a holding-pawl; Fig. 17, a plan and elevation of a rocking frame, and Fig. 18 an elevation of a filling-fork and of the bar J^3 of Fig. 2 and of the connections between this fork and bar.

In the several views the same letters refer to the same parts.

A is part of the loom side.

B is the shuttle-box lever, upon which is the pin b^{10}. (See Figs. 1 and 5.)

The bar B^{10}, constituting part of the brake for the shuttle-box-shifting mechanism, swings upon the pin b^{10} and slides between two plates B^{12} and B^{13}. These plates are shown with leather linings b^{12} and b^{13}, respectively, the faces of which are in contact with the bar B^{10}. These plates are held upon the ends of the pins b^{14} and b^{15}, respectively. The pin b^{15} is held by a set-screw b^{16} firmly in the hub of the yoke B^{14}, which yoke is bolted to the loom side A. The pin b^{14} slides in a hub of the yoke B^{14}, and its end opposite to the plate B^{13} is in contact with the upper end of the lever D^{10}.

Bearing against the center of the lever D^{10} is the end of a screw d^{10}, which screw is held in the loom side. At the bottom end of the lever D^{10} is an eyebolt d^{12}, which is connected with a stud d^{14} of a plate D^{14} by a spring d^{13}. The plate D^{14} is bolted to the loom side. The action of the spring d^{13} is, through the lever D^{10}, to press the pin b^{14} against the plate B^{13}, and thus to grip the bar B^{10} between the plates B^{12} and B^{13}. The swinging of the shuttle-box-shifting lever B moves the bar B^{10} between the plates B^{12} and B^{13}, pressed toward each other, as described, the friction exerted thereby acting as a brake for the lever B. The pin b^{15} has its rounded end bearing in the conical cup of the plate B^{12}, and similarly the pin b^{14} has one of its rounded ends bearing in the conical cup of the plate B^{13}. These plates B^{12} and B^{13} are therefore free to swing in any direction, so as to come into full contact with the faces of the bar B^{10} when pressure is applied between them and the bar, the flanges b^{22} and b^{23} of the plates B^{12} and B^{13},

respectively, which project beyond the leather linings b^{12} and b^{13} of these plates, keeping the bar B^{10} from swinging out from between the said plates B^{12} and B^{13}. The conical cup at the upper end of the lever D^{10} bears upon the rounded end of the pin b^{14}, and the V-shaped groove d^{20} in this lever (see also Fig. 7) bears upon the end of the screw d^{10}. By these two bearings the lever is kept in position. The joint of the lower end of the bar B^{10} upon the pin b^{10} should be sufficiently loose to allow the bar to swing somewhat in the direction of the length of the pin and thus come freely into place between the plates B^{12} and B^{13}.

Prior to this my invention, so far as I am aware, the custom has been to steady the movement of the shuttle-box-shifting lever by the application of a pad or shoe directly upon a part of the said lever itself. This method has been objectionable because it did not secure uniformity of bearing and of pressure by reason of the spring of the lever and its consequent trembling. In this my invention, as just described, the brake is composed of a bar B^{10}, which is jointed to the shuttle-box-shifting lever, and of friction-surfaces, (shown as plates,) which are clamped upon the said bar and are so mounted or held that they may rock and tip, so as to come to a full bearing upon the bar with uniform pressure, and thus give a reliable and constant frictional resistance to the movement of the bar in the direction of the length of the bar. Freedom of movement and self-adjustment of the friction-plates in directions other than that of the length of the bar is best provided for by the use of pins in connection with these plates in the manner I have described; but I desire to have it understood that the one essential feature of this invention, so far as it applies to the brake mechanism for the shuttle-box-shifting lever, lies in the employment of surfaces which are pressed upon the bar jointed to and moved by the said lever and are kept from moving in the direction of the length of the said bar.

