March 22, 1960 W. E. KIMMEL 2,929,411

PICK AND PICK AUTOMATIC LOOM

Filed Dec. 3, 1956 6 Sheets-Sheet 1

FIG. 1

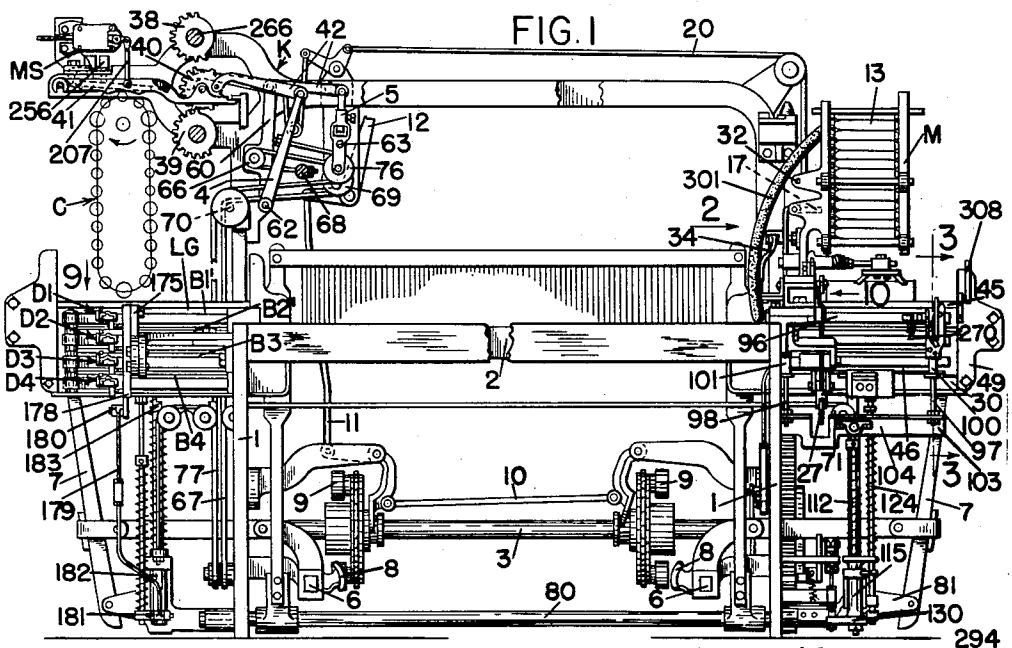



FIG. 2

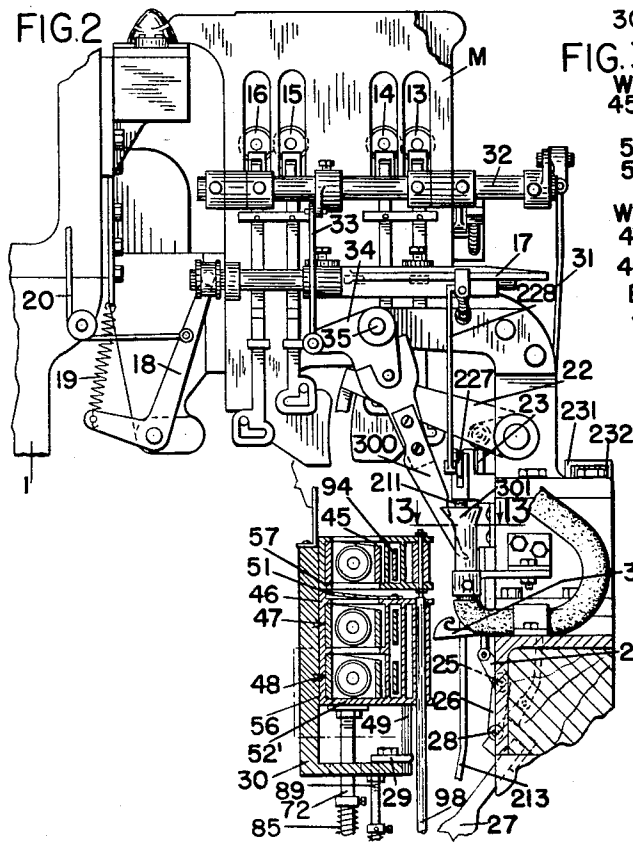
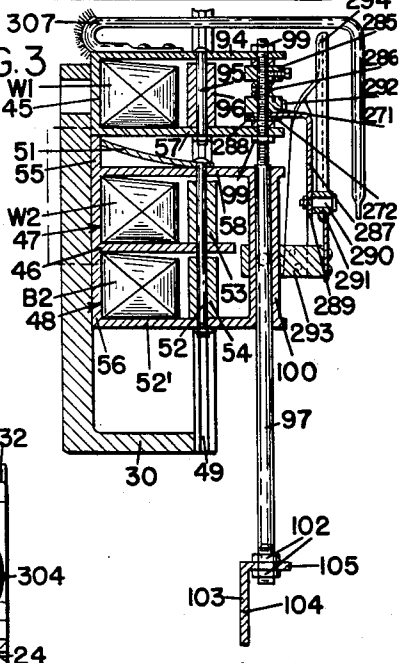



