June 18, 1940. J. LUCAS 2,204,606

LOOM

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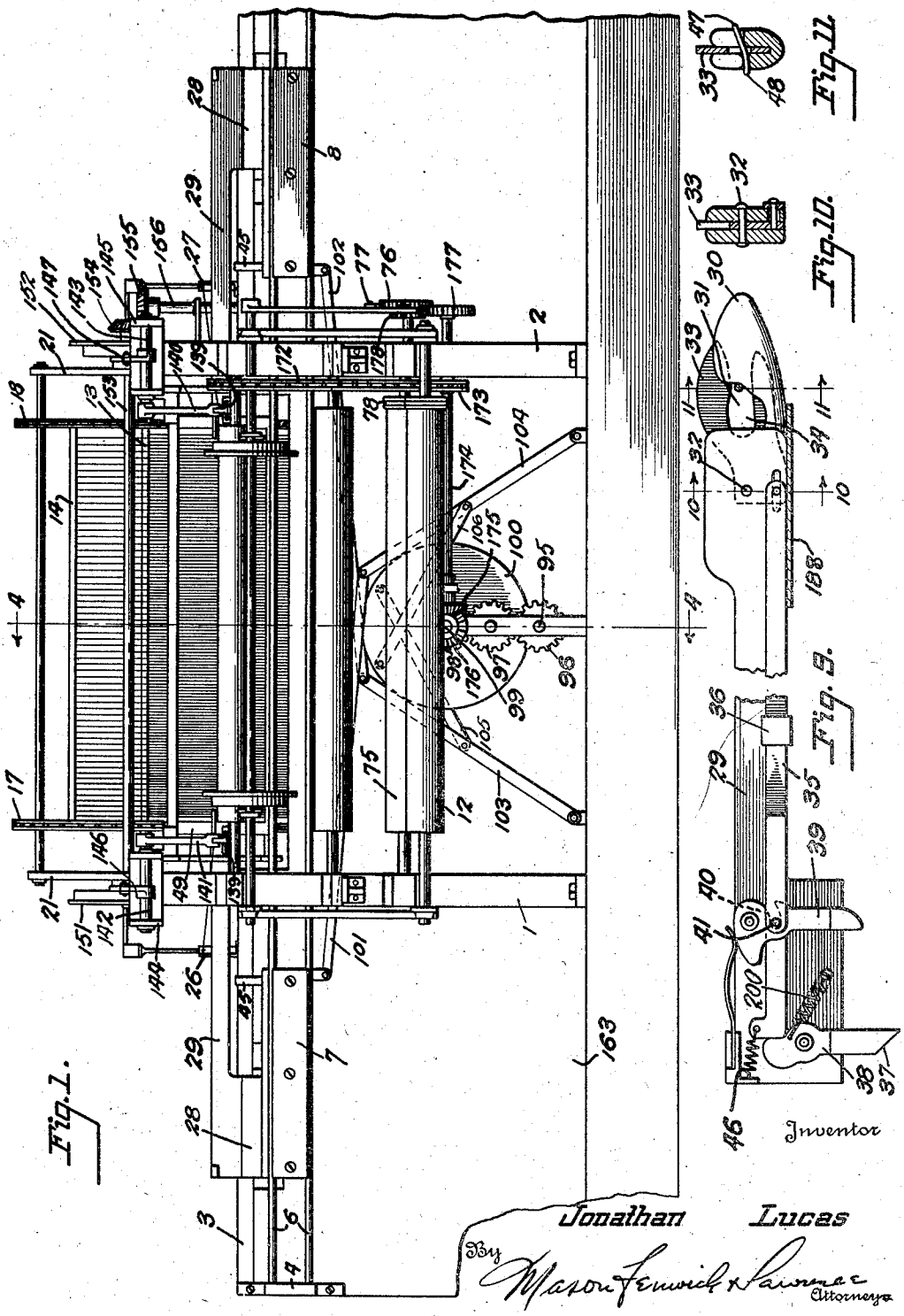

Fig. 1.

Fig. 11.

Fig. 10.

Fig. 9.

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June 18, 1940. J. LUCAS 2,204,606

LOOM

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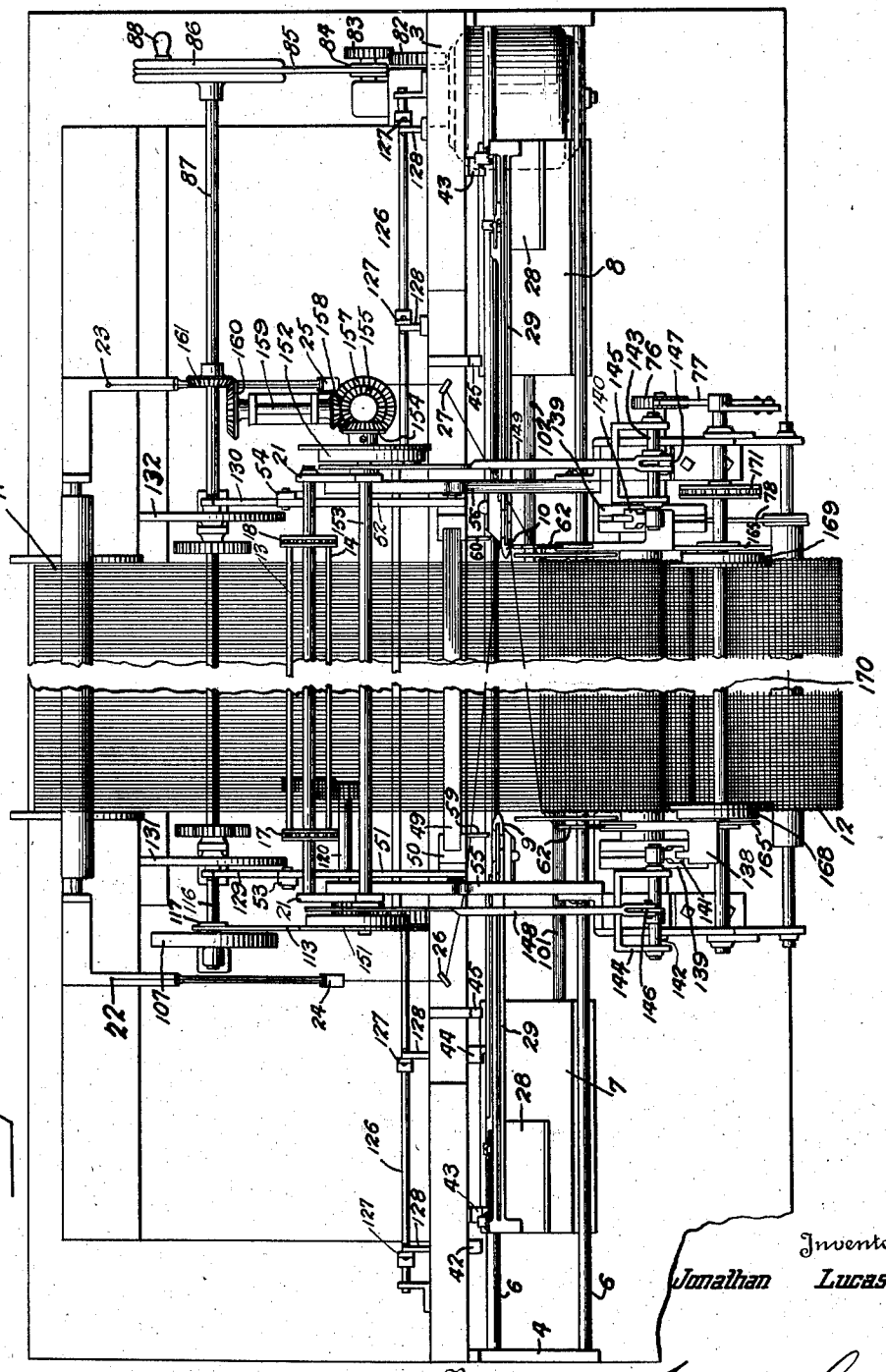

Fig. 2.

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June 18, 1940. J. LUCAS 2,204,606

LOOM

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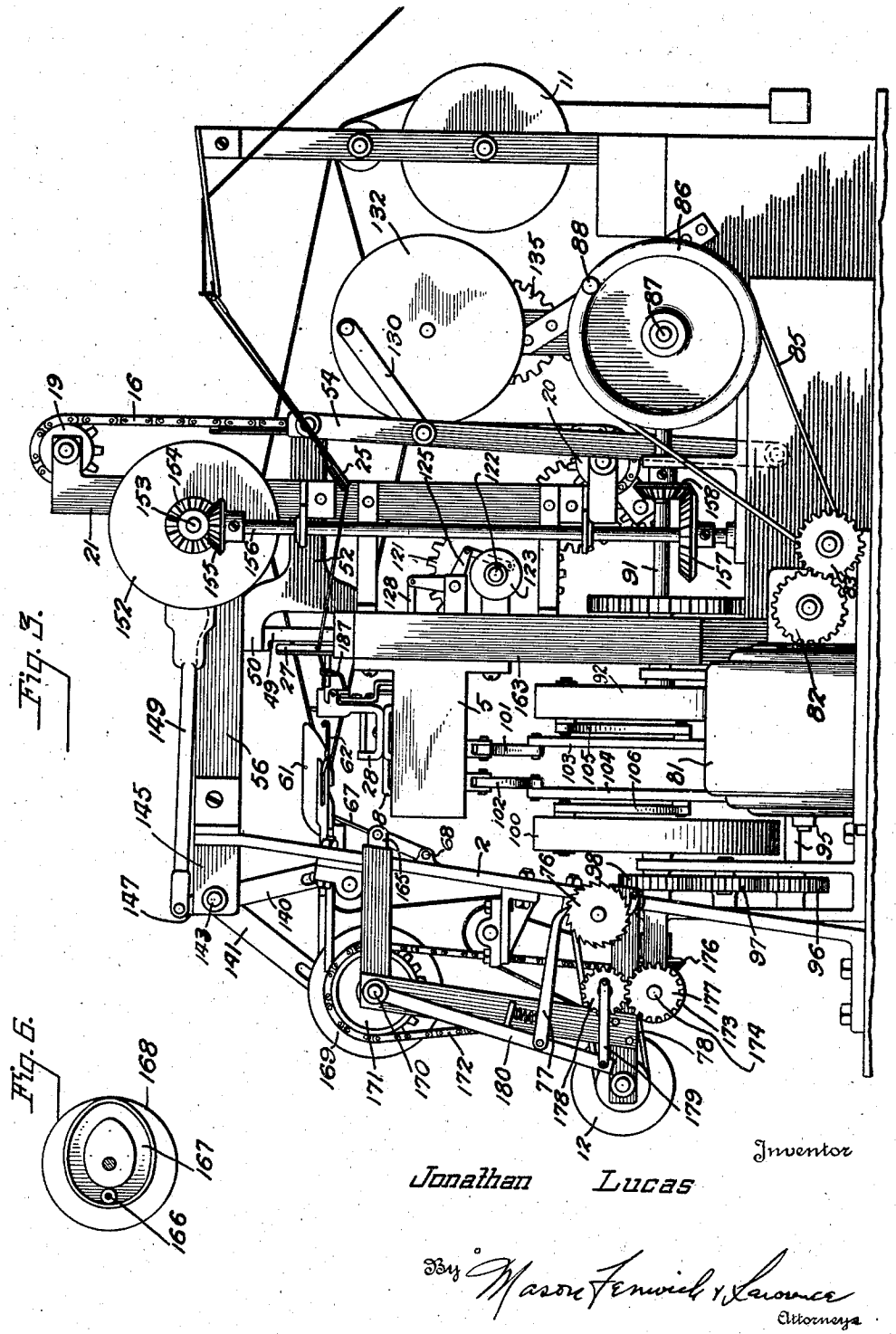