In my previously-patented loom the lever G^4 has a plain arm, for which I now substitute an arm having at its end a pin g^{10}. This pin is connected with the pin g^{12} on the lever G^{12} (see Figs. 1, 2, 3, and 8) by the rod G^{10}. The lever G^{12} turns upon the stud G^{13}, which is fast to the loom side. The rod G^{11}, which at its lower end swings upon the stud at the end of the elbow-lever G′, passes at its upper end through a hole in the head g^{25} of the pin g^{20} (see Figs. 2, 3, and 9) instead of, as in my previously-patented loom, through an ear in a sliding frame. This pin g^{20} turns in the hole which is in the arm g^{21} of lever G^{14}. The lever G^{14} swings upon a pin g^{13}, which passes through the ears g^{13a} of the lever G^{12}. The pin g^{22} (see Figs. 2, 3, and 11) turns in the hole in the arm g^{24} of the lever G^{14} and has its flattened head sliding in the space h^{10} of the sliding and rocking frame H^{10}. (See Figs. 2, 3, and 12.) This frame H^{10} is supported upon the shaft H^{12} and can both swing and move lengthwise upon this shaft. By the swinging of the frame the stud h^{15} may move with the pattern-bar, with which it is in contact, when the pattern-chain is carried along by the turning of the chain-wheel, while the length of the bar determines the position of the frame in the direction of the length of the shaft H^{12}, and therefore of the pin g^{22} and the lever G^{14}, independently of any rocking movement given to the frame. The shaft H^{12} has the enlargements forming the pattern-chain wheel h^{12}, (see Figs. 2, 4, and 13,) the ratchet-wheel h^{13}, and the grooved wheel h^{14}. It turns in the bearings A^{10} and A^{12}, which are fast upon the loom side.

The swinging frame D, the connecting-rods d^8 and d^9, the segmental heads E^{11} and E^3, and the engaging device, shown as a bar b', are all as in my previously-patented loom, the shuttle-box lever being moved positively in one or the other direction, according as it is, by the pattern-surface and the parts actuated by the said surface, brought into operative connection with either the one or the other of the segmental heads E^{11} or E^3.

The swinging frame D is in my present invention provided with a fixed stud D^{16}. Upon this stud swings the lower end of the rod D^{12}, the upper end of which swings upon the pin k^{12} of frame K^{12}. (See Figs. 2, 3, and 17.) This frame K^{12} swings upon the shaft H^{12}, having motion imparted to it from the frame D, through the rod D^{12}, just referred to. Through the ears k^{13} of frame K^{12} a pin k^{14} (see Figs. 3 and 4) passes, and upon this pin, which passes also through the ears k^{18} of the frame K^{18}, (see Figs. 2, 3, 4, and 15,) this frame K^{18} swings. At one end of the frame K^{18} is a pawl k^{19} and at the other an arm k^{20}, which will be referred to hereinafter. The pawl works upon the ratchet-wheel h^{13}, and through it moves the pattern-chain wheel h^{12} intermittently, and also the chain itself, which is carried upon this wheel. Upon a pin a^{10}, which is fixed to the loom side, swings a pawl K^{25}, (see Figs. 2, 4, and 16,) which catches upon the ratchet-wheel h^{13} to hold it from turning backward. A weight K^{27} is suspended by a cord K^{26}, which passes over the grooved wheel h^{14} and is fastened at one end to the loom side at a^{12}. This cord acts as a brake upon the wheel and prevents the pattern-chain from going too far when moved by the pawl k^{19}.