FIG. 3




INVENTOR
WILLIAM E. KIMMEL

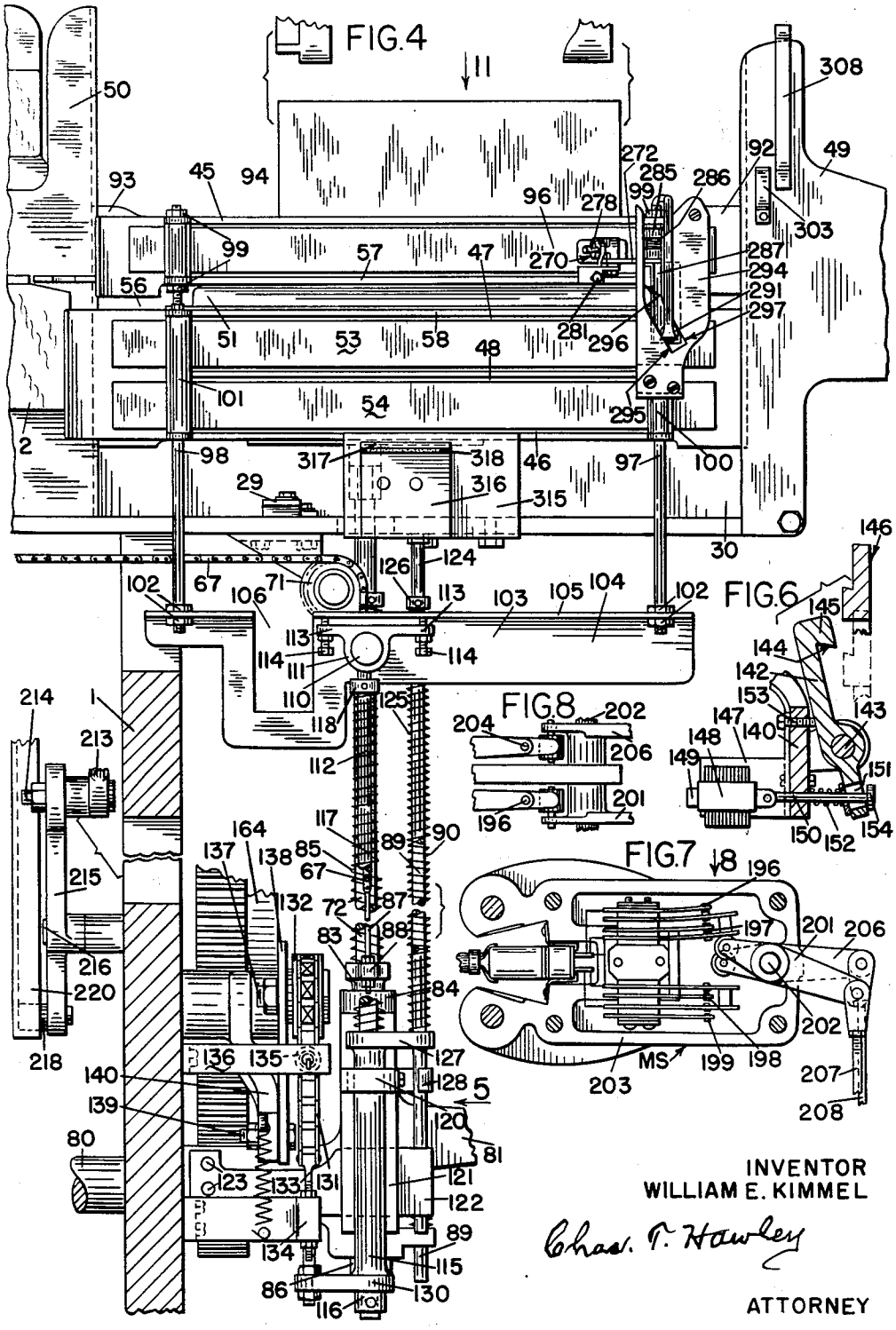
Chas. T. Hawley

ATTORNEY

March 22, 1960 W. E. KIMMEL 2,929,411

PICK AND PICK AUTOMATIC LOOM

Filed Dec. 3, 1956 6 Sheets-Sheet 2




INVENTOR
WILLIAM E. KIMMEL

Chas. T. Hawley

ATTORNEY

March 22, 1960 W. E. KIMMEL 2,929,411

PICK AND PICK AUTOMATIC LOOM

Filed Dec. 3, 1956 6 Sheets-Sheet 3

FIG.5

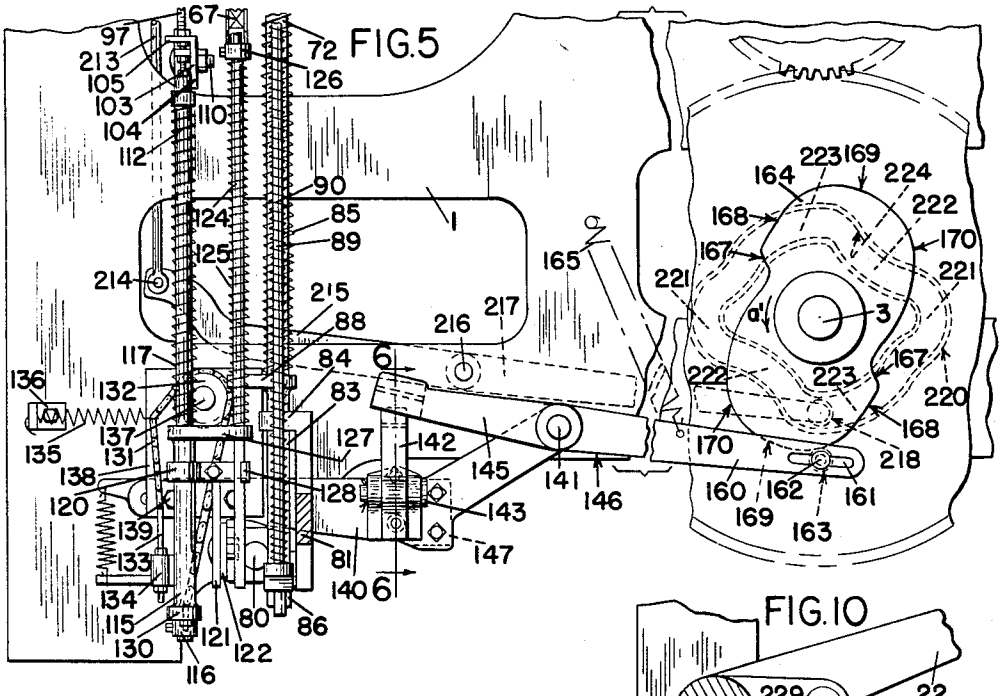



FIG.9

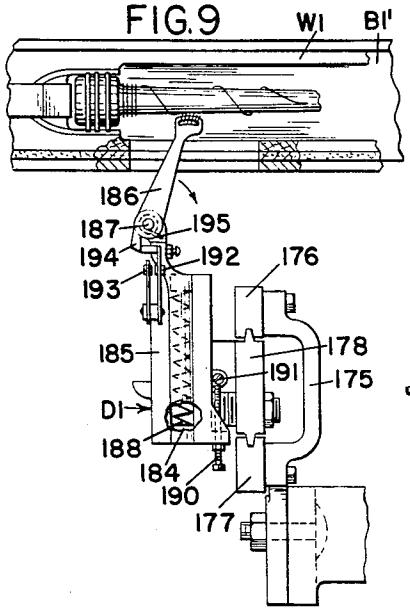



FIG.10

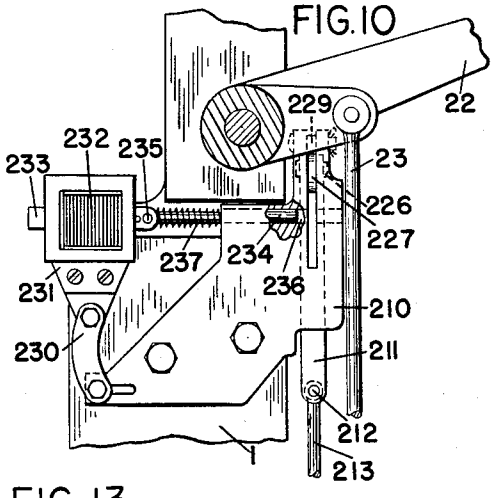
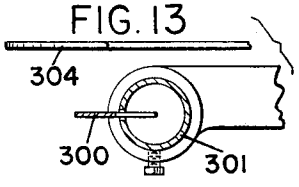



FIG.13




INVENTOR
WILLIAM E. KIMMEL

Chas. T. Hawley

ATTORNEY

March 22, 1960 W. E. KIMMEL 2,929,411

PICK AND PICK AUTOMATIC LOOM

Filed Dec. 3, 1956 6 Sheets-Sheet 4

FIG. 11

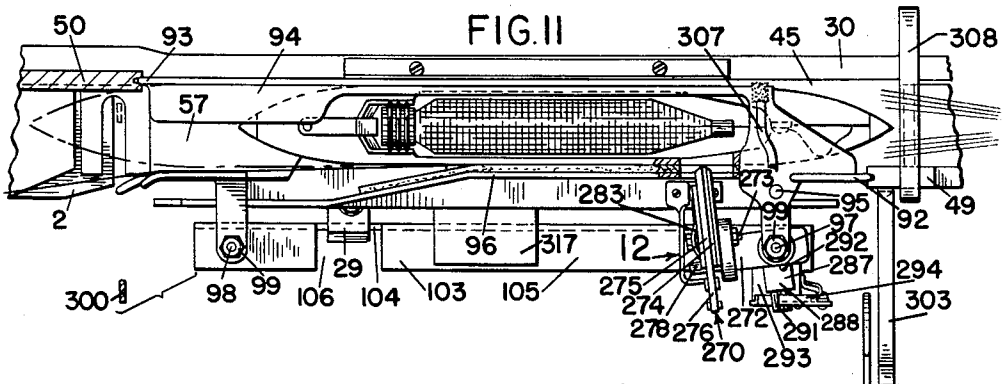



FIG. 12

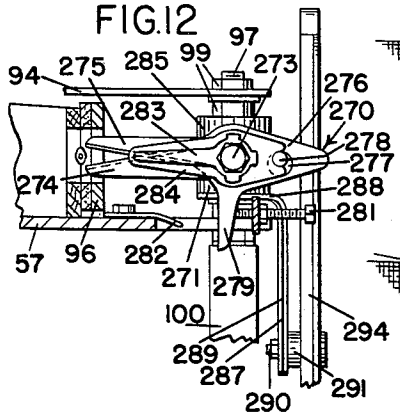



FIG. 14

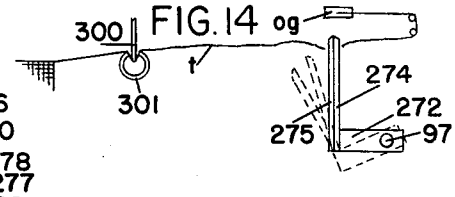



FIG. 15

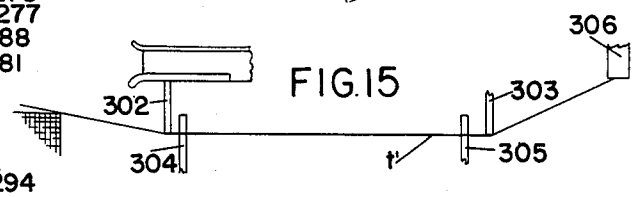



FIG. 20

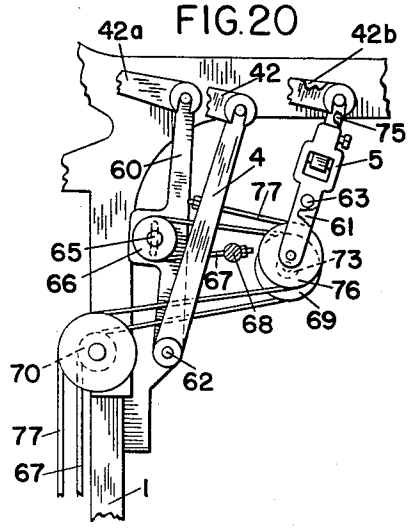
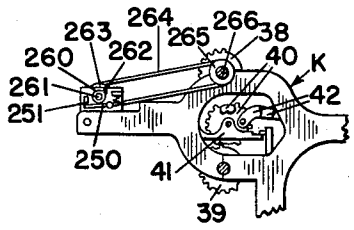