Fig. 5.

Fig. 6.

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June 18, 1940. J. LUCAS 2,204,606

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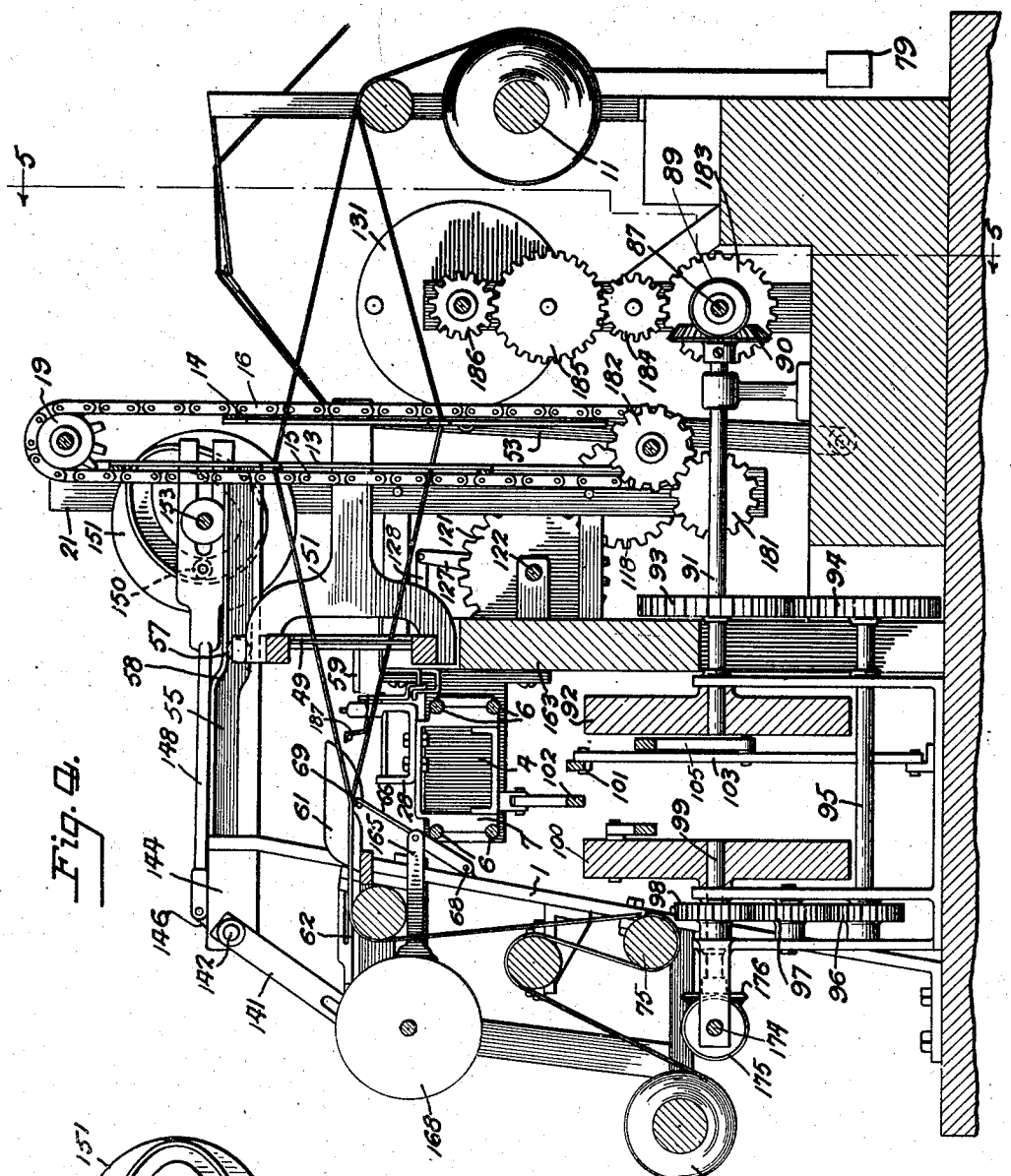

Fig. 4.

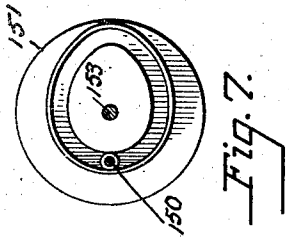

Fig. 7.

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June 18, 1940. J. LUCAS 2,204,606

LOOM

Filed Sept. 29, 1938 8 Sheets-Sheet 5

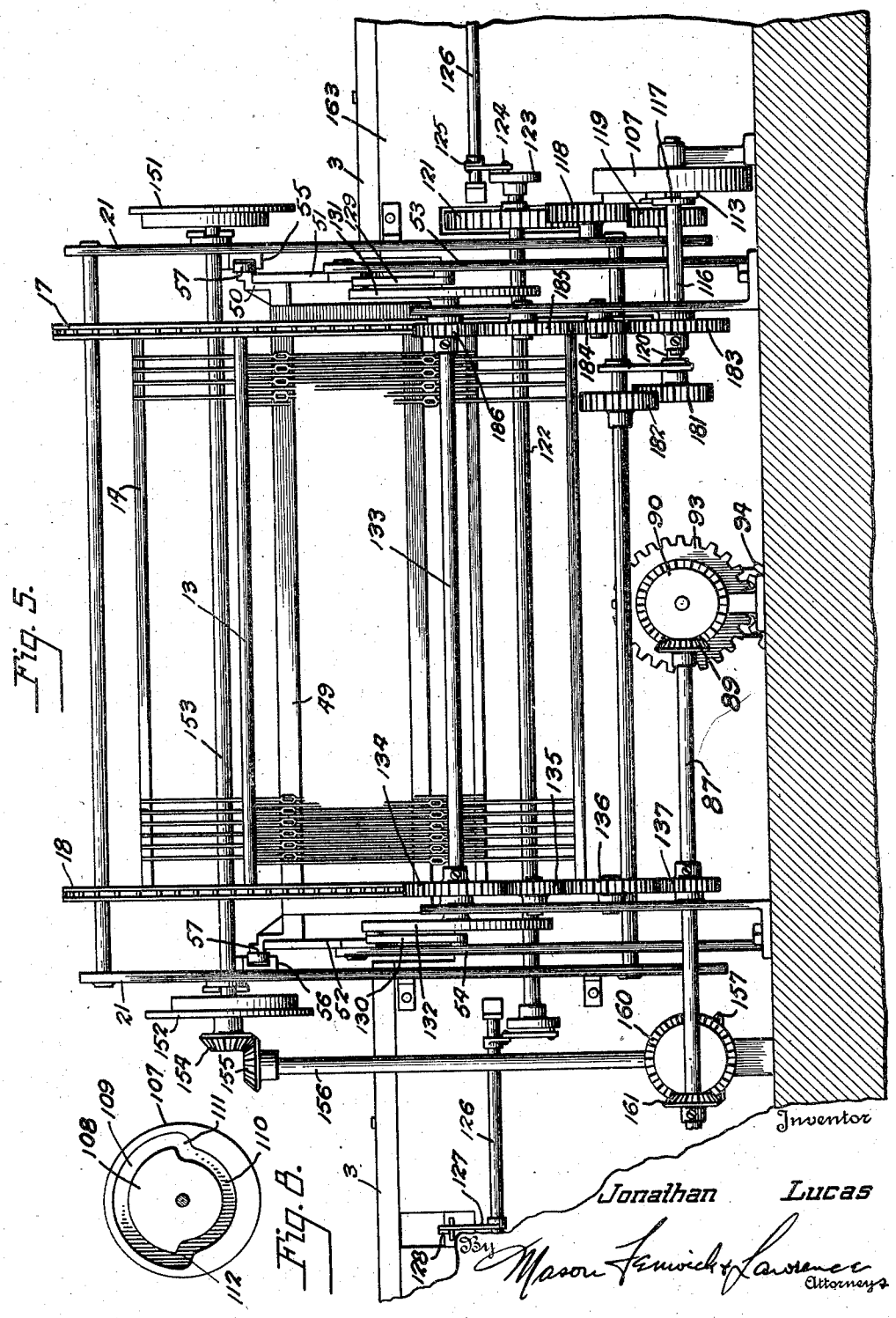

Fig. 5.

Fig. 8.