The pattern-chain consists of a series of bars h^{20} h^{21} h^{22}, &c., connected with each other by links h^{26}, and is made up with the bars projecting different distances to the right, according to the pattern of the cloth woven in the looms. Split pins put through the holes in the pattern-bars keep the links from coming off the bars. Three different styles of bars are shown in the pattern-chain. The bar h^{20} has the part between the links of a size suitable to fit into the spaces between

the teeth in the pattern-chain wheel, and the ends of the enlarged parts form shoulders, against which the links h^{26} bear. The bar h^{21} is of the same size throughout, and upon it is a tube h^{21a}, which serves the same purpose as the enlarged part of the bar h^{20}. The bar h^{22} is like bar h^{20}, with the addition of the collar h^{22a}. The projecting stud h^{15} of the sliding and rocking frame H^{10} is brought into contact with the end of each of the pattern-chain bars as the chain is moved to bring these bars in succession opposite the said stud.

In this loom, as in my previously-patented one referred to, the position of the engaging device determines which of the different shuttles shall at any given time be operated in the loom, and the position of this engaging device depends upon the length of the pattern-chain bar. The lever G^{12} has a uniform movement derived from the rod G^{10} and the lever G^4. When, therefore, the pin g^{13} in this lever G^{12} is moved to the left hand, it always stops at the same point, and while it remains there the position of the lever G^{14} and of the rod G^{11} and the lever G′ are determined by the position in the direction of the length of the shaft H^{12} of the frame H^{10}, which is in turn determined by the length of the pattern-bar, against the end of which the stud h^{15} of the said frame bears, as already explained. The levers G′ and G^{14} should be of such size and proportion that their own weights, united with that of the rod G^{11}, which connects them, will press the pin g^{22} in the arm G^{14} with sufficient force against the frame H^{10} to slide the latter to the left until it is stopped by the pattern-chain bar, as described, against which the stud h^{15} shall strike. As therefore the projecting length of the particular pattern-bar determines the position of the frame H^{10} in the direction of the length of the shaft H^{12}, and through it that of the rod G^{11} and the engaging device, it is obvious that whichever of the shuttles in the change shuttle-box shall be thrown is dependent upon the length of the pattern-bar which is at the time in contact with the stud h^{15}, each shuttle having its corresponding bars in the pattern-chain. If the bar of the pattern-chain against which the stud h^{15} strikes be like h^{20} or h^{21}, the movement of the frame H^{10} will stop when the left-hand end of the bar strikes against the face of the ratchet-wheel h^{13}. In this case the projection of the bar to the right will be determined by the total length of the bar. If the bar be like h^{22}, the movement of the frame will stop when the left-hand face of the collar h^{22a} strikes against the side of the groove h^{12a} made in the pattern-chain wheel. In this case the projection of the bar to the right will be fixed by the length of the bar from its right-hand end to the left-hand side of the collar h^{22a}. In any case the projecting length of the pattern-bar determines the position of the change shuttle-box.

The links h^{26}, by which the different bars of the pattern-chain are connected, and the pins put through the bars for holding the links on the bars, are such as have been employed in pattern-chains heretofore in common use; but upon one or more of the bars of such pattern-chains wheels have been placed, according to the requirements of the pattern of cloth to be woven. These pattern-wheels have come in contact with suitable levers or bars and have exerted pressure upon them in a direction transverse to the lengths of the pattern-chain bars. The improvement I introduce in such chains by making the bars of different lengths instead of putting wheels upon the bars, according to the shifting of the change shuttle-boxes which may be required in the weaving of any particular pattern, is of decided value in reducing the weight and complication of the chain. It is obvious that when plain pattern-bars (like h^{20} or h^{21}, and not having a fixed collar like h^{22a} on the bar h^{22}) are used the ends of all the bars which are on the edge of the chain next to the face of the wheel h^{13}, against which these ends bear, must all come even with each other, or, in other words, must all lie in the same plane perpendicular to the direction of the lengths of the bars, and that the other edge of the chain must take all the irregularity due to the different lengths of the bars used.

For the weaving of certain patterns a pattern-chain known as a "twisted" chain is in common use, it being made by taking a certain length of common pattern-chain, the ends of which are not connected with each other, and fastening one end of each of the two lines of links which hold the two ends of each of the pattern-bars, not, as in the common straight pattern-chain, to the opposite end of the same line, but to the opposite end of the other line.