FIG. 26




INVENTOR
WILLIAM E. KIMMEL

Chas. T. Hawley

ATTORNEY

March 22, 1960 W. E. KIMMEL 2,929,411

PICK AND PICK AUTOMATIC LOOM

Filed Dec. 3, 1956 6 Sheets-Sheet 5

FIG. 17

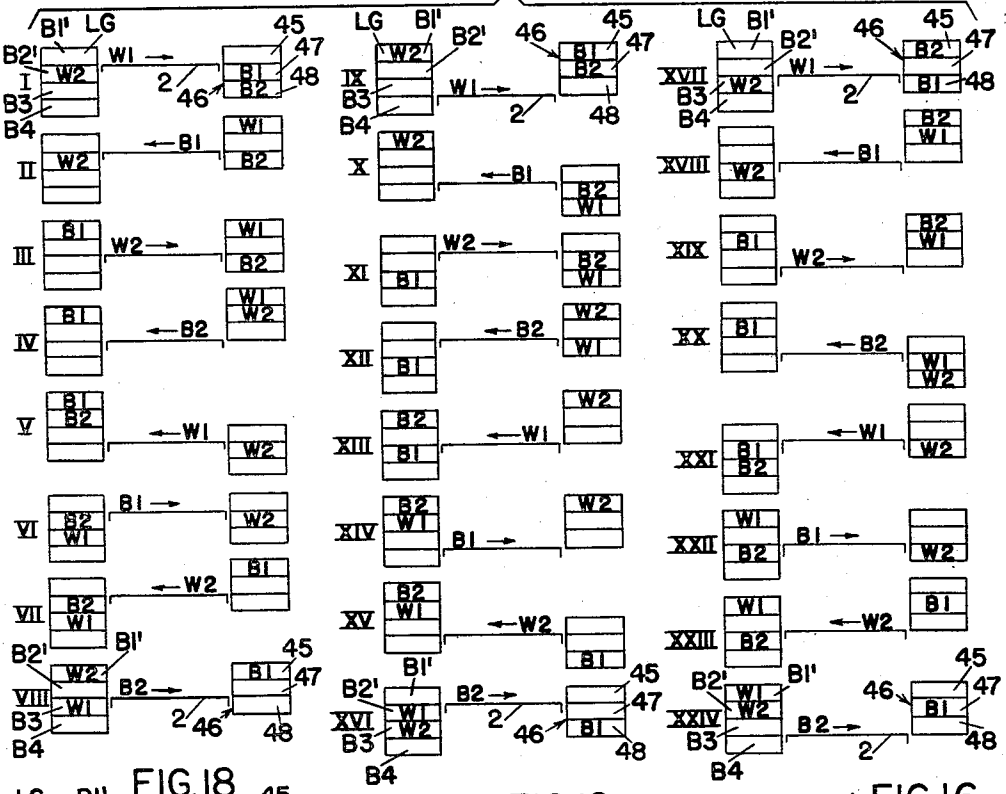



FIG. 18

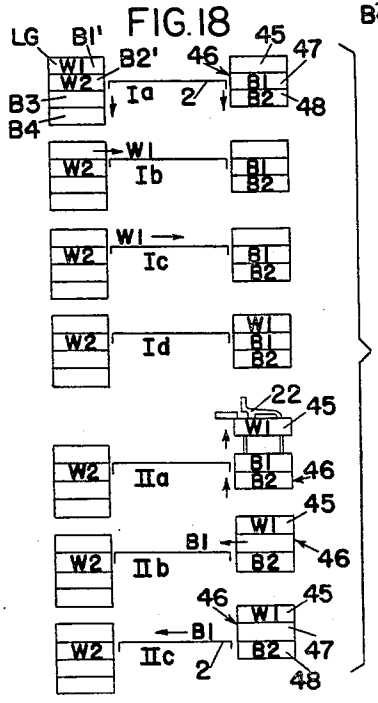



FIG. 19

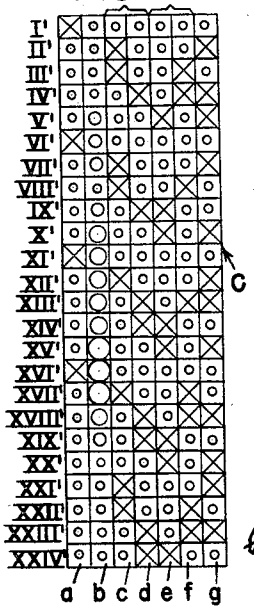
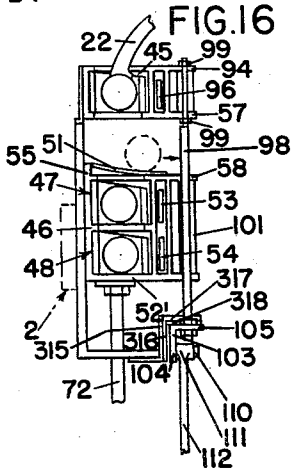



FIG. 16




INVENTOR
WILLIAM E. KIMMEL

Chas. T. Hawley

ATTORNEY

March 22, 1960 W. E. KIMMEL 2,929,411

PICK AND PICK AUTOMATIC LOOM

Filed Dec. 3, 1956 6 Sheets-Sheet 6

FIG. 21

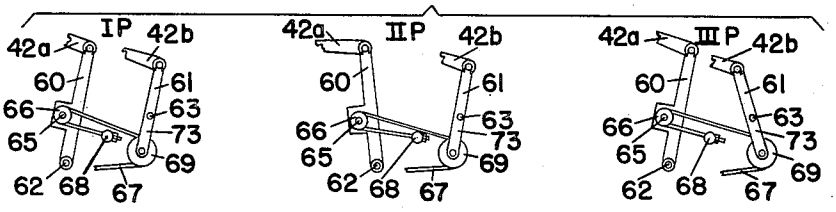



FIG. 23

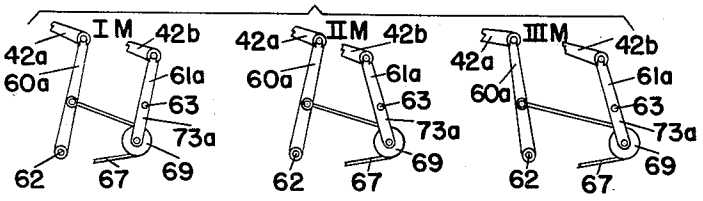



FIG. 22

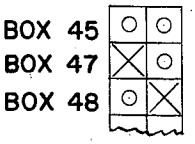



FIG. 24

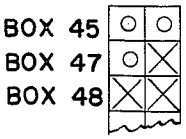
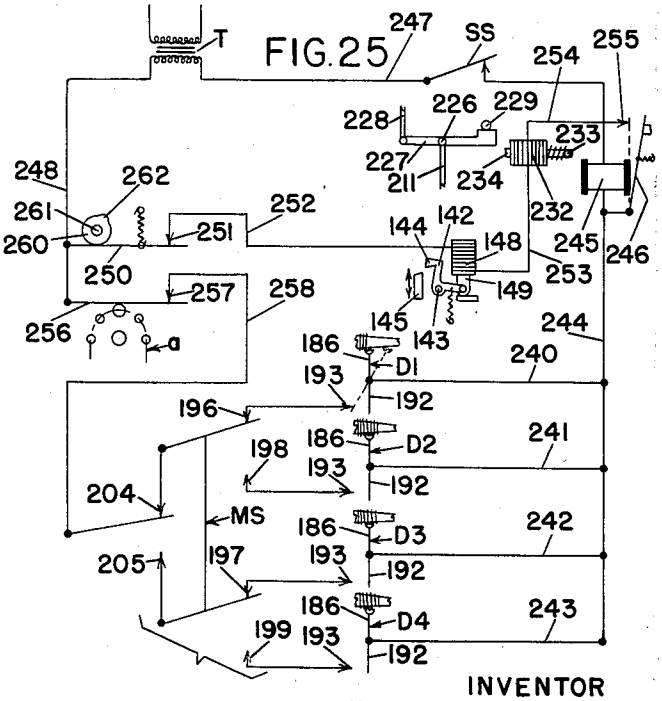



FIG. 25




INVENTOR
WILLIAM E. KIMMEL

Chas. T. Hawley

ATTORNEY

United States Patent Office 2,929,411
Patented Mar. 22, 1960



2,929,411

# PICK AND PICK AUTOMATIC LOOM

William E. Kimmel, Millbury, Mass., assignor to Crompton & Knowles Corporation, Worcester, Mass., a corporation of Massachusetts

Application December 3, 1956, Serial No. 625,788

14 Claims. (Cl. 139—232)

This invention relates to improvements in two-color weft replenishing pick and pick looms and it is the general object of the invention to provide a loom of this type in which two shuttles are assigned to each color and wherein perfect blending of both colors is attained.

There have already been proposed pick and pick looms of the general type mentioned, but they have required either a gang of shuttle box cells one of which has a built-in bobbin deflector, necessitating excessive box shifting movements, or have operated in such manner as to prevent temporary storage of an idle shuttle at the magazine end of the loom on weft replenishing beats. These conditions impose limitations which prevent efficient production of two-color pick and pick fabrics in which perfect blending can be attained when two shuttles are assigned to each color.

It is an important object of the present invention to overcome the aforesaid limitations by providing plural shuttle box cells at the magazine end and separating the top cell from the lower cells so that it can be momentarily lifted away from the cells below it to provide a path for the outgoing bobbin. All of the box cells are usable so that excess box shifting movements are avoided and the lower cells can be used to hold idle shuttles on weft replenishing beats of the loom. These conditions make possible a shuttle sequence for effecting perfect blending.

By having the top box at the magazine end of the loom detachable it is possible not only to accommodate at that end of the loom a temporarily idle shuttle for weaving pick and pick but also provides accommodation for a shuttle which is called upon only infrequently to lay a decorative narrow stripe in the fabric.

The box structure at the magazine end of the loom will ordinarily be shifted when the lay of the loom is between approximately its bottom and top center positions. A subgang of two cells or boxes is below the single box and will shift on ordinary time so that it will be approximately half shifted at front center, but the single top box will be moved more quickly and will reach the transfer station of the magazine when the lay is at front center. The gap or space opened up below the top box and above the bottom gang is therefore amply large for the outgoing bobbin and is due not only to the larger motion which the single top box has but also to the fact that it moves at a faster rate than the boxes below it.

In order to effect the aforesaid separation of the top box it is a further object of the invention to provide an auxiliary or secondary box shifting mechanism connected only to the top box. This auxiliary mechanism is ordinarily inactive with respect to the top box and is called into action only on those picks or beats of the loom when replenishment is required. On such beats the subgang below the top box will be shifted by a primary shifting mechanism which on nonreplenishing beats of the loom will shift all of the boxes at the magazine end in unison as though they were a single unit.