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June 18, 1940. J. LUCAS 2,204,606

LOOM

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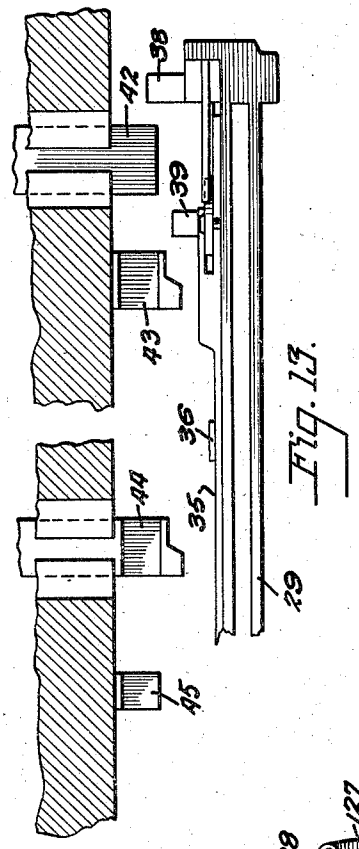

Fig. 13.

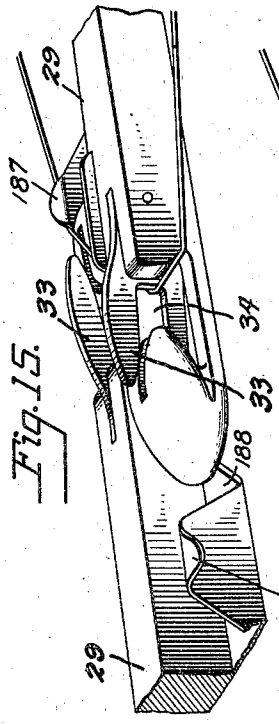

Fig. 15.

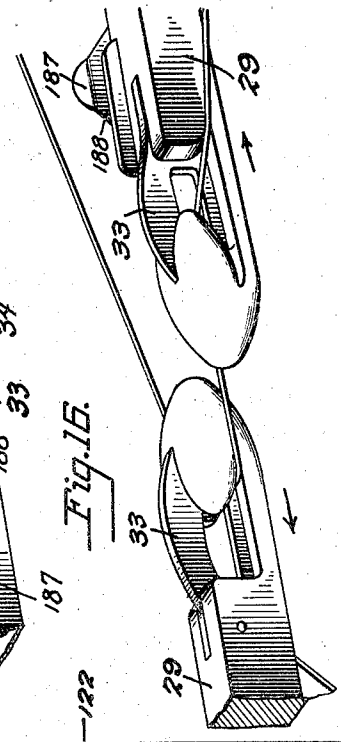

Fig. 16.

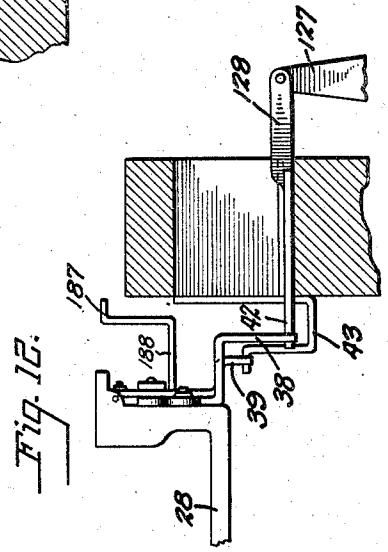

Fig. 12.

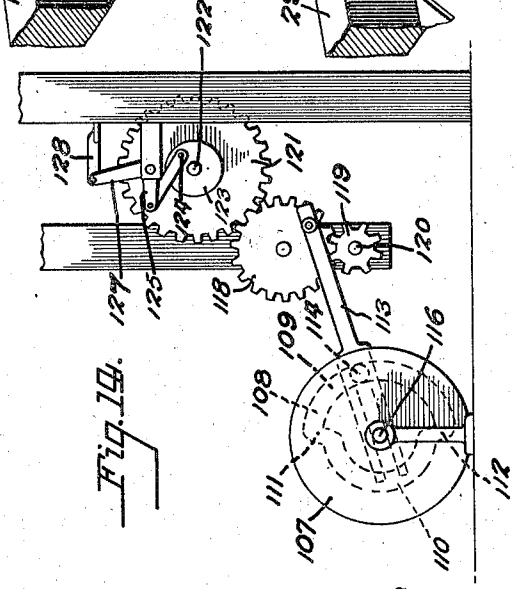

Fig. 14.

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June 18, 1940. J. LUCAS 2,204,606

LOOM

Filed Sept. 29, 1938 8 Sheets-Sheet 7

Fig. 18.

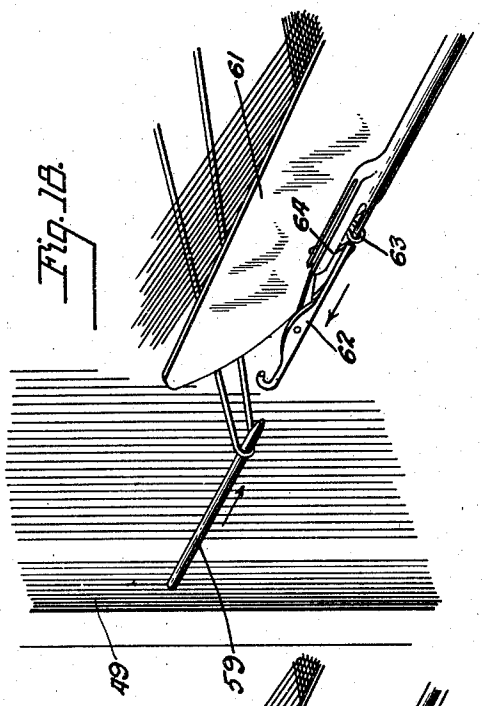


Fig. 20.

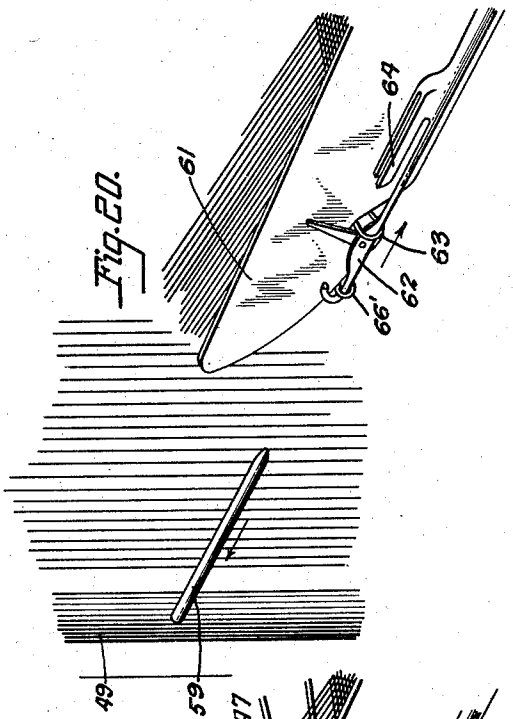


Fig. 17.

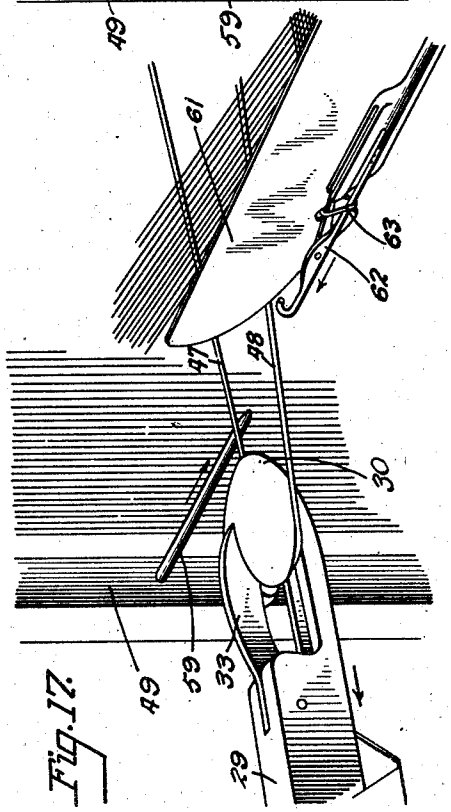
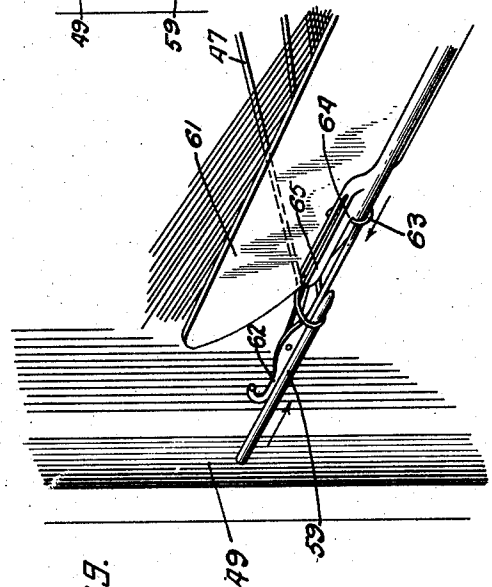


Fig. 19.



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June 18, 1940. J. LUCAS 2,204,606

LOOM

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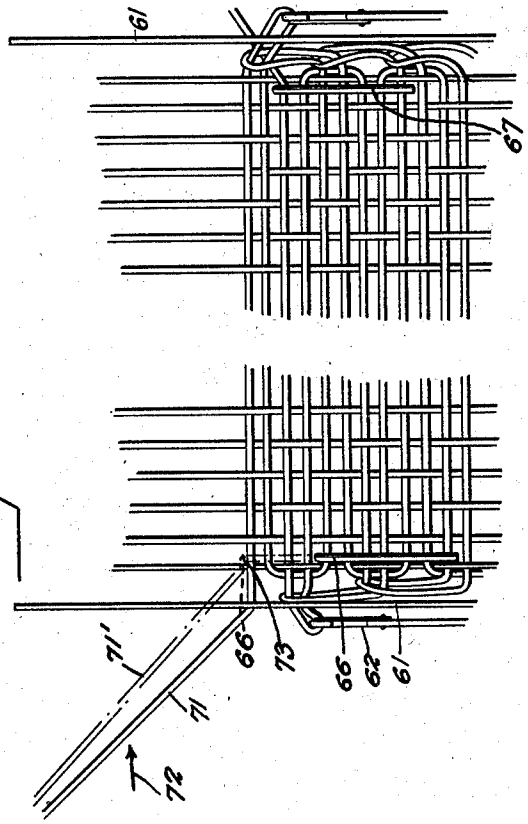

Fig. 23.