I need not state the advantages in or the limitations to the use of a twisted chain, since my invention offers nothing new in this direction; but in any twisted chain each bar of the chain comes into place on the chain-wheel first with one end to the right and next with the other end to the right, the same end appearing at the right only every other time that the bar rests upon the wheel and the other end the alternate times.

The pattern-bars h^{22}, already described, are made with the collar h^{22a}, in order that they may be used in a twisted chain with either end to the right or left. In this bar h^{22} there are two independent working lengths, one being measured from one end of the bar to the face of the collar h^{22a} which is opposite to this end, and the other from the other end of the bar to the other face of the collar. In many patterns the bars h^{20} and h^{21} will, however, answer as well as h^{22} and are cheaper than it; but in practice in a mill having occasion to keep a supply of the bars h^{22} for use in certain exigencies it will be often convenient to utilize these bars and to mix them at

random with bars like h^{20} and h^{21} on the same chain. When the swinging of the lever G^{12} carries the pin g^{13} to the right, the rod G^{11} falls until it brings up at its lowest point. When the rod can fall no farther, the continued movement of the lever G^{12} carries the frame H^{10} to the right and withdraws the stud h^{15} from the pattern-chain and allows the latter to be moved one bar farther along.

The pattern-chain is often so long and heavy that it is difficult to move it as quickly as the transfer from the action of one of the bars to that of the adjoining one has to be made. It has been already explained that in my arrangement the action of the different chain-bars to determine the shifting of the shuttle-boxes is entirely through the stud h^{15} on the frame H^{10}, and that the swinging of the frame does not disturb this action. It is therefore obvious that the swinging of the frame to bring the stud opposite to any pattern-bar serves the same purpose as the moving of the chain when the frame does not swing, and it is plain that the light and compact frame can be moved much more easily and quickly than a long and heavy pattern-chain. In the regular working of the loom the stud h^{15} rests upon the rib k^{21} of the frame K^{12}. As this frame swings so that the rib k^{21} moves downward, the weight of the frame H^{10} keeps the stud h^{15} against this rib. As the rib k^{21} rises the stud h^{15} will be raised by it. Inasmuch as the frame K^{12} carries the frame K^{18}, which has on it the pawl k^{19}, it follows that when the said pawl acts upon the ratchet-wheel to move it and the pattern-chain forward the stud h^{15} and the pattern-chain bar opposite to the said stud move together to keep in line with each other. When the frame K^{12} makes the return-stroke, the pattern-chain remains at rest and the stud h^{15} swings so as to come opposite to the next succeeding bar of the chain.

I have provided additional means to swing the frame H^{10} forward, so that should the filling be broken the stud h^{15} will again come against the pattern-bar with which it has last been in contact and the chain be arrested in its movement while the loom is stopping, in order that when the filling has been made right in the shuttle and the loom again started the proper thread shall be woven in. This swinging of the frame and lifting of the pawl are accomplished as follows, viz: When the filling breaks, the bar J^3 is moved to the right (see Figs. 2 and 18) by the ordinary filling-fork-sliding bar Q. The connection between J^3 and Q is through the two arms S and R and the shaft T, to which these arms are fastened. This shaft swings in bearings V, which are bolted to the loom breast-beam W. The right-hand end of the bar J^3 is inclined, as shown, and the inclined part rests upon the hub J^{10}, which is bolted to the loom side and has a wing j^{10} to keep the bar in place. When this bar J^3 is moved to the right, it rises and strikes against the end of and raises the upright bar J^{12}. This bar J^{12} is at its foot forked, so as to bear upon both sides of the loom side, and is held between the ears j^{12}, which are on the loom side. Near its upper end this bar passes through a hole in the ear a^{13} of the loom side. Over the end of the bar is the rib h^{16} of the frame H^{10}. If the frame H^{10} is in such a position that the rib h^{16} is at its lowest point, the raising of the bar J^{12} to its highest position swings the frame H^{10}, so as to carry the stud h^{15} from opposite the pattern-chain bar h^{23} (see Fig. 3) to opposite the bar h^{24}, from which latter position it had in the regular working of the loom but just come. The arm k^{20} of the frame K^{18} is over the stud h^{15}, and when this stud is raised by the bar J^{12} from the rib k^{21} of the frame K^{12} it lifts the arm k^{20}, so that the pawl k^{19} on the same frame K^{18} is raised clear of the teeth of the ratchet-wheel h^{13}. In this manner the breaking of the filling-yarn causes the stud h^{15} to swing opposite the proper pattern-chain bar and at the same time arrests the progress of the pattern-chain. There is necessarily in the working of the loom so little time between the action of the filling-stop and the shifting of the change shuttle-box that it would be entirely impracticable to move the pattern-chain backward with sufficient rapidity to correct the disturbance produced by the breaking of the filling; but the little frame H^{10} is easily thrown forward in ample time. The advantages in the use of this swinging frame H^{10}, especially as connected with the filling-stop motion, over that of other devices now employed for a similar purpose, are very decided.