The primary mechanism can therefore shift all of the boxes on nonreplenishing beats and the subgang only on replenishing beats, and the secondary mechanism is able to shift the top box alone on replenishing beats only.

It is desirable to cut the thread of the outgoing bobbin in order to prevent it from being dragged into the warp shed and it is a further object to accomplish this result by a thread cutter normally in noncutting position but moved to cutting position due to the differential motion of the top box with respect to the subgang on weft replenishing beats of the loom. To effect this result the cutter is provided with two cooperating parts one of which is on the single box and the other of which is on the subgang. During normal loom running when all the boxes move as a unit these two parts have no relative motion but on replenishing beats when the top box moves away from the subgang and the condition for cutting arises the cutter will move to cutting position.

In order to lay a pick every beat of the loom it is necessary that the subgang be in position to pick a shuttle shortly after the top box has been lifted to the transfer station. It is a further object of the invention to make the aforesaid secondary box mechanism in such manner that it will effect return of the top shuttle box to its position adjacent to or supported by the subgang prior to the picking operation which immediately follows replenishment. In this way restoration to normal relative positions of the top box and subgang will not cause vibration to interfere with picking as might otherwise occur if the top box descended on the gang at the time of picking.

As set forth hereinafter there are three shuttle boxes at the magazine end of the loom, the subgang having two boxes. Any one of these shuttle boxes can be in active shuttle receiving position but a weft replenishing operation can be initiated only when the top box is actively placed to receive a depleted shuttle from the opposite end of the loom. It is a further object of the invention to provide a control for the weft replenishing mechanism which will prevent initiation of the replenishing operation by a weft detector mechanism at the end of the loom opposite the magazine unless the top box at the magazine end is actively placed to receive the depleted shuttle.

A further object of the invention is to provide a shuttle box construction having two box members one of which is movable independently of the other and wherein the two members have cooperating guide means to keep the members aligned. As will be set forth hereinafter the previously-mentioned top box is supported on rods or the like which pass through guides mounted on the subgang and the shuttle binders for the boxes are between the shuttles in the boxes and the guide means.

In the usual multi-cell shuttle box mechanism the amount of shift of a gang to move one cell out of active position and another into active position is ordinarily a simple factor of the distance between adjacent cells. Thus, in a 3-cell box gang of ordinary construction the gang will have either a one box shift or a two box shift which is twice the amount of a one box shift. In the present instance, however, a deflector plate for the outgoing bobbin is secured to the top of the subgang and the center of the top box is spaced above the center of the second box, the top box of the subgang, by a distance greater than the height of one box but less than twice the height of a box. This means that when all three boxes move as a unit under control of the primary box shifting mechanism the shift from the first box to the second box will be an amount greater than a one box shift but less than a normal two box shift, since the bobbin deflector is of a height much less than that

of a box. The shift from the second box to the third box, however, is a regular one box shift.

It is a further object of the present invention to provide a form of primary box shifting mechanism so constructed that it can shift the three boxes at the magazine end of the loom through distances which will correctly place any of the three boxes in active position aligned with the lay.

In order that the invention may be clearly understood reference is made to the accompanying drawings which illustrate by way of example two embodiments of the invention and in which:

Fig. 1 is a front elevation, parts being broken away and parts being in section, of a loom having the preferred form of the invention applied thereto,

Fig. 2 is an enlarged side elevation looking in the direction of arrow **2**, Fig. 1, certain of the parts being in section,

Fig. 3 is an enlarged vertical section on line 3—3, Fig. 1,

Fig. 4 is an enlarged front elevation, parts being broken away and parts being in section of the lower right-hand part of Fig. 1,

Fig. 5 is a detailed side elevation, parts being broken away, on a reduced scale looking in the direction of arrow **5**, Fig. 4,

Fig. 6 is a detailed vertical section on line 6—6, Fig. 5, on an enlarged scale,

Fig. 7 is a view partly in section of one of the electric switches used with the invention,

Fig. 8 is a fragmentary detailed view looking in the direction of arrow **8**, Fig. 7, parts being omitted,

Fig. 9 is a plan view partly in section of an enlarged scale looking in the direction of arrow **9**, Fig. 1,

Fig. 10 is a detailed enlarged side elevation, parts in section, looking in the direction of arrow **10**, Fig. 1,

Fig. 11 is a plan view looking in the direction of arrow **11**, Fig. 4, certain of the parts being in section,

Fig. 12 is a detailed side elevation looking in the direction of arrow **12**, Fig. 11, showing the thread cutter mechanism in its normal noncutting position,

Fig. 13 is an enlarged horizontal section on line 13—13, Fig. 2, showing part of the thread control used with the invention,

Fig. 14 is a diagrammatic plan view indicating the control for the thread of the outgoing bobbin,

Fig. 15 is another diagramamtic view showing the control for the thread of the incoming bobbin,

Fig. 16 is a diagrammatic view similar to a part of Fig. 2 but showing the top box raised to the transfer station to provide a space under it for the outgoing bobbin,

Fig. 17 is a diagrammatic view showing a sequence of 24 successive shuttle box positions operating according to the present invention, this figure representing only one example of a number of different sequences which can be used,

Fig. 18 shows a sequence of position for the shuttle boxes in two successive beats of the loom, each box being for one of the well-known quarter center positions of the lay,

Fig. 19 is a diagram showing the pattern chain for controlling the several parts of the loom, including the shuttle picking sequence shown in Fig. 17,

Fig. 20 is an enlarged view of part of the mechanism shown in the upper left-hand part of Fig. 1 and showing the preferred form of the primary box shifting mechanism for the shuttle boxes at the right-hand end of the loom as viewed in Fig. 1,

Fig. 21 is a bracketed view showing certain of the levers of Fig. 20 diagrammatically and in the three relative positions which they assume to place the three boxes at the magazine end of the loom in active position,

Fig. 22 is a fragmentary diagram of a box chain for controlling the levers shown in Fig. 21,



Fig. 23 is another bracketed view showing three different positions of levers of a modified box shifting mechanism for the boxes at the magazine end,

Fig. 24 is a view similar to Fig. 22 but shows a chain for the modified form of box mechanism shown in Fig. 23,

Fig. 25 is a diagram of an electric circuit which can be used in connection with the invention, and

Fig. 26 is a fragmentary view of the upper left-hand part of Fig. 1, showing the timer switch and drive therefor used in conjunction with the electric circuit of Fig. 25.

Referring particularly to Figs. 1 and 2, the loom has a stationary frame **1**, a lay **2** which passes through the usual quarter center positions, that is, bottom, front, top and back center positions for each beat of the loom, a control mechanism generally indicated at K of the well-known Knowles type, a 4-stack stationary magazine M, and a bottom shaft **3** which completes a rotation thereof every second beat of the loom. The left-hand end of the lay is provided with a gang LG of four vertically aligned shuttle box cells which move as a unit in well-known manner controlled by box levers **4** and **5** of usual operation and construction.

Each side of the loom is provided with a picker shaft **6** operatively connected to its corresponding picker stick **7** and a cam **8** for each shaft is actuated by one or another of the pairs of picking balls **9** mounted to slide along but rotate with the shaft **3**. This is a type of selector picking mechanism which has come into use in the type of loom to which the present invention relates, but other forms of selector picking mechanism can be used, if desired. Such mechanisms should be able to pick a shuttle from either end of the loom on any beat of the loom. A link **10** causes the right and left-hand pairs of picking rolls **9** to move in unison under control of a vertical rod **11** connected to a lever **12** under control of column *g* of the pattern chain generally indicated at C and shown diagrammatically in Fig. 19 and applied to the loom in Fig. 1.

The magazine M is similar to the well-known stationary 4-color magazine and has four stacks of reserve bobbins **13**, **14**, **15** and **16** reading from front to back, the stacks **13** and **15** being provided with bobbins of one color, such as white, and the stacks **14** and **16** containing bobbins of another color, such as black. The magazine is provided with the usual color slide **17** which is moved horizontally by a bell crank lever **18** which is urged forwardly, to the right in Fig. 2, by a spring **19**, but can be moved rearwardly by a flexible connector **20** which extends across the loom and is under control of the rolls on the pattern chain indicated in column *b* of Fig. 19.

The magazine is provided with a transferer arm **22** which in the present instance is somewhat different from the usual transferer arm in the manner in which the operating force is applied to it. A rod **23** connected to and depending from arm **22** has its lower end connected to the upper arm of a lever **24** pivoted at **25** on a fixed axis. The lower arm **26** of lever **24** has a latch **27** pivoted thereto at **28**. Ordinarily the latch is in the down position shown in Fig. 2 but can be lifted for engagement with a bunter **29** secured to a layend **30** secured to the right-hand end of the lay **2**, see Fig. 1. When the latch is thus engaged the rod **23** is moved downwardly and rocks the transferer arm to transfer a bobbin under it into a shuttle as will be described in more detail hereinafter.

The latch **27** is lifted from its normal nonset to its set position aligned with the bunter **29** by a rod **31** connected to a rocker shaft **32** forming a usual part of the magazine M. Shaft **32** is connected by rod **33** to a thread placer mechanism **34** pivoted on a fixed stud **35** of the magazine.