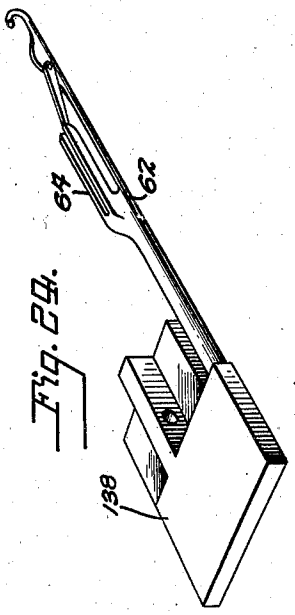

Fig. 24.

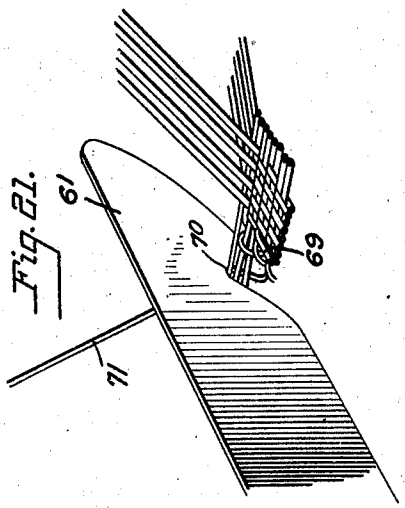

Fig. 21.

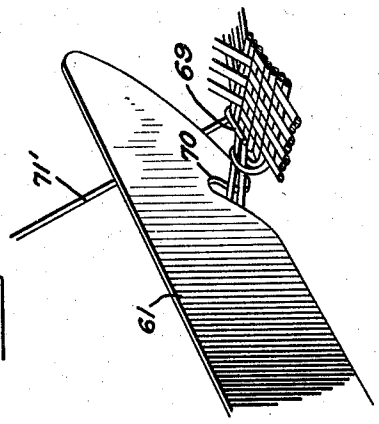

Fig. 22.

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Patented June 18, 1940 2,204,606

UNITED STATES PATENT OFFICE

2,204,606

LOOM

Jonathan Lucas, Savannah, Ga.

Application September 29, 1938, Serial No. 232,449

12 Claims. (Cl. 139—124)

This invention relates to looms or fabric weaving machines of that type in which the flying shuttle with its bobbin, which must be frequently replenished, is dispensed with, the filling being drawn from independent supply cones or other suitable packages of yarn, one for each side of the warp, and in the aggregate preferably containing sufficient yarn to weave the entire yardage of the warp, a double filling yarn being carried through the open warp from opposite sides from the respective cones, alternately at each pick or opening of the shed, in the form of a loop, the bight of which is laid at the opposite side of the warp from that at which the loop entered the warp.

One of the objects of the invention is to provide a loom of the type described, in which the loops constituting the double yarn picks are laid in the warp by cooperating carriers constantly mechanically controlled, in ensuring a perfect measured lay of the filling, with even tension, without slack or "spot-overplus" at any part of the filling yarn, and with no sudden pull or shock to the yarn.

A further object of the invention is the provision in a precision loom of cooperating filling yarn carriers movable into the open warp from opposite sides, one pushing in a loop of double filling from the supply source at one side, to a point in the middle of the warp and there transferring its yarn to the other carrier, which latter carrier receives the yarn and draws it to the opposite side of the warp, the carriers reversing their function to lay a double filling from the other supply source after the shed of the warp reverses.

Another object of the invention is to provide carriers for the filling which do not meet point to point in the middle of the shed, nor do they pass into one another, but meet and pass side by side a predetermined distance. Thus all danger of a crash or collision of the carriers within the confines of the shed is avoided.

Another object of the invention is to provide a loom in which the carriers have disengaged from the yarns which they carry during the formation of the selvage loops, so that the carriers may be made of sufficient size and sturdiness to be free from objectionable vibration regardless of their length, without the drawback of having a loose large looped selvage. This is one of the factors which adapts the loom of the present invention to wide fabrics.

Another object of the invention is the provision of a loom in which each and every pick or filling yarn is held at a definite and determined width dimension at the sides of the warp, until after the reed beats up the double filling yarn into its normal position, thereby avoiding excess shrinking and "pull-ins" of the fabric in the process of weaving; and producing a fabric of uniform near reed width.

A further object of the invention is to provide in a precision weaving machine, means for placing a double thread or filling yarn in the open warp at each pick or opening of the warp, alternately from opposite sides, in the form of a loop, the closed bight of this double yarn or filling being loop-locked at the selvage edge of the warp on the opposite side to that from which the loop came in, with the preceding double yarn or pick on the same side of the warp, and the bight formed at the base of adjacent loop picks in the selvage at which the loop enters being brought around the neck of the bight at the selvage edge in the conventional form of a single thread weave, tieing or locking the crossed warp yarns.

Another object of the invention is to provide a reed with means carried thereupon at opposite sides for engaging in a bight of the loop of double filling upon the approach of the reed to beat-up position, to hold the bight in the path of the locking needle which lock-loops the bights, permitting release of the bight by the carrier prior to the locking of the loop.

Another object of the invention is to provide a guide for controlling the motion of the reed, so synchronized with the bight-engaging means on the reed that after said bight-engaging means has come under one yarn of said loop, said reed rises, spreading the loop and insuring that the engaging means shall pass between the two yarns of said loop.

A further object of the invention is the provision of temples which assume definite positions in the line of the selvages and form mechanical turning points for the yarn at the bases of the double filling loops where successive loops are laid from the same side of the warp, which temples preferably project inside the first warp thread so as to cause the filling yarn at the turning point to hug the warp tightly, each temple remaining in position until the next double filling loops goes in from its side, the main object of the temple being to cause this next laid loop to draw solely from the supply source and to prevent its drawing upon the yarn which the temple is holding in place and which would narrow the fabric.

Another object of the invention is the provision in connection with the locking needle which loop-locks the bights of the double filling loops, of a

cam plate adjacent said needle which depresses the upper limb of the loops adjacent the bight after the needle has passed through the loop, causing it to hug the needle so that it will assuredly be caught in the hook of the needle when the latter recedes.

Another object of the invention is to provide a deflector on the needle and above the plane of the open latch for guiding the loop as it slides back over the latch to a plane beneath the latch so that it will assuredly close the latch and pass off of the needle when the latter recedes.

Still another object of the invention is the provision of a notched cam plate for depressing the end of the double filling loop which leads to the supply source when the loop is beaten up by the reed, causing the said end to spring up into the notch where it is held in fully beat up position until embraced by the hooked end of the temple which dislodges it from the notch and holds it in beat-up position and in alignment for the carrier arm.

A fabric weaving machine using arms to carry filling through warp shed to produce a perfect fabric of a continuous thread free from pull ins or over plus with uniform borders of a locked selvage as tight as desired from continuous filling yarn supply (of different colors if desired) at each side carried into the warp alternately by arms from opposite sides, the arms being only slightly longer than half the width of the warp and of as sturdy construction as desired in which the filling is always under control as to tension and position all without the use of shuttles or bobbins to carry the filling or to fix a selvage.

Other objects of the invention will appear as the following description of a preferred and practical embodiment thereof proceeds.

In the drawings throughout the several figures of which the same characters of reference have been employed to designate identical parts:

Figure 1 is a front elevation of a loom embodying the features of the present invention;

Figure 2 is a top plan view;

Figure 3 is an end elevation, viewing the right end of the loom;

Figure 4 is a vertical section taken along the line 4—4 of Figure 1;

Figure 5 is a vertical section taken along the line 5—5 of Figure 4;

Figure 6 is a front elevation of the temple cam;

Figure 7 is a front elevation of the needle cam;

Figure 8 is a front elevation of the harness cam;

Figure 9 is a side elevation of one of the carriers, the intermediate part being broken away;

Figures 10 and 11 are sections taken respectively on the lines 10—10 and 11—11 of Figure 9.

Figure 12 is a rear end view of the carrier showing the actuating pawls attached thereto, and one of the withdrawable trip cams.

Figure 13 is a plan view partly in section showing the relation of the carrier pawls to the trip cams.

Figure 14 is a detail view in elevation showing the common train for oscillating the harness gear and operating the movable trip cams.

Figure 15 is a perspective view showing the carriers in mid position in the act of transferring the yarn.

Figure 16 is a similar view showing the carriers receding after having made the transfer, it being noted that only one double filling loop is involved in the transfer.

Figure 17 is a perspective view showing the carrier which is at the left in Figure 16, as having traveled to a position outside the line of the selvage, showing the pin on the approaching reed, entering the loop preparatory to raising and opening the same, the proximity of the loop-locking needle and deflector cam being indicated.

Figure 18 is a similar view, the loop having been released by the carrier and being carried on the pin, approach of the lock needle being indicated by the position of the loop on the needle which has shifted from the top of the lock as shown in Figure 17 to a position at the rear of the lock and beneath the guard.

Figure 19 is a similar view showing that the needle has entered through the loop while the latter is still held on the reed pin, the reed having moved forward in a beat-up direction to press the upper yarn of the loop against the deflector.

Figure 20 is a similar view, the reed having completed its beat-up movement and shown in a receding phase, the needle also receding and about to draw the newly hooked loop through the preceding loop.

Figure 21 is a perspective view showing that yarn of the loop last beat-up, which leads to the supply source, caught in a notch on the underside of the deflector preparatory to being released from said notch by the temple and being held in beat-up position by said temple.

Figure 22 is a similar view showing the yarn referred to in the preceding paragraph released from the notch and held by the temple, the latter now acting as a turning point.

Figure 23 is a diagrammatic plan view showing the formation of the selvage.

Figure 24 is a perspective view of the lock needle and the operating slide on which it is mounted.

Referring now in detail to the several figures, it will be noted that the loom is built upon spaced standards 1 and 2 and a vertical member 163 which latter supports a cross beam 3 having forwardly directed end extensions 4 and 5. These end extensions support four parallel rods 6, the upper two of which are shown in Figure 2, the front vertical pair being shown in Figure 1 and all of them being shown in section in Figure 4. These rods form a track or guideway for two carriages 7 and 8 which reciprocate toward and away from one another, operated by means which will later be described. Each of these carriages supports a yarn carrier, said carriers being designated, respectively, by the reference characters 9 and 10.