In this my invention it will be seen from the foregoing description that the pattern-chain has only a forward movement, that the horizontally-extended ends of the pattern-chain bars constitute the variable surface which determines the selection of the shuttle-boxes, and that a single stud carried by a sliding frame is made to meet the end of the pattern-chain bar then in operative position, and in such condition the pattern-chain is moved forward, the stud remaining in contact with the end of the said bar until the shuttle is thrown, after which it is withdrawn from contact with the pattern-chain bar and the frame carrying the stud is swung back to bring the said stud opposite the end of the next succeeding bar of the chain, when, in case the shuttle-thread is unbroken, the said stud is moved longitudinally into contact with the end of the said bar, while, however, if the filling has been broken the frame carrying the stud h^{15} is thrown forward and the stud, striking the arm k^{20}, disengages or raises from operation the pawl k^{19}, which moves the pattern-chain, the said frame being swung forward far enough, as described, to again bring the stud opposite the end of that bar of the pattern-chain which has not been represented in the cloth by the proper filling.

I completely obviate the necessity of reversing the movement of the pattern-chain

to compensate for broken filling, and instead of reversing the chain I give to the stud h^{15}, through the action of the filling-stop-motion mechanism, a supplementary forward movement to again place it opposite the bar against which it rested before the filling was broken.

The correction of the disturbance caused when the filling breaks by swinging the pattern-feeling stud h^{16}, carried on a light frame in order to bring the appropriate pattern-bar and the stud opposite to each other in the direction of the lengths of said stud and pattern bar, I believe to be entirely novel and regard it as constituting one of the most important features of my invention.

It will be seen that in my invention the pattern-chain bars are of different lengths, each bar corresponding to a step shown as made in a head through which the box-shifting lever is moved, each step representing a certain cell of the shuttle-box. This is an essential feature of this part of my invention, irrespective of the particular construction of the step-engaging device, through which the lever B is moved about its fulcrum.

I claim—

1. The shuttle-box-shifting lever, the vibrating heads, and means to move the said heads, the pattern-chain having bars of different lengths, means to move the pattern-chain, the frame having the stud h^{15}, and means to move the said frame to place the said stud against the end of one of the said bars prior to moving the said shuttle-box-shifting lever, combined with an engaging device between the said lever and vibrating heads and with connections between the said engaging device and the frame carrying the stud h^{15}, to operate substantially as described.

2. The pattern-chain having bars of different lengths and means to move the chain, combined with a sliding frame provided with a stud to co-operate with the ends of the said bars and with means to move the said frame, as and for the purpose set forth.