Referring again to mechanism K, upper and lower mutilated cylinder gears **38** and **39** respectively turning

in opposite directions cooperate with vibrator gears 40 on vibrator levers 41 over the chain C. The vibrator gears are attached to connectors 42 which in turn operate various parts of the loom as will be described in more detail hereinafter.

In the operation of the loom thus far described the picking mechanism will act on every beat of the loom to pick a shuttle from either the right or the left-hand end of the lay when the latter is approximately on its top center position and the shuttle will continue in flight across the lay as the latter moves through its back center position and until the lay reaches approximately its bottom center position, at which time the shuttle will be boxed. The lay then continues to its front center position where a bobbin transfer, if previously called, will occur and continued motion of the lay will return it to its next top center position for the next picking operation. The positions of the boxes and shuttles as shown in Fig. 17 are those which occur when the lay is approximately in its back center position after the boxes have come to rest with respect to the lay after their shifting movements. The matter thus far described may be made and operative except as noted hereinafter in the usual manner or as set forth in my copending application, Serial No. 552,233. It will be noted that the magazine M is in a position somewhat but not very much higher than the position shown in that application.

An important feature of the invention is the shuttle box structure at the magazine end of the loom, this structure being made in two members or parts, the upper of which is a single shuttle box 45 and the lower of which is a subgang 46, having upper and lower cells or boxes 47 and 48 respectively permanently united and moving together. The lower member 46 is guided in usual manner by the outer and inner vertical guides 49 and 50 respectively secured to the layend 30. The upper member 45 is guided to some extent, but not exclusively, by guides 49 and 50.

Primary and secondary box shifting mechanisms are used for the boxes at the magazine end, the primary mechanism being connected to the subgang 46 and the secondary or auxiliary mechanism being for the top box 45.

Referring to Fig. 3 it will be seen that a bobbin deflector 51 is secured to the top of the subgang 46 in fixed relationship thereto by means including the usual pin 52 for the upper and lower shuttle binders 53 and 54 of the subgang. This deflector 51 is curved upwardly and rearwardly and rests against an upper extension 55 of the back 56 of the subgang. The floor 57 of the top box 45 rests on this extension 55 and is partly supported by it. The distance between the floor 57 and the top 58 of the subgang is considerably less than the center to center distance of the boxes 47 and 48 and since during the greater part of the operation of the loom the three boxes 45, 47 and 48 shift vertically as a unit the usual type of box shifting mechanism cannot be used for the subgang 46 but must be modified due to the fact that a vertical shift of the three boxes as a unit from its lowest position to the position in which box 47 will be in active picking position aligned with the lay is appreciably more than a one-box shift but not nearly as much as a two-box shift. When these three boxes are being raised from their second to their high position to place the lowest box 48 in active position the amount of shift is of the usual kind, that is, a one-box shift.

The unequal shifting required by box members 45 and 46 is accomplished by either of two mechanisms which can be used in mechanism K and shown in Fig. 20. Located behind the previously described box lifter levers 4 and 5 for gang LG are levers 60 and 61 forming parts of the preferred form of primary box lifter mechanism. Lever 60 is rockable at its lower end about a fixed axis 62 around which lever 4 turns and lever 61 is rockable intermediate its ends about a fixed axis 63 around which lever 5 turns. The upper ends of levers 60 and 61 are connected to their vibrator gear connectors 42*a* and 42*b* respectively. These connectors 42*a* and 42*b* will have the usual amount of motion derived from the turning of their corresponding vibrator gears so that the upper ends of the levers 60 and 61 will move through their usual distances.

Lever 60 is provided with a stud 65 on which is rotatably mounted a chain sprocket wheel 66 around which is trained a box lifting chain 67 an end of which as shown in Fig. 20 is secured in fixed position to a cross bar 68 forming part of the usual mechanism K. The chain 67 is trained around a second sprocket wheel 69 rotatable on the lower arm 73 of lever 61 and then extends to the left and is trained over a small guide pulley 70 and thence in usual manner as indicated in Fig. 1 to the opposite side of the loom where it is trained around a second guide pulley 71 and thence downwardly and operatively connected to a box lifter rod 72 the upper end of which is secured to the bottom plate 52' of box 48 as shown in Fig. 4.

The lever 61 has the upper part thereof formed in usual manner and is provided with a vertically adjustable bar 75 for attachment to the vibrator gear connector 42*b*, but the lower arm 73 is somewhat longer than the corresponding arm of lever 5 part of which is broken away in Fig. 20. With further reference to lever 5, it has mounted rotatably thereon the usual sprocket wheel 76 around which is trained box lifter chain 77, one end of which is connected directly to lever 4 and the other end of which is connected operatively to box gang LG under the mechanism K in usual manner.

The operation of the box shifting mechanism for the boxes at the right-hand or replenishing end of the loom is shown diagrammatically in Fig. 21, positions IP, IIP and IIIP. In position IP the lifter chain 67 causes the top shuttle box 45 to be in active shuttle receiving position to receive a shuttle picked from gang LG. The bobbin deflector 51 and the two boxes below it are all below active shuttle receiving position. When it is desired to lift box 47 to active position the lifter chain 67 must be moved a distance equal to the center to center distance of boxes 45 and 47 when the boxes are as shown in Fig. 3. This distance is greater than the height of one box but less than twice the height of a box. It is because of this unusual amount of shift that the ordinary box motion cannot be used. As an example, in worsted looms the height of a shuttle box is usually 1¾ inches. The distance between boxes 45 and 47, that is, the space occupied by the bobbin deflector, is ¾ of an inch, to mention the distance actually used in one form of the invention. The lifter chain must therefore be pulled a distance equal to 2½ inches. This is accomplished by shifting lever 60 from the position shown in IP to the position shown in IIP, keeping the lever 61 stationary. The axis of sprocket wheel 66 is so located on lever 60 that as the latter moves from its end position of IP to its end position of IIP the lifter chain will exert an upward force on the subgang 46 which will locate box 47 in active position.

The upward shift to place box 48 in active position is a normal amount, the center to center distance of boxes 47 and 48 being equal to a normal one box shift. To effect this shift the levers 60 and 61 move to the position IIIP. When lever 60 moves to the position shown in IIIP it would have the effect of lifting the boxes an amount equal to twice a one box shift plus the ¾ inch for the deflector because of the increased length of arm 73, but when lever 61 is shifting to its position of IIIP lever 60 is also shifting back to its position of IP and in doing so subtracts the shift of 2½ inches from the shift of 4¼ inches which lever 61 would otherwise produce, leaving a net lift of 1¾ inches, the center to center distance between boxes 47 and 48.

Fig. 22 shows diagrammatically the manner in which those parts of the box pattern chain assigned to boxes

45, 47 and 48 would be built. To call box 45 to active position the vibrator levers for connectors 42*a* and 42*b* would be over low rolls or sinkers. To call box 47 a sinker would correspond to connector 42*b* but a high roll would correspond to connector 42*a*. To call box 48 the high and low rolls would be reversed from their position for box 47. This is the usual way to build a pattern chain to call boxes in the relative positions of boxes 45, 47 and 48.

The second or modified box shifting mechanism is shown diagrammatically in Fig. 23. The levers 60*a* and 61*a* are more nearly like levers 4 and 5 than are the levers 60 and 61 and a structural view is not believed to be necessary.

In Fig. 23 lever 60*a* is the same as lever 4, that is, the lifter chain is connected directly to it and when shifting from its end position in IM to its end position in IIIM it produces a one box shift. Lever 61*a*, however, differs from lever 5 in that its lower arm 73*a* is shorter so that when lever 61*a* shifts from its end position shown in IM to its end position shown in IIIM it produces a lift equal to one box plus the distance between boxes 45 and 47.

When levers 60*a* and 61*a* are as shown in IM of Fig. 23 box 45 will be active. To lift box 47 to active position lever 61*a* is swung to the position shown in IIM, thus producing a lift, to refer to the previous example, of 2½ inches. To lift box 48 to active position lever 61*a* remains as in IIM but lever 60*a* shifts as indicated in IIIM. This will cause a one box shift beyond the shift caused by lever 61*a*.

The modified form may appear to be simpler than the preferred form, but it requires a change from standard practice in building the box pattern chain. In Fig. 24, similar to Fig. 22, box 45 would be called by two low rolls on the pattern chain, but to call box 47 the high and low rolls would be reversed from their position in Fig. 22, and in order to call box 48 two high rolls would need to be under the vibrator levers corresponding to connectors 42*a* and 42*b*.

The box lifter arrangements shown in Figs. 21 and 23 are two examples of forms of mechanisms for lifting the boxes at the magazine end for nonreplenishing beats, but the invention is not necessarily limited to these two forms.

The connections between box lifter chain 67 and the subgang 46 are shown in Figs. 1, 4 and 5. The rocker shaft 80 which supports the lay has secured thereto a rocker iron 81 of more or less usual form. The box lifter rod 72 is secured to and depends from the subgang 46 and passes through a sleeve 83 slidable in a lateral guide 84 at the top of the rocker iron. A compression spring 85 around rod 72 rests on the top of the sleeve and exerts an upward force on the subgang which is limited by engagement of a stop collar 86 on the bottom of the rod with the lower end of the sleeve. The chain 67 is connected by a short rod 87 to a lug 88 at the top of the sleeve. An upward pull on chain 67, see Fig. 4, lifts the sleeve and the latter acts through the spring to raise the subgang. A rod 89 secured at its upper end to layend 30 is surrounded by a push down spring 90 acting on the sleeve to help gravity to lower the subgang when chain 67 is slackened.