Between the standards 1 and 2 are the warp carrying instrumentalities consisting of the warp beam 11 at the rear and the cloth beam 12 at the front, between which beams the warp is stretched.

The harness frames 13 and 14 are suspended at their ends, respectively, from the opposite flights 15 and 16 of oscillating sprocket chains 17 and 18, there being one chain at each side of the harness frames and said chains passing over upper and lower sprockets 19 and 20, respectively, said sprockets being supported upon a fixed member 21 of the loom. The means for oscillating the chains 17 and 18 will presently be described, but it can readily be understood that as the chains oscillate, one harness frame goes up while the other goes down, thus the shed which is clearly shown in Figure 4 is opened and reversed.

The carriers 9 and 10 have a range of movement which carries them outside of the line of selvage on each side of the warp and brings them

into slightly overlapping relation in the middle of the shed. The carriers do not meet head-on nor does one enter within the other in the middle of the shed but they traverse closely adjacent paths.

The filling is fed into the warp by the carriers from separate supply sources, not shown, but which may be considered as coming to the loom from the points 22 and 23 in Figure 2. The sources of supply may be cones, spools or other conventional yarn packages and it is contemplated that the aggregate amount of yarn carried by both sources of supply shall be enough to weave the entire yardage of the warp. In the event that the color or style of filling yarn is to be changed during the weaving, a larger number of cones may be provided, one carrying each color with selectors for presenting the proper yarn at the right time to the carriers.

The yarns pass through tensioning devices 24 and 25 of conventional construction and which need not therefore be described, from which tensioning devices they pass through fair-leaders or direction changers 26 and 27 on the cross beam 3, the purpose of which is to bring the yarn diagonally across the path of the carriers and at a small angle to the direction of the fill.

Assuming that the carriers are in their extreme positions outside of the lines of the selvage and beginning with the right hand carrier, the function of this is to move forwardly, catch the yarn which lies diagonally across its path and push it into the open shed in the form of a loop having tensioned limbs and a bight or apex which grows progressively more acute as the carrier pushes it in. Both right and left carriers come in together and when they have reached their middle, slightly overlapping position, the right hand carrier transfers the loop which it is pushing, into the jaw of the left hand carrier, the latter carrier then drawing the loop the rest of the way through the shed to the edge of the warp opposite to that at which the loop entered. While the left hand carrier is drawing out the loop, the right hand carrier having delivered its yarn is returning to the adjacent edge of the warp. When both carriers have reached their outermost position, the one having brought out a loop and the other having returned idly, the shed changes. Then the functions of the carriers reverse. The left hand carrier moves in, engaging the left hand yarn which crosses its path and pushes in a loop to the middle of the open shed whereupon the loop is transferred to the right hand carrier and drawn out to the right hand edge of the warp, the left hand carrier returning to its outermost position. While the carriers are returning to the respective edges of the warp after having made transfer of their yarns to the opposite carrier, they still engage the yarn affording more perfect control position and tension at all times.

The construction of the carrier will now be described. It consists of a flat channel member 28 bolted or otherwise secured to the carriage 7. Said channel member has rigidly affixed thereto an arm 29. Said arm is somewhat longer than half the warp and has a rounded interior end or head 30. Said arm back of said head is formed with a yarn encompassing recess 31. The back part of the head 30 as well as the arm rearwardly of the recess 31 are bifurcated and in the bifurcation is mounted by means of a pivotal connection 32 a jaw 33 which oscillates in a vertical plane. Said jaw has a forwardly opening indentation 34. When said jaw is in an upward position, the open end or mouth of the indentation 34 is above the plane of the upper surface of the anterior end of the carrier so that when the carrier moves against the yarn which intersects its path, said yarn is deflected upwardly by the rounded end of said carrier and enters the indentation 34. When the jaw 33 swings downwardly it closes the recess 31 forming a hole through which the yarn can freely run but from which it cannot escape until the jaw opens. The jaw 33 is normally closed. Consider the right hand carrier to be in its outermost position and ready to move inwardly, with its jaw closed. As it approaches the yarn which crosses its path, the jaw is automatically opened by means which will presently be described.

The jaw is in open position when the carrier engages the yarn so that the yarn enters the indentation 34 and goes into the recess 31. The means which opened the jaw now releases it, so the jaw closes. It remains closed until the carrier reaches its middle position in the shed. Then when it and the opposite carrier are about to overlap, the jaw again opens. When it opens, the lower limb of said jaw raises the thread out of the recess 31 holding it above the level of the rounded end 30. The open jaw on the other carrier now receives the yarn which is held out transversely in the path of the receiving carrier by passing beneath a lip 187 at the end of a recessed plate 188 extending laterally of the carrier on the side to be overrun by the opposite carrier when the carriers assume their lapping relationship. The jaws now move a little further in the overlapping direction, overrunning the means which held their jaws open so that the jaws of both now close, loosely embracing the yarn. The carriers now recede and the means which would open the jaw of the carrier which now holds the yarn, at the same phase in the travel of the carrier at which it opened on the inner movement of the carrier is rendered inactive so that the jaw does not open but remains closed until the carrier is outside of the shed. It was, of course, very important that this carrier which is pulling the loop should remain closed while the loop is being drawn to the outer edge of the warp but it is altogether a matter of tension, position and control that the retreating right hand carrier shall still embrace its yarn as it starts to retreat. Its jaw is opened on the retreat stroke, releasing the yarn along which it is retreating. The jaw of the carrier which is pulling the loop through the shed does not open until several important functions have been performed.

One can logically infer that the phase for the opening of the jaws will not be the same for each advancing and retreating stroke of the carrier. Beginning with the function of pushing the loop into the shed by right arm and assuming that the normal position of the jaw is closed, the jaw opens just outside of the shed to enable the carrier to pick up the yarn on its entering stroke. The right jaw must again open when the carrier reaches the middle of the shed and is about to overlap the left carrier for purpose of raising the filling to alignment for transfer. Inasmuch as the carriers over-run their middle position until the left jaw closes around the thread, it is essential that on the outward stroke of the left jaw it does not open at the center but merely opens once when it leaves the shed. On the next stroke inward of right arm, which may be termed an

idle stroke since it carries no thread but goes in to receive a thread from the opposite carrier, it is not necessary that the right jaw should open at all until it approaches its middle position in the shed. Then upon returning with the thread which it has received from the left carrier, it is essential that the jaw remain closed as it passes the middle position and that it remain closed until after the loop of yarn has been drawn to a position outside of the shed and until certain operations have been performed preliminary to locking the selvage.

The opening of the jaw in these different proper phases is accomplished by a system of pawls on the carrier and a system of cams for engaging the pawls. Referring now to Figure 9, it will be understood that the pivotally mounted jaw 33 is connected to a rod 35 carried by the arm 29 extending parallel thereto and slidable within a guide lug 36 carried by said arm. One end of said rod is pivotally connected to the jaw 33, with suitable lost motion to permit arcuate movement of the pivotal connection as the jaw rocks, the rear end of the rod 35 is engaged by a pivoted pawl 38 which will hereinafter be referred to as the long pawl. This pawl is normally in the substantially vertical position shown in Figure 9, kept against the rod 35 by the spring 200, and the rod 35 being normally kept pulled back by the spring 46, to the limit of its movement in a rearward direction determined by the closed position of the jaw 33 to which the rod 35 is connected. This pawl has a sloping shoulder 37 at the rear of its lower end. It is obvious that when the lower end of this pawl strikes a cam when the carrier is moving forward, the pawl rocks against the tension of the spring 46 moving the rod 35 in forward direction and opens the jaw 33 but that due to the sloping shoulder 37 this pawl never effects the opening of the jaw when the carrier is retreating, for the sloping shoulder causes it to ride tiltingly over any cam obstruction. There is another pawl 39 hereinafter for convenience referred to as the short pawl pivotally mounted on the carrier and having an arcuate slot 40 which embraces a pin 41 on the arm 35. The lower end of the short pawl is beveled on the forward side. It is obvious that this pawl never causes an opening movement of the jaw 33 when the carrier is moving forward for the pawl simply rocks moving freely about the pin 41 by virtue of the slot 40 and that the short pawl concerns itself solely with the opening of the jaw 33 when on the retreating stroke of the carrier said pawl encounters a cam obstruction.

Now, on the adjacent face of the cross beam 3 or on a fixed bar which parallels said cross beam are a series of cams 42, 43, 44 and 45, the cams 43 and 45 being fixed while the cams 42 and 44 are withdrawable through guideways in the cross beam 3 by means of instrumentalities presently to be described.

Figure 12 shows the shape of the long pawl 38 and short pawl 39, also the shape of the fixed cams 43 and 45 and the movable cams 42 and 44. Figure 13 shows that the long pawl 38 travels in a path to engage the movable cam 42 and the fixed cam 45 while the short pawl 39 moves in a path to engage the fixed cam 43 and the movable cam 44. Considering the left hand carrier, for instance, on its first inward stroke wherein it pushed the loop of double filling into the shed, the long pawl 38 strikes the movable cam 42 which moves the rod 35 forward opening the jaw 33 to yarn-engaging position. The jaw then closes under the pull of the spring 46 when the pawl 38 has ridden over the cam 42. Cams 43 and 44 may be disregarded in this movement of the carrier as they are engageable only by the short pawl which rides freely over them on this stroke. When the carrier has reached the middle of the shed, the long pawl 38 engages the fixed cam 45 which again opens the jaw in readiness for the transfer of the yarn to the opposite carrier. On the return stroke of the carrier, the short pawl 39 strikes the movable cam 44 releasing the yarn which at once springs into a straight line with the yarn which has been pulled through by the opposite carrier, under the influence of the tensioning device 25. On the next inward stroke of the left hand carrier which may be termed its idle stroke since it carries no yarn, the movable cam 42 is withdrawn so that the long pawl 38 does not strike it and the jaw 33 consequently remains closed. When the head of the carrier has reached the middle of the shed, the long pawl 38 strikes fixed cam 45 and the jaw opens, in readiness to receive the yarn transferred from the opposite carrier. On the next return stroke in which the left hand carrier functions to pull the yarn through the shed, the movable cam 44 is withdrawn so that the short pawl 39 does not strike it so that the jaw remains closed until the head of the carrier has passed outwardly of the edge of the warp. Finally, the short pawl 39 strikes fixed cam 43 and the jaw 33 opens to release the bight of the loop of drawn-in yarn, but this does not happen until the loop is otherwise held at a slight distance from the selvage.