3. The shuttle-box pattern-chain having bars of different lengths, means to move the said chain, the frame having a stud h^{15} to co-operate with the ends of the said bars, and means to move the said frame, combined with the filling-stop mechanism and with a bar under the control of the said filling-stop mechanism to give to the said frame a rocking movement, which places the stud h^{15} again opposite that bar of the pattern-chain with which the said stud was last in contact prior to the operation of the said filling-stop mechanism, substantially as described.

4. The pattern-chain, the pattern-chain wheel and shaft, and the ratchet-wheel, the sliding and rocking frame having the stud h^{15} and the pawl-carrying frame K^{18}, combined with the bar J^{12} and means to actuate it to throw the pawl of the said pawl-carrying frame out of connection with the ratchet-wheel of the pattern-chain mechanism, as set forth.

5. The change shuttle-box lever and the slide bar b' carried on it, the lever G', the rod G^{11}, the levers G^{11} and G^{12}, and means to move the lever G^{12}, combined with the frame H^{10} and with the pattern-chain and the means to operate it, substantially as described.

6. The pattern-chain, the wheel h^{12}, the ratchet-wheel h^{13}, the shaft H^{12}, the frame K^{18}, having the pawl k^{19} and the arm k^{20}, and the frame K^{12} and means to move the said frame, combined with the frame H^{10}, having the stud h^{15}, and means to move it lengthwise upon the said shaft, whereby the pattern-chain and the stud h^{15} are moved in proper relation to each other, substantially as described.

7. The segmental heads E^{11} and E^3 and means to operate them back and forth, the shuttle-box lever B, the sliding bar b', the frame H^{10}, having the stud h^{15}, means to connect the said bar with the said frame, and means to move the frame lengthwise upon the shaft H^{12}, combined with the pattern-chain having bars of different lengths and with means to operate said chain, whereby through the engagement of the bar b' with steps upon the heads E^{11} and E^3 the position of the shuttle-box lever is controlled by the lengths of the pattern-chain bars, substantially as described.

8. The bar J^3, means to move it, the hub J^{10}, bar J^{12}, frame H^{10}, frame K^{18}, having the arm k^{20} and the pawl k^{19}, and the frame K^{12}, and means to move it, combined with the ratchet-wheel h^{13}, the pattern-chain wheel h^{12}, and the pattern-chain, substantially as described.

9. The bar J^3, means to move it, the hub J^{10}, the bar J^{12}, and the frame H^{10}, combined with the pattern-chain, whereby the stud h^{15} of the said frame H^{10} is, when the filling has given out, moved opposite to a given bar of the pattern-chain, substantially as described.

10. A pattern-chain bar h^{22}, having a collar h^{22a}, combined with a pattern-chain wheel h^{12}, having a groove h^{12a}, substantially as described.

11. The shuttle-box-shifting lever and its loosely-attached bar, combined with friction-surfaces to firmly clamp the said bar, substantially as described.

12. The shuttle-box-shifting lever and its loosely-attached bar, combined with friction-surfaces between which the said bar is clamped, and with means to support the said friction-surfaces to permit them to rock or tip, substantially as described.

13. A shuttle-box lever and means to move it, and a bar B^{10}, combined with the plates B^{12} and B^{13}, the fixed pin b^{15}, and the sliding pin b^{14}, and with means to press the last-named pin against the plate B^{13}, substantially as described.

14. In a loom, the following instrumentalities, viz: a shuttle-box-shifting lever, a pattern-chain having bars of different lengths,

means to move the pattern-chain, a frame having a stud h^{15}, means to move the said frame and place the said stud against the end of that one of the said pattern-chain bars which is to determine the next shuttle to be used, vibrating heads, and a co-operating engaging device between the said heads and the shuttle-box lever, adapted to engage one or another of a series of steps, and means intermediate to the stud-carrying frame and the said engaging device to determine the position of the said lever, substantially as described.

JAMES D. BUTLER.

Witnesses:
CHARLES C. HEDRICK,
SUMNER B. SARGENT.