The connections between chain 67 and subgang 46 is of usual construction and is described in some detail only because at times it lifts top box 45 which is not directly connected to rod 72 and also because of its proximity to the secondary box motion for top box 45 yet to be described.

The top box 45 and the secondary box shifting mechanism for operating it are shown in Figs. 1, 3, 4 and 5.

Right and left-hand tongues 92 and 93 of box 45 fit into the box guides 49 and 50 respectively, as shown in Fig. 4. The top 94 and bottom 57 of box 45 are extended forwardly, to the right in Fig. 3, and are joined by a pin 95 for a shuttle binder 96. Right and left-hand lifter and guide rods 97 and 98 respectively, Fig. 4, are secured at their upper ends to the top 94 and bottom 57 of box 45 by nuts 99 screw threaded on the threads at the upper ends of the lifter and guide rods.

The subgang 46 has secured thereto right and left tubular guides 100 and 101 through which the rods 97 and 98 respectively slide. The lower ends of rods 97 and 98 are secured by nuts 102 to a lifter bar 103 which is forward of the layend 30, see Figs. 3 and 4. The lifter bar 103 has a vertical flat body 104 and has at its top a horizontal flange 105 to which the rods 97 and 98 are fastened. The bar 103 is recessed at 106 to make room for the transfer latch 27 when the latter is raised to engage bunter 29.

A stud 110 held in body 104 as shown in Fig. 5 passes through a rod head 111 on the upper end of a box lifter rod 112. Lateral arms 113 on the rod head support positioning screws 114 which press tightly against flange 105 to fix the rod 112 with respect to the lifter bar 103. Rod 112 passes down through a sleeve 115 and has a collar 116 secured to the lower end thereof to engage the bottom of the sleeve. A compression spring 117 around rod 112 between a collar 118 fast on the rod and the top of sleeve 115 holds the collar 116 up against the sleeve and transmits lifting force from the sleeve to the top box 45.

Sleeve 115 is slidable vertically in a laterally extending guide 120 on a carrier 121 secured to a plate 122 which in effect is a second rocker iron fastened at 123 to the main rocker iron, see Fig. 4. A rod 124 fast at its upper end with the layend 30 is surrounded by a push down compression spring 125 between a collar 126 and an arm 127 extending laterally from the upper part of sleeve 115. A small guide 128 secured to guide 120 partly surrounds rod 124 to prevent the latter from moving back and forth with respect to upright 121. Since rod 124 passes through part 127 of sleeve 115 the latter is prevented from turning. As viewed in Fig. 4, box lifter rod 72 is behind box lifter rod 112, and rod 89 is to the right of rods 72 and 112 and behind rod 124. As seen in Fig. 5, box lifter rod 72 is to the right of box lifter rod 112 and behind rod 89.

The bottom of sleeve 115 has a lateral arm 130 connected to a chain 131 which as shown in Fig. 5 extends upwardly and over a sprocket wheel 132 and then down to a rod 133 anchored to a fixed support 134. A tension spring 135 has its right-hand end, see Fig. 5, connected to chain 131 and has its left-hand end held by a fixed support 136. This spring takes up any slack which may develop in the chain and serves to hold it taut.

The sprocket 132 is rotatable on a stud 137 on a plate 138 held at 139 to a lever 140 rockable on a fixed stud 141. This lever has a latch 142 pivoted to it at 143 and formed with a hook 144 for engagement with the lifting arm 145 of an actuator or operator lever generally indicated at 146 also pivoted on stud 141, see Figs. 5 and 6.

Lever 140 has secured thereto a support 147 on which is mounted a solenoid 148 having a core 149 to which is pivoted a pull rod 150 passing through a hole 151 in latch 142. A compression spring 152 surrounding rod 150 between lever 140 and latch 142 normally holds the latch in the position shown in Fig. 6 against a stop screw 153 on lever 140 when the solenoid is deenergized. When the solenoid is energized it pulls rod 150 to the left, Fig. 6, and a head 154 on rod 150 moves the latch clockwise around its pivot in position to be raised by lifter arm 145.

The right-hand arm 160 of lever 146, see Fig. 5, has a slot 161 therein for adjustment of a stud 162 on which a roll 163 rotates. The roll is held in engagement with a cam 164 by a tension spring 165. Cam 164 is secured to the bottom two pick shaft 3 of the loom and rotates during loom operation to give lever 146 a complete reciprocating movement each beat of the loom. Cam 164 turns counterclockwise in the direction of arrow *a'*, Fig. 5.

Cam 164 has two equal halves each including an abrupt incline 167 leading to a more gradual incline 168 which ends at some such point or area as 169 and then continues with a decline 170 to the bottom of the other incline 167. This cam and associated parts are in the position shown in Fig. 5 when the lay is approximately in its front center position.

The weft detector mechanism for determining the condition of weft in the shuttles is located at the left-hand or head end of the loom as viewed in Fig. 1 and is shown more specifically in Fig. 9. Associated parts are shown in Figs. 7, 10, 19, 25 and 26.

Referring to Fig. 9, a stand 175 secured to the loom frame 1 supports guides 176 and 177 between which moves a vertically reciprocating weft detector carrier 178. A rod 179, Fig. 1, has its upper end 180 attached to the carrier 178 and its lower end 181 attached to a sleeve 182 operatively connected to a box lifter rod 183 by the chain 77. The rod 179 and carrier 178 rise and fall in unison with the rising and falling of shuttle box gang LG.

The carrier 178 has mounted thereon four weft detectors generally indicated at D1, D2, D3 and D4 for the shuttle boxes B1', B2', B3 and B4 respectively of gang LG. These detectors D1–D4 are all alike and only one will be described, namely, D1.

Detector D1 has a base 184 fixed to carrier 178. A slide member 185 is mounted on the base for horizontal back and forth motion and has located thereon a weft detector finger 186 pivoted at 187. A spring 188 intermediate the base 184 and slide member 185 urges the slide member rearwardly. A set screw 190 on slide member 185 contacts stop screw 191 on base 184 to limit rearward motion of the slide member.

Member 185 has mounted thereon a pair of contacts 192 and 193 held in spaced relationship to each other by a trigger 194 extending from finger 186. A spring 195 surrounds pivot 187 and urges finger 186 in a counterclockwise direction as viewed in Fig. 9. Weft detector D1 operates in a well-known manner, that is, as the lay 2 approaches front center position, finger 186 will be moved forwardly with slide member 185 if there is sufficient weft on the bobbin. If the bobbin is depleted of weft, finger 186 will move clockwise about pivot 187 thereby permitting contacts 192 and 193 to close to effect a change in loom operation. It will be understood that weft detectors D2, D3 and D4 operate in similar manner.

Referring to Figs. 1 and 7, mechanism K has mounted thereon a selector switch generally indicated at MS having contacts 196, 197, 198 and 199 to coact with a switch closing lever 201 pivoted at 202 on the casing 203. A pair of contacts 204 and 205, see Figs. 8 and 25, coact with a switch closing lever 206 also pivoted at 202. Levers 201 and 206 have depending therefrom connectors 207 and 208 respectively, the lower ends of the connectors being attached to their respective vibrator levers 41. Vibrator levers 41 and their respective connectors 207 and 208 are under control of the rolls on the pattern chain C as indicated at vertical columns *e* and *f*, Fig. 19. The contacts 196–199 and contacts 204 and 205 of switch MS are under selective control to complete a circuit to initiate a change in loom operation when any one of the shuttle boxes B1'–B4 is level with the shuttle race provided the bobbin that is at shuttle race lever is substantially depleted of weft and finger 186 moves clockwise to permit closing of contacts 192 and 193. For a further understanding of the construction and operation of switch MS reference is made to Patent No. 2,592,126, issued to R. A. Donnan on April 18, 1952.

Referring to Figs. 5, 10 and 25, a stand 210 guides a rod head 211 for vertically reciprocating motion during loom operation. Rod head 211 has connected as at 212 a depending rod 213 the lower end of which is pivoted as at 214 to a cam lever 215 pivotally mounted on a stud 216 fixed to frame 1. Lever 215 has an arm 217 which supports a cam roll 218. A cam generally indicated at 220 is held fast on bottom shaft 3 and has high areas 221, low areas 222 and intermediate dwell areas 223. Rise and fall portions of the cam connect said areas to form a groove generally indicated at 224 for cooperation with roll 218. Areas 221 are diametrically opposite each other as are areas 222, and areas 223.

Rod head 211 has pivotally mounted on its upper end at 226 a chopper pin lever 227. The left-hand end of lever 227, Fig. 25, has pivotally attached thereto a rod 228 operatively connected at its upper end to the aforementioned color slide 17. The right-hand end of lever 227 cooperates with a stationary pin 229 which limits the upward motion of the right-hand end of lever 227.

The stand 210 supports a bracket 230 to which is fixed a casing 231 containing a solenoid 232 having a core 233. A sliding pin 234 has its left end, Fig. 10, pivoted at 235 to core 233 and has its right end guided in hole 236 in stand 210. A spring 237 interposed between stand 210 and core 233 normally keeps pin 234 out of the path of lever 227. The operation of the parts above described with reference to Figs. 5, 10 and 25 is well known in the art with the exception of cam 220, and it is sufficient to state that when exhaustion of weft is detected by any one of the detectors D1–D4 a circuit will be completed whereupon solenoid 232 will be energized to move pin 234 under lever 227 to set the magazine for a transferring operation. The cam 220 moves lever 215 substantially as set forth in U.S.A. Patent application Ser. No. 425,138, now U.S.A. Patent No. 2,781,792 filed by Clifford Darwin and myself.