It will be noted from Figure 11 that the side of the recess 31 which the yarn engages when it is being pulled by the carrier is so shaped that the yarn assumes a slanting position against the forward wall of said recess bringing the top yarn 47 of the filling loop at a higher level than the bottom yarn 48 for a purpose that will soon appear.

It will be observed in Figure 2 that the two limbs or yarns 47 and 48 which constitute the limbs of the double filling loop make a small acute angle with a line parallel to the fell and that both are of the same length through the width of the warp. They have been laid under an even tension determined by the tensioning devices 24 and 25 and at an approximately even speed characterized only by a very slight acceleration and deceleration toward the respective limits of motion. Therefore, when these yarns are beat up by the reed there will be no unevenness in tension or what is known as "spot-overplus" which means areas of fullness in the filling yarn. This is in sharp contradistinction to the conventional filling shuttle which is driven by the impact blow of the picker-stick and therefor starts out at maximum velocity which is quickly reduced through friction of the shuttle with the warp yarn in the shed. Inertia draws an an excess length of yarn from the bobbin in the shuttle which yarn disposes itself in a wavelike line through the shed, which when beat up forms a filling with tight and full spots giving rise to unevenness in the weave and an impairment in the strength of the fabric.

It will be understood from what has been described up to this point that the weft of the fabric consists of loops laid in alternately first from one side and then from the other of the warp from separate supply sources of yarn and that

the bights of these loops are released in the line of the selvage on each side of the warp. Means are provided, as will appear, for loop-locking these bights preferably by a conventional locking stitch, these interlocked bights forming one element of the selvage. It will readily be understood that there is another element to consider in the formation of the selvage in that when successive double filling loops are laid from the same side of the warp there is a turning point of the yarn against the warp. These turning points also have to be locked forming another element of the selvage.

First, referring to the loop-locking of the bights of the double filling loops, the reference character **49**, Figures 2 and 17 to 20, inclusive, represent the reed which is carried by the lay **50**. The lay consists of a pair of spaced yokes **51** and **52** which embrace the upper and lower corners of the reed and are themselves pivotally attached to the spaced pivoted bars **53** and **54**. Said bars are rocked by mechanism which will be later described. The yokes **51** and **52** and consequently the reed are guided in lateral channels **55** and **56**. It will be seen from Figure 4 that the lay has rollers **57** which ride in said channels. The channels slope upward at the points **58**, shown in Figure 4, and the reed consequently moves vertically upward at this point for a reason as will appear.

Referring now to Figure 4 and the series of Figures 17 to 20, inclusive, the reed at opposite sides is provided with pins **59** and **60** projecting outwardly from the reed in the plane of travel of the carriers and toward the path of the carriers. Figure 17 shows the left hand carrier near its extreme retracted position outside of the shed but with the jaw still closed and the yarn retained. It has already been explained that due to the shape of the forward face of the recess **31**, the bight of the loops is held slantingwise. Figure 17 shows that the more elevated yarn **47** is on the side next to the reed. In Figure 17 the reed **49** is moving toward beat-up position and the pin **59** has just protruded beneath the top yarn **47** of the filling loop. The lay is just about to reach the points **58** in the channels **55** and **56** which will cause the reed **49** to rise vertically and the pin **59** to move upwardly against the underside of the top yarn **47** to open said loop. This act is solely for the purpose of insuring that on its further forward movement the pin **59** will pass above the bottom yarn **48** of the loop. Figure 17 shows a fixed deflector cam **61** arranged perpendicularly to the path of the carrier, and a locking needle **62** lying parallel to and close behind said deflector cam. The yarns **47** and **48** in the position of parts shown in Figure 17 are not in contact with said deflector cam. The purpose of the latch needle is to lock the bights of the double filling loops in the selvage by a conventional locking stitch.

Figure 18 shows that the reed **49** has moved a little further forward in its beat-up direction, that the pin **59** has passed through both sides of the loop, that the carrier has moved out to its extreme limit so that the jaw **33** has opened releasing the bight of the loop, the carrier not being shown, and that the loop when released has sprung back with tension against the pin **59** under the urge of one of the tensioning devices **24** or **25**, shown in Figure 2. The arrows in Figure 18 show that the reed and the latch needle are approaching one another and that the pin **59** of the reed is carrying the double filling loop closer to the deflector cam **61**. It will be noted from Figures 17 and 18 that the bight **63** of the preceding double filling loop on the same side of the warp is already on the needle behind the latch. Figure 19 shows that the reed **49** and pin **59** have moved still further in the beat-up direction of the reed, that the latch needle **62** has passed through the loop and that the latter is now lying on top of the latch. This figure also shows that the movement of the reed and pin **59** has brought the top yarn **47** of the loop into contact with the downwardly sloping face of the deflector cam **61** and has depressed the top yarn **47** causing it to closely hug the latch needle so that upon the retreat of the latch needle the loop is sure to be hooked by said needle. It will be noted that the latch needle is provided with a guard **64** back of the latch and bifurcated in a vertical plane so that it slightly overlaps the arc of movement of the latch permitting the end of the latter to pass through the bifurcation. When the latch is in its full opened position, prongs **65** of the guard are above the latch leaving a space below them into which the loop traveling rearwardly along the top of said latch must enter. This space carries the yarn to a plane below the level of the end of said latch so that when the needle retracts the loop will assuredly move under said latch and close the same so that the loop can pass off of the needle when the newly caught loop is drawn through.

Figure 20 shows the retrogressive position of both the pins **59** and the latch needle **62**. The reed has accomplished its beat-up and is now retreating. The latch needle is also retreating. The previously formed loop **63** is about to close the latch and pass off of the end of the needle over the newly caught loop **66'**. It is thus that the bights of the double filling loops are interlocked in the selvage.

One of the important functions of the loom of the present invention is to produce selvage edges which are at a mechanically determined distance apart equal substantially to the width of the reed and to produce a fabric which is not subject to narrowing and in which the tension of each pick shall be uniform. It is obvious in the absence of such a mechanical provision that when the carrier pushes against a yarn one end of which is continuous with the last beat-up pick and the other end of which leads to the source of supply, the tension produced by the pushing in of the yarn will cause the yarn to be drawn from two directions, one from the last beat-up pick and the other from the source of supply. This would result in a pull on the last beat-up pick shortening it, increasing its tension, and pulling in of the selvage edges toward one another resulting in narrowing of the fabric. The mechanical means which the present invention provides for inhibiting this drawing upon the pick already laid and beat up comprises a pair of spaced temples **66** and **67** each consisting of an oscillating arm pivoted as at **68** to a face member of the loom below the plane of the warp and terminating in a hooked end **69** which may be projected upward to a slight distance above the plane of the warp and retracted to an inactive position. The temples work in the vertical planes of the selvage edges and being turning points for the filling yarn they positively determine the width of the fabric and the uniform tension of the weft fillings.

Referring now to the group of Figures 21 to 24, inclusive, it will be observed that the de-

flector cam 81 has a notch 70 at the base of its downwardly sloping surface and that when the last laid double filling loop is beat up, the end 71 which leads to the supply source is pushed into the notch 70 and thus temporarily held in beat-up position. It will be understood from Figure 23 in which the web is viewed from beneath that when the next double filling loop is formed by the carrier engaging the portion 71 of yarn which leads to the supply source, for example, at the point represented by the arrow 72, it will form a bight where the portion 71 joins the last beat-up pick. Before the carrier engages the portion 71, the temple 66 which has formed the turning point for the previously turned bight and which has retracted from the fabric while the last pick from the opposite side was being laid, swings up and toward the web so as to embrace the last laid pick at the point 73, Figure 23. The hooked end 69 of the temple is directed rearwardly, that is to say, toward the fell of the fabric so that its action in engaging the last beat-up pick is to draw the portion 71 of the yarn out of the notch 70 so that the portion 71 now assumes the position 71', Figure 23, transferring its point of deflection from the notch 70 to the temple 6. The carrier then moves in in the direction of the arrow 72 and turns the yarn at a sharp angle about the temple 66, the latter thus constituting for the moment an immovable and mechanically determined turning point. When the double filling loop formed by the incursion of the carrier into the shed in the direction of arrow 72 and by the drawing of the same loop from the middle of the shed to the opposite selvage by the opposite carrier has been laid, the shed reverses, the loop is beat up and the bight around the temple is firmly and tightly fixed in the selvage. It will be understood from the contemplation of Figure 23 that the bight formed around the temple also embraces the neck of the alternating loop laid in from the opposite side of the warp so that the bight formed around the temple is locked by the neck of the double filling loop which it embraces. It is apparent that on account of the mechanical turning points afforded by the temple, the yarn which goes to make the double filling loop is drawn solely from the source of supply and not at all from the last pick which has been beat up and is held in place by the temple so that the tension of all of the weft fillings is uniform and there is no shortening of the last beat-up pick to cause drawing in or narrowing in the width of the fabric.

Figure 23 shows clearly that the selvages are formed of two series of elements, the interlooped bights of the double filling loops drawn alternately from opposite sides of the warp, and the bights formed at the bases of successive double filling loops on the same side of the warp and which bights embrace and are locked by the necks of the double filling loops adjacent the loop-locked bights.

The fabric as woven is wound upon a cloth roll 12 through the instrumentality of a sand roll 75 positively actuated step by step through the instrumentality of a ratchet wheel 76 on the shaft of the sand roll driven by an oscillating pawl 77 synchronized with the movements of the loom. The cloth roll 12 is driven from the sand roll 75 by a connection such as a belt 78 capable of slipping under excess load. The fabric is looped around the sand roll 75 sufficiently to assure non-slipping traction between the fabric and the surface of the sand roll. The pawl 77 operates the sand roll against the resistance opposed by a conventional let off in the usual position. As the diameter of the fabric roll 12 progressively increases in the course of winding, the increasing differential between an arc at the surface of the fabric roll and an arc of equal angularity on the sand roll is compensated by slippage at the belt 78 relative to the cloth roll so that the tension of the winding of the cloth roll remains constant.

The following sets of what may be termed "end instrumentalities" have now been described.

(*a*) The oppositely reciprocatory carriers, with the pawls and cams that control the sequence in the operations of the jaws of the carriers.

(*b*) The harness reciprocating chains.

(*c*) The reed and lay, with the pins on the reed that hold the bights of the double filling loops and presents them to the latch needles.

(*d*) The temples for mechanically maintaining the width of the fabric constant and substantialy equal to the width of the reed.

(*e*) The pawl and ratchet means for winding the fabric on the cloth roll.

(*f*) The latch needle operating mechanism.

These are directly involved in the production of the fabric and constitute both singly and in combinations the most important features of the invention. These "end instrumentalities" are operated from a common source of power by trains of mechanism which it is recognized may be re-designed, modified, or substituted by mechanical equivalents without materially alternating the inventive concept. Such operating trains will now be described.

Power is derived from an electric motor 81 which, through the gears 82 and 83, drives a pulley 84 with a belt connection 85 to a larger pulley 86 on the end of the drive shaft 87. All of the above tabulated "end instrumentalities" are driven from this drive shaft. A handle 88 on the pulley 86 permits the loom to be operated by hand when occasion so requires.

Figure 4 shows that the drive shaft 87 has a bevelled gear 89 meshing with a bevelled gear 90 which drives a shaft 91 carrying at its end a crank wheel 92 which is massive, serving also as a flywheel. A gear 93 on the shaft 91 meshes with a gear 94 which drives a shaft 95. On the opposite end of said latter shaft is a gear 96 meshing with a reverse gear 97, the latter meshing with a gear 98 on a stub shaft 99, the latter shaft being coaxial with the shaft 91 and carrying at its end a massive crank wheel 100 similar to the crank wheel 92.

Figures 1 and 3 show that the carriers 7 and 8 have links 101 and 102 pivotally connected thereto, said links being pivotally connected in the upper ends of pitmen 103 and 104, the latter being pivotally supported at their lower ends to the frame of the loom. Crank arms 105 and 106 are connected in opposite phases to the respective crank wheels 92 and 100 and through the rotation of said crank wheels in opposite directions, due to the interposition of the reverse gear 97, the carriers 7 and 8 are reciprocated to and from one another.

The harness chains are oscillated through motion derived from the harness cam 107 mounted on the end of a shaft 116 which last named shaft is connected to the reed crank shaft 133 through a train including the serially meshing gears 183, 184, 185 and 186. The shaft 133 is in turn connected with the drive shaft 87 through a gear

train including the serially meshing gears 134, 135, 136 and 137. The face of the harness cam has a continuous cam groove 108 substantially one-half of which is a concentric arc 109 of relatively large radius while substantially the other half is a concentric arc 110 of relatively small radius. Said arcs are connected by approximately radially extending groove portions 111 and 112. A crank arm 113, Figure 14, carries a roller 114 which travels in said cam groove. Said crank arm is kept close to the face of the harness cam and the roller thereby retained within the cam groove by a bifurcated portion 115 of said crank arm which slips upon the shaft 116 of the harness cam between said cam and the collar 117. The opposite end of the crank arm 113 is connected eccentrically to a gear 118. As the harness cam rotates, the roller 114 will remain a constant distance from the axis of the shaft 116 while it is in either the groove 109 of large radius or the groove 110 of small radius. At such times the crank arm 113 will be immovable but when passing through the approximately radial groove portions 111 and 112 which connect the cam arcs of large and small radius, the crank arm 113 will reciprocate first in one direction then in the other, imparting an oscillatory motion to the gear 118. This oscillatory motion is communicated to a gear 119 which is on the shaft 120, said shaft carrying a gear 181 meshing with a gear 182 on the same shaft with the lower sprockets 20 of the harness chains. Thus, an oscillatory movement is imparted to said chains so that the harness frames which are attached to the opposite flights of said chains move in opposite phases to one another and are alternately reciprocated up and down.

The gear 118 also imparts oscillatory motion to a gear 121 on a shaft 122, Figures 3, 4 and 14. Said shaft carries a small crank wheel 123 having an eccentrially mounted crank 124 which when the shaft 122 oscillates imparts oscillatory movement to an arm 125 fixed with respect to a shaft 126, the latter shaft extending parallel to the cross beam 3, see Figure 2, and substantially throughout the length of the range of movement of the carriers 7 and 8. On said shaft are fixed radial arms 127 to the ends of which are pivotally mounted the rods 128 which operate the movable cams 42 and 44 which affect the opening movement of the jaws 33 of the carriers.

The reed is actuated by a pair of lay bars 53 and 54 pivoted at their lower ends to a fixed part of the loom and being pivotally connected at their upper ends to the yokes 51 and 52 which yokes carry the reed as has been described. The lay bars are actuated by connecting rods 129 and 130, the ends of which are eccentrically pivoted to the reed cranks 131 and 132, and in the same phase so that the lay bars work together. The reed cranks are fixed to a shaft 133 on one end of which is a gear 134 which through the intermediary of the gears 135 and 136 is driven from the gear 137 on the drive shaft 37. The function of the rise in the reed guide channels 55 and 56 has already been referred to in connection with the opening of the bights of the double filling loops by the pins on the reed. The elevation of the reed before the beat up takes place has another advantage in that it causes the lower part of the reeds adjacent the lower reed frame member to strike the fell, this lower part of the reed being considerably stiffer than the middle portion of the reed and therefore imparting a closer beat up.

Figure 24 shows that the latch needles 62 are mounted on slides 138 movable along guides 139. Said slides are respectively connected to levers 140 and 141, one on each side of the loom, said levers being fixed to short shafts 142 and 143 carried in suitable supporting bearings 144 and 145. Said shafts each have an arm 146 and 147 pivotally connected to links 148 and 149, the outer ends of which carry rollers, one of which is shown at 150 in Figure 7 and which rollers travel in ovoid cam grooves on the face of the needle cams 151 and 152 which are mounted on the opposite ends of a shaft 153. As the latch needles operate alternately, the needle cams are mounted in opposite phases. The construction of the links 148 and 149 are best shown in Figure 4, being similar to the cam arm 113 of the harness operating mechanism.

The shaft 153 carries a bevelled gear 154 meshing with a small bevel gear 155 at the top of the vertical shaft 156. The lower end of this shaft carries a bevel gear 157 meshing with a bevel gear 158 on the end of a shaft 159 which by means of meshing bevelled gears 160 and 161 connects with the drive shaft 87.

The temples 66 and 67 are pivotally mounted at their lower ends as indicated by the reference character 68 to the standards 1 and 2 at opposite sides of the loom and are each actuated at an intermediate point in their length by a link 165 pivotally connected thereto, the opposite ends of said links carrying rollers, one of which designated as 166 being shown in Figure 6. Said rollers play in ovoid cam grooves 167 on the faces of temple cams 168 and 169 which are mounted on a shaft 170 at opposite sides of the warp. As the temples operate alternately, the temple cams are mounted in opposite phases. The links 165 are constructed in the same manner as the links 148 and 149. The shaft 170 carries a sprocket 171 upon which rides a driving chain 172, the lower end of which chain passes over a sprocket 173 carried by a shaft 174 which at its opposite end has a gear 175, meshing with a gear 176 on the shaft 99.

The shaft 174 also carries at its outer end a gear 177 which drives a crank gear 178, Figure 3. A connecting rod 179 is eccentrically pivoted to the crank gear 178 at one end and at its other it is pivoted to a pitman 180 which is freely journaled upon the end of the shaft 170 that carries the temple cams. Oscillation of the pitman 180 reciprocates the pawl 77 and operates the fabric winding ratchet 76 in a manner hereinbefore described.

While I have in the above description disclosed what I believe to be a preferred and practical embodiment of my invention, it will be understood to those skilled in the art that the specific details of construction and arrangement of parts as described are by way of illustration and not to be construed as limiting the scope of the invention.

What I claim is:

1. Loom of that type in which the weft filling is drawn from yarns at opposite sides of the warp fed from separate supply sources, tensioning means for said yarns at opposite sides of said warp, carriers reciprocable in opposite phase in a path extending transversely of the warp between the line of the fell and said tensioning means, from positions outside the warp to lapping positions at the middle of the shed, said carriers cooperating to lay a double fill loop through the shed derived alternately from opposite yarns,

at each reversal of said shed, normally closed jaws on said carriers, so shaped as to freely embrace the yarn permitting it to run through said jaws, said opposite yarns between the line of the fell and said tensioning means intersecting the path of said jaws, means for operating the jaws of said carriers, so synchronized that the jaw of one opens at the beginning of each alternate of its inward strokes to receive the yarn which it engages at a point between the fell and tensioning means, that the jaws of both open at the middle of the shed to effect transfer of the yarn from the one to the other of said carriers and then close, that the jaw of the one carrying the bight of the transferred loop opens to release said bight beyond the line of the selvage, and that the jaw of the simultaneously returning other carrier opens in the course of its return stroke to release the yarn which it embraces.

2. Loom of that type in which the weft filling is drawn from yarns at opposite sides of the warp fed from separate supply sources, tensioning means for said yarns at opposite sides of said warp, carriers reciprocable in opposite phase in a path extending transversely of the warp between the line of the fell and said tensioning means, from positions outside the warp to lapping positions at the middle of the shed, said carriers cooperating to lay a double fill loop through the shed derived alternately from opposite yarns, at each reversal of said shed, normally closed jaws on said carriers, so shaped as to freely embrace the yarn permitting it to run through said jaws, said opposite yarns between the line of the fell and said positioning means intersecting the path of said jaws, means for operating the jaws of said carriers, so synchronized that the jaw of one opens at the beginning of each alternate of its inward strokes to receive the yarn which it engages at a point between the fell and tensioning means, that the jaws of both open at the middle of the shed to effect transfer of the yarn from the one to the other of said carriers and then close, that the jaw of the one carrying the bight of the transferred loop opens to release said bight beyond the line of the selvage, and that the jaw of the simultaneously returning other carrier opens in the course of its return stroke to release the yarn which it embraces, the carrier which first engages the yarn pushing in a loop to the middle of the shed, the carrier to which the loop is transferred drawing it beyond the opposite side of the shed, a reed for beating up the double fill loop thus laid, and a temple engageable with the fell yarn of the beat up double fill loop at the selvage line acting as a fixed turning point for the yarn at the base of the next loop pushed in on the same side of the warp as said temple, assuring that the said next loop shall be drawn solely from said supply source and not in part from said fell, and mechanically determining a uniform width of the fabric, said temple being duplicated on the opposite side of said warp, said temples being alternately actuated.