Referring particularly to Fig. 25, the detectors D1–D4 are electrically connected by wires 240, 241, 242 and 243 respectively to wire 244. Wire 244 has connected thereto a holding relay 245 and a switch blade 246. From relay 245 a wire 247 having connected thereto a shipper switch SS extends to one side of the transformer T. From the other side of the transformer a wire 248 has connected thereto a switch blade 250 to coact with a contact 251 having a wire 252 connected to one side of the aforementioned solenoid 148, the other side of the latter having a wire 253 connected to previously mentioned solenoid 232. A wire 254 extends from solenoid 232 to a contact 255 to cooperate with switch blade 246. Wire 248 has also connected thereto a switch blade 256 for engagement with contact 257 on wire 258 extending to the previously referred to switch MS. Blade 256 is under control of the rolls in column *a* of chain C, Fig. 19. Switch blade 250 is under control of a cam 260 fast on a shaft 261 journaled for rotation on mechanism K, see Fig. 26. A high point 262 on cam 260 periodically moves blade 250 away from contact 251 for a purpose to be described hereinafter. A sprocket wheel 263 fixed to shaft 261 is driven by a chain 264 meshing with a sprocket wheel 265 fixed on shaft 266 rotatably mounted on mechanism K.

A weft detecting operation will now be described with reference to weft detector D1 and shuttle box B1 and it is to be understood that said operation applies also to weft detectors D2–D4 and shuttle boxes B2'–B4. During loom operation lay 2 reciprocates back and forth and near the end of its forward motion detector finger 186 enters shuttle box B1' and shuttle W1 to contact a bobbin therein for a weft detection operation. If there is ample weft on the bobbin, finger 186 and slide member 185 will be moved forwardly by continued forward movement of the lay. Contacts 192 and 193 on slide member 185 therefore will remain open and a change for loom operation will not be given. However, if the bobbin is depleted of weft, as shown in Fig. 9, continued forward motion of the lay will cause finger 186 to move clockwise around pivot 187 to permit contacts 192 and 193 to close. Upon closure of these switches

the following circuit will be completed: contact 192, wire 240, relay 245, wire 247, transformer T, wire 248, blade 256, contact 257, wire 258, contacts 204, 196 and 193. Upon completion of this circuit holding relay 245 will be energized to move blade 246 into engagement with contact 255 whereupon the following holding circuit will be completed: wire 248, blade 250, contact 251, wire 252, solenoid 148, wire 253, solenoid 232, wire 254, contact 255, blade 246, wire 244, holding relay 245, wire 247 and transformer T. Upon completion of the holding circuit solenoids 232 and 148 will simultaneously be energized to effect a change in loom operation as described hereinbefore.

During weft detection, weft detector D1 and gang LG will be moving vertically, either up or down, to move shuttle box B1' into or out of picking position. If box B1' is to move out of picking position a low roll in column *a* of chain C will be under switch blade 256, thus permitting the blade to drop away from contact 257 to prevent completion of the first described circuit even though finger 186 moves counterclockwise, Fig. 25, in the described manner to close contacts 192 and 193. On the other hand, if box B1' is to move into picking position a high roll in column *a* will maintain blade 256 against contact 257 and upon counterclockwise movement of finger 186, Fig. 25, the circuit first described above, will be completed to energize holding relay 245 whereupon the holding circuit will be completed to initiate a change in loom operation as described hereinabove. Transfer of a bobbin from the magazine M to a shuttle occurs on the front center position of the lay 2 following detection of weft exhaustion. From the time of detection of weft exhaustion at front center and at least until latch 142 is operatively connected to lifting arm 145, switch blade 250 will be against contact 251 due to the low portion of cam 260. Shortly after arm 145 and latch 142 are connected, which occurs after bottom center and before front center on a weft replenishing operation only, the high point 262 of cam 260 will move blade 250 away from contact 251 to open the holding circuit. High point 262 operates on every beat of the loom before front center to separate blade 250 and contact 251. Opening of the holding circuit will also cause deenergization of solenoids 232 and 148 with resultant inactivation of core 234 and latch 142 whereupon the loom will continue to operate in the usual manner until the next detection of weft exhaustion occurs.

Referring to Figs. 4, 11 and 12, thread cutting mechanism generally indicated at 270 is supported on the upper end of rod 97, see Figs. 3 and 12. A collar 271 loosely surrounds rod 97 and has extending therefrom an arm 272 carrying a stud 273 on which a pair of cutting blades 274 and 275 are mounted, blade 274 being fixed with respect to studs 273 and 275 being pivotally movable thereon. Blade 275 has an extension 276 formed with a hole 277 through which extends a pin 278 fixed to arm 272. Hole 277 is larger than pin 278 to permit pivotal motion of blade 275. Blade 274 has a hole (not shown) to receive pin 278, said hole being only slightly larger than the pin, thereby preventing any appreciable pivotal motion of blade 274. Blade 275 has depending therefrom a tail piece member 279 for coaction with a screw 281 and a cutter blade actuator 282 in a manner to be described hereinafter. A pressure spring 283 on stud 273 exerts a force against a plate 284 to maintain blades 274 and 275 frictionally engaged to each other.

Spaced above collar 271 is another collar 285 fixed to rod 97. A spring 286 surrounds rod 97 between the collars 271 and 285, one end of the spring being fixed to collar 271 and the other end being fixed to collar 285. The action of the spring tends to move the cutter blades in a clockwise direction around rod 97 as viewed in Fig. 11. An inverted L-shaped member 287 mounted loosely on rod 97 has a forwardly extending leg 288 and a downwardly extending leg 289, the lower end of which carries a stud 290 having a cam roll 291 thereon. Leg 288 has a short upstanding pin 292 for engagement with arm 272 and collar 271, said pin maintaining cutter mechanism 270 in forwardly retracted position during normal loom operation. A supporting block 293 on tubular guide 100 has fixed thereto a cam plate 294 having a slot to receive cam roll 291 therein, said slot being generally indicated at 295. Slot 295 has a vertical dwell portion 296 joining a portion 297 inclined downwardly and to the right, see Fig. 4. Cam plate 294 may be considered as an actuator for L-shaped member 287.

During normal loom operation the cutter mechanism 270, rod 97, cam plate 294 and L-shaped bracket 287 move up and down in unison with the shifting of the boxes 45, 47 and 48. Roll 291 will also move up and down with slot 295 but the cutter mechanism will neither be moved to cutting position nor have a cutting action due to the fact that there is no relative motion between box 45 and subgang 46. When a weft replenishing operation is to occur, due to an indication of weft exhaustion, box 45 will be moved upwardly away from subgang 46 to a transfer or weft replenishing position as described hereinbefore.

Roll 291 will move upwardly and to the left along slot 296 and thereby, due to relative motion between box 45 and subgang 46, move pin 292 clockwise around rod 97, Fig. 11, thus permitting spring 286 to exert its force to move cutter mechanism 270 away from stop screw 281 to cutting position. As the lay advances toward transfer position cutter blade actuator 282 engages tailpiece member 279 moving the latter forwardly causing blade 275 to move downwardly to coact with blade 274 to cut the thread *t* of the outgoing depleted bobbin *og*, see Fig. 14. Torsion spring 286 is stronger than flat spring 283 and there will be no forward movement of the cutter mechanism until the bottom of hole 277 contacts pin 278 whereupon continued motion of the lay will move the cutter mechanism forwardly such that tailpiece member 279 will be just back of screw 281 when the lay is at front center at which position the weft replenishing operation will be completed.

After completion of the weft replenishing operation, the lay will start to move backwardly and box 45 will start down as will roll 291. Before the next picking operation box 45 will be operatively connected to subgang 46, and roll 291 will be in the inclined slot portion 297. The movement of roll 291 from the dwell portion 296 to inclined portion 297 will cause arm 288 to turn counterclockwise, Fig. 11, around rod 97 whereby pin 292 on arm 288 will engage arm 272 and cause the latter, together with the cutting mechanism, to move counterclockwise to retracted nonoperative position. As the cutting mechanism moves counterclockwise, Fig. 11, tailpiece member 279 will engage screw 281 and blade 275 will move away from blade 274 to open position. It will be noted that pin 292 is located forwardly and to the right of the vertical axis of rod 97, see Fig. 11, thus providing a means for holding the cutting mechanism in retracted position when the roll 291 is in its low position in the inclined portion 297 of slot 295, but it is to be understood that the pin 292 and its location on arm 287 is shown as but one means of holding the cutting mechanism in retracted position and that other means may be employed without departing from the scope of the invention.

Referring to Figs. 2 and 11, thread control and shuttle box feeler mechanism 34 has depending therefrom a thread placer 300 which positions the outgoing thread *t* after it has been cut, Fig. 14, into a pneumatic thread remover 301. When the magazine is set for transfer in the manner above described, thread placer 300 will move to the dotted line position, Fig. 11, and upon resetting of the magazine in the usual manner following a weft re-

plenishing operation, thread placer **300** will be moved to the full line position to place outgoing thread *t* into thread remover **301**. In the event that thread placer **300** is prevented from moving rearwardly either by a misplaced shuttle indicated by dot and dash lines, Fig. 11, or failure of shuttle box **45** to separate from subgang **46** during a weft replenishing operation, the placer **300** will be engaged by the shuttle or subgang, as the case may be, and be moved forwardly by forward motion of the lay, to the full line position, Fig. 11, to prevent a weft replenishing operation in a manner well known.