3. Loom of that type in which the weft filling is drawn from yarns at opposite sides of the warp fed from separate supply sources, means for laying double fill loops through the shed of the warp from said yarns alternately in opposite directions at each reversal of the shed, a reed for beating up the double fill loops thus laid, means on each side of the warp for loop-locking the bights of the double fill loops laid at that side, means on each side of the warp operable in alternation to engage the fell of the double fill loop last laid from that side, at the selvage line, whereby when the next double fill loop is laid from that side, said fell-engaging means functions as a mechanical turning point, forming a bight about the neck of the intervening last laid double fill loop from the opposite side, and determining a uniform width for the fabric.

4. Loom of that type in which the weft filling is drawn from yarns at opposite sides of the warp fed from separate supply sources, means for suitably tensioning said yarn, carriers acting in alternation, at each reversal of the shed, for catching said yarns and laying double fill loops through the shed from opposite directions bringing the bights of said loops a slight distance beyond the selvage line on each side, said carriers being constructed to hold one side of the loop above and in advance of the other, a reed for beating up each double fill loop, pins projecting from the sides of the reed toward the web, and in vertical planes embracing the selvage edges, said carrier-held loops being in the path of travel of said pins when the reed moves forward to beat-up, a guide for said reed having an upward jog effective before the beat-up to elevate said reed at a point in its travel when either of the pins has entered beneath the upper side of the loop which is in its path, spreading said loop to assure the passage of said pin through said loop, means synchronized with said reed for releasing said loop from said carrier after said pin has entered said loop, said tensioning means contracting said loop about said pin, determining the selvage size of said loop, and a reciprocable latch needle movable parallel to the selvage line and advanceable relative to said pin-held loop to enter said loop, and retractable to draw said loop from said pin and to shed the previous loop carried by said needle over the newly acquired loop, locking the bights of the double fill loops on one side of the fabric in a lock stitch, said lock stitching forming mechanism being duplicated on the opposite side of the warp and operating in alternation.

5. Loom as claimed in claim 4, including means on each side of the warp operable in alternation to engage the fell of the double fill loops last laid from that side, at the selvage line, whereby when the next double fill loop is laid from that side, said fell-engaging means functions as a mechanical turning point, forming a bight about the neck of the intervening last laid double fill loop from the opposite side and determining a uniform width for the fabric.

6. Loom of that type in which the weft filling is drawn from yarns at opposite sides of the warp fed from separate supply sources, means for suitably tensioning said yarn, carriers acting in alternation, at each reversal of the shed, for catching said yarns and laying double fill loops through the shed from opposite directions bringing the bights of said loops a slight distance beyond the selvage line, on each side, said carriers being constructed to hold one side of the loop above and in advance of the other, a reed for beating up each double fill loop, pins projecting from the sides of the reed toward the web, and in vertical planes embracing the selvage edges, said carrier-held loops being in the path of travel of said pins when the reed moves forward to beat-up, a guide for said reed having an upward jog effective before the beat-up to elevate said reed at a point in its travel when either of the pins has entered beneath the upper side of the loop which is in its path, spreading said loop to

assure the passage of said pin through said loop, means synchronized with said reed for releasing said loop from said carrier after said pin has entered said loop, said tensioning means contracting said loop about said pin, the size of the loop being determined by the size and position of the pin and independent of the size of the carrier, whereby the latch may be made as sturdy as may be necessary to avoid vibration without producing a loose loop selvage.

7. Loom of that type in which the weft filling is drawn from yarns at opposite sides of the warp fed from separate supply sources, means for suitably tensioning said yarn, carriers acting in alternation, at each reversal of the shed, for catching said yarns and laying double fill loops through the shed from opposite directions bringing the bights of said loops a slight distance beyond the selvage line, on each side, said carriers being constructed to hold one side of the loop above and in advance of the other, a reed for beating up each double fill loop, pins projecting from the sides of the reed toward the web, and in vertical planes embracing the selvage edges, said carrier-held loops being in the path of travel of said pins when the reed moves forward to beat-up, whereby said pin enters said loop before beat-up, means synchronized with said reed for releasing said loop from said carrier after said pin has entered said loop, said tensioning means contracting said loop about said pin, determining the selvage size of said loop, a reciprocable latch needle movable parallel to the selvage line, said reed-carried pin and said latch needle being mutually advanceable up to a point just prior to the point of beat-up, where said needle enters said loop to withdraw it from said pin, a cam plate at the side of the path of said pin and latch needle with a cam surface downwardly inclined in the direction of the web, so intersecting the path of transverse movement of the yarn constituting the upper side of the loop carried by the pin, as the latter advances, as to engage said yarn after the entrance of said latch needle into said loop, to depress said yarn causing said loop to hug said needle ensuring that said loop will be caught by the hook of said needle when the latter retreats.

8. Loom as claimed in claim 7, said cam plate having a notch in its cam surface substantially in the line of the fell into which the last pick from the adjacent side of the warp is pushed by the reed at the moment of beat-up, and means synchronized with said reed to engage the said last pick at the selvage line on the side from which said pick emanated, after the next fill loop from the opposite side has been laid, said means releasing the pick which it engages from said notch and supplanting said notch as a means for holding said pick at the fell line, said means acting as the turning point forming a bight about the neck of the said filling loop from the opposite side, and determining a uniform width for the fabric.

9. In a loom, means for periodically laying a double weft loop through the warp bringing the bight a slight distance beyond the selvage line on one side and holding it there, a pin at the selvage line entering said bight prior to the beat-up of said loop, means for releasing said bight from said laying means after said pin has entered said bight but before the beat-up, tensioning means for drawing said bight close to said pin after its release from said laying means, a reciprocable latch needle entering said bight on said pin, means for causing said bight to hug said latch needle ensuring its being hooked by said latch needle and drawn off of said pin upon the retreat of said latch needle, the latter upon retreating, shedding the previous bight carried by said needle, over the newly acquired bight, locking the bights of successive double fill loops on the same side of the warp, in a stitch.

10. Loom of that type in which the weft filling is drawn from yarns at opposite sides of the warp, fed from separate supply sources, carriers reciprocable in opposite phase in a path transversely of the warp, from positions outside the warp to lapping positions at the middle of the shed, said carriers cooperating to lay a double fill loop through the shed derived alternately from opposite yarns, at each reversal of the thread carrier, one carrier engaging the yarn at one side of the warp between the fell and the supply source, and pushing it to the middle of the shed, the other receiving the yarn and pulling it to the other side of the warp, said carriers each comprising a frame having a head at the advance end rounded in a vertical plane so as to deflect yarns crossing its path in a generally horizontal direction, said frame having a vertical longitudinal slot intersecting the rear part of said head and extending rearwardly therefrom, said frame being formed with a transverse recess therethrough, behind said head, intersecting said slot and opening at the top of said frame, a jaw in said slot pivoted to said frame rearwardly of said recess to swing upwardly, said jaw bridging said recess and having the forward end extending into the part of the slot in said head, said jaw having a forwardly opening longitudinal slot opening in the sides thereof, intersecting said recess and forming with the front wall of said recess an eye to freely surround a yarn retained in said carrier, the slot in said jaw defining upper and lower bifurcations, the outer side of the upper bifurcation forming a yarn-deflecting continuation of the upper surface of said head when said jaw is closed, the lower side of said upper bifurcation extending obliquely above said head when said jaw is open, forming a guide to lead a yarn engaged thereby down into said recess, the upper side of said lower bifurcation kicking the retained yarn to a position above the level of the upper side of said head when said jaw opens, permitting release of said yarn, a bar carried by said frame connected to said jaw for rocking the same to open or closed positions, and means for actuating said bar.

11. Carrier for a loom as described in claim 10, the means for actuating said bar comprising a pair of swinging pawls carried by said frame respectively concerned solely with actuating said bar in one of the respective directions of movement of said carrier, and means engageable with said pawls for operating the jaws of said carriers in proper phase.

12. Loom of that type in which the weft filling is drawn from yarns at opposite sides of the warp, fed from separate supply sources, carriers reciprocable in opposite phase, in a path transversely of the warp, from positions outside the warp to lapping positions at the middle of the shed, said carriers cooperating to lay a double fill loop through the shed derived alternately from opposite yarns, at each reversal of the shed, one carrier engaging the yarn at one side of the warp between the fell and supply source, and pushing it to the middle of the shed, the other receiving

the yarn and pulling it to the other side of the warp, said carriers each comprising a frame having a head at the advance end rounded in a vertical plane so as to deflect yarns crossing its path in a generally horizontal direction, said frame having a vertical longitudinal slot intersecting the rear part of said head and extending rearwardly therefrom, said frame being formed with a transverse recess therethrough, behind said head, intersecting said slot and opening at the top of said frame, a jaw in said slot pivoted to said frame rearwardly of said recess to swing upwardly, said jaw bridging said recess and having the forward end extending into the part of the slot in said head, said jaw having a forwardly opening longitudinal slot opening in the sides thereof, intersecting said recess and forming with the front wall of said recess an eye to freely surround a yarn retained in said carrier, the slot in said jaw defining upper and lower bifurcations, the outer side of the upper bifurcation forming a yarn-deflecting continuation of the upper surface of said head when said jaw is closed, the lower side of said upper bifurcation extending obliquely above said head when said jaw is open, forming a guide to lead a yarn engaged thereby down into said recess, the upper side of said lower bifurcation kicking the retained yarn to a level above the upper side of said head when said jaw opens, permitting release of said yarn, a plate on said carrier extending laterally in a position to be overrun by the opposite carrier when said carriers overlap, a lip on the outer side of said plate engaging the yarn carried by said carrier, spreading the bight of said yarn across the path of the opposite carrier, ensuring that it shall be received by said carrier, and means on said carrier engageable with actuating means extraneous to said carrier for operating the jaws of said carrier in proper sequence.

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