Fig. 15 shows diagrammatically the controls for the thread *t'* of a newly replenished shuttle after its first picking operation. During flight of the shuttle the lay first moves rearwardly and then forwardly and on its forward stroke left and right thread pushers **302** and **303** on the lay move the thread *t'* into holding relationship with left and right retaining hooks **304** and **305** respectively fixed with respect to the loom frame **1**. During loom operation a temple thread cutter (not shown, but the operation of which is well known) will cut the thread *t'* adjacent the fabric and the thread thereafter will be removed by a thread holder **306** in well known manner. Thread guides **307** and **308**, Figs. 1, 3 and 11, prevent entanglement of the filling threads with the going parts on the weft replenishing side of the loom.

Fig. 17 diagrammatically shows a sequence of 24 successive picks numbered from I to XXIV, in which two colors of filling are used with two pairs of shuttles, one color being used with one pair of shuttles only, and the other color being used with the other pair of shuttles only. During weaving, the picking of the shuttles will be such that a shuttle of one of said pairs will be followed by a shuttle of the other of said pairs which in turn is followed first by the second shuttle of said first pairs and secondly, by the second shuttle of said second pairs. In the sequence I–XXIV the shuttles will be picked W1, B1, W2, B2, etc. for a 24-pick repeat and it will be noted that none of the shuttles of any pair are picked consecutively thereby resulting in perfect blending of both colors. The sequence above described is but one example of a number of different sequences which can be employed.

Fig. 18 diagrammatically illustrates the weft replenishing operation for one shuttle, namely, W1, and will be understood that weft replenishing of any of the remaining shuttles will be the same. I*a* represents the position of the lay at front center or at the time indication of weft exhaustion takes place, I*b* is top center or the start of picking of the shuttle, I*c* is back center or the midway position of the flight of the shuttle toward box **45**, and I*d* is bottom center position or the position at which the shuttle is fully boxed in box **45**. At bottom center the lay will be moving forwardly, the magazine M will have been previously set, arm **145** will be operatively connected to latch **142**, box **45** will move upwardly away from subgang **46** and the ensuing front center, II*a*, a bobbin corresponding to shuttle **W1** will be transferred thereinto, and depleted bobbin *og*, Fig. 14, will be ejected therefrom to move down along chute **51**, through the space between box **45** and subgang **46** into a bobbin receiver or receptacle (not shown). After position II*a* but before position II*b*, the start of picking of shuttle B1 or top center, shuttle box **45** will be operatively connected to the subgang **46** to prevent any vibration of the shuttle boxes at the time of picking. II*c* represents back center position of the second pick in the above sequence. Weaving thereafter will continue in the normal manner, i.e., without separation of box **45** from subgang **46**, until indication of weft exhaustion is given again.

Referring to Fig. 19 the chain C controls the sequence illustrated in Fig. 17. The usual high and low rolls of horizontal rows I' to XXIV' correspond to the sequence I–XXIV of Fig. 17 respectively. Vertical columns *a*, *b*, *c* and *d*, *e* and *f*, and *g*, contain high and low rolls to control respectively switch blade **256**, color slide **17**, vertical shifting of shuttle boxes at the magazine end of the loom, switch MS as well as vertical shifting of gang LG, and lateral movement of picking balls **9** along shaft 3. It will be noted that column *b* has 4 sizes of rolls to move color slide **17** to register with any one of the four stacks of reserve bobbins **13–16**.

Referring to Fig. 17, the shuttle box B4 of gang LG, in this instance, is not utilized, but it is apparent by those skilled in the art that by rebuilding the chain in the usual manner box B4 may be utilized to accommodate a shuttle, and if desired, one having a decorative color therein and still retain the features of perfect blending of the two ground colors. As shown in the lower part of Fig. 25, provision is made in the circuit for weft detecting mechanism in the event box B4 is utilized.

It is believed that the operation of the various parts of the loom will be understood from the foregoing description and that it will be sufficient to add a brief summary of the operation of the loom as a whole. The pattern chain will be built in such a way as to cause the two pairs of shuttles to follow each other in such sequence as will effect perfect blending without requiring any blank picks in the sequence. On those beats of the loom other than weft replenishing the three boxes at the magazine end of the loom will shift as a main gang, each of the three boxes being movable to active position to receive a shuttle. A weft replenishing operation is initiated when a shuttle in active position in gang LG is depleted of weft and the single box **45** is in active shuttle receiving position. As soon as the depleted shuttle arrives in box **45** the auxiliary of secondary box motion will lift the box **45** away from the subgang thereby opening up a space below it for the outgoing depleted bobbin even though the subgang itself is being lifted during the actual bobbin transferring operation. The separation of box **45** from the subgang **46** produces a relative motion between the operating parts of the cutter mechanism to move the latter to cutting position to sever the thread of the outgoing bobbin. The cam which controls the rising of the box **45** is so designed that it permits the top box to return to a position where it is supported by the subgang before the immediately ensuing picking operation. While this is a desirable mode of operation the invention is not necessarily limited to it. It should be noted that this cam does not positively lift the box **45** to its highest position but serves initially to give the box an upward motion so that the box by its momentum can continue on to the transfer position without requiring the application of positive force throughout the entire up motion of the box. A stop means shown in Figs. 4, 11 and 16 limit up motion of the box **45**. This stop means comprises an angle iron **315** secured to the layend **30** having secured to it a second angle piece **316** having a horizontal part **317** the under side of which is provided with a stop **318** made preferably of some such material as leather. The stop **318** overhangs the bar **103** and arrests it in its upward motion to limit the rise of box **45**.

During a weft replenishing operation both the secondary and the primary box motion are in action, the secondary mechanism acting solely on the box **45** and the primary box motion lifting the subgang so that its top box **47** will be in picking position for the next top center position of the lay. It is for this reason that no blank picks are needed for the operation of the loom.

The fact that there are three boxes at the magazine end which are ordinarily moved as a main gang avoids the unduly large box skip motions which have been necessary in certain types of looms heretofore developed for weaving the type of pick and pick fabric generally described herein. The box lifting levers for the subgang are so made as to permit an amount of shift which is intermediate a one-box shift and a two-box shift by

employing the usual parts of the mechanism K except for modifications of the levers which are operatively connected to the box lifter chain 67.

Having now particularly described and ascertained the nature of the invention and in what manner the same is to be performed, what is claimed is:

1. In a weft replenishing loom having a reserve bobbin transfer station, a single shuttle box shiftable vertically below the station, a gang of at least two shuttle boxes separate from the single box shiftable vertically under the single box, box shifting mechanism effective on non-replenishing beats of the loom to shift said single box and said gang as a unit to place each of the boxes one at a time in active shuttle receiving position, and means operative on a weft replenishing beat of the loom and dependent upon depletion of weft in a shuttle in the single shuttle box when the latter is in active position to raise the single box away from the gang to the transfer station to leave a space below the single box and above the gang for egress of a depleted bobbin from the single box, said means including a cam which effects a positive lift of the single box partway to the transfer station and the single box completes its up motion to the transfer station due to its momentum and is able due to its momentum while completing its motion to the transfer station to withstand the downward force incident to insertion into it of a reserve bobbin without requiring additional support.

2. In shuttle box structure for a weft replenishing loom having primary and secondary box shifting mechanisms, a gang of at least two shuttle boxes for operation by the primary mechanism, a single shuttle box above the gang for operation by the secondary mechanism, lifting elements secured to and depending from the single box for operative connection with the secondary mechanism to effect upward motion of the single box relative to the gang, guide means on the gang for said elements, said secondary mechanism including a box lifter rod operatively connected to the lifter elements, a chain one end of which is fixed and the other end of which is operatively connected to the box lifter rod and is trained over a vertically movable sprocket, and means to lift the sprocket to effect raising of the lifter rod and elements and the single box.

3. In a weft replenishing loom operating with two vertically aligned and shiftable shuttle box members which on nonreplenishing beats of the loom are adjacent to each other and shift without relative motion as a unit but which on replenishing beats of the loom have a relative vertical motion to lift the upper member away from the lower member to a transfer station and open a space between them for egress of a spent bobbin moving downwardly from the upper member, a weft thread cutter for a thread in the upper member normally in noncutting position, and two cooperating parts, one on each member, effective due to said relative vertical motion of the members to move the thread cutter to thread cutting position.

4. In a weft replenishing loom operating with two vertically aligned and shiftable shuttle box members which on nonreplenishing beats of the loom are adjacent to each other and lift without relative motion as a unit but which on replenishing beats of the loom have a relative vertical motion to lift the upper member away from the lower member to a transfer station and open a space between them for egress of a spent bobbin moving downwardly from the upper member, a weft thread cutter for a thread in the upper member normally in noncutting position moving vertically and remaining in register with the upper box member, and two cooperating parts, one moving vertically with the cutter and the other mounted on and moving with the lower member, effective due to said relative vertical motion of the members to move the thread cutter to thread cutting position.

5. In a loom having three shuttle boxes shiftable to place each box in active shuttle receiving position and wherein the distance between the centers of the first and second boxes is greater than the center to center distance of the second and third boxes but less than twice said center to center distance, two levers one of which has a chain sprocket wheel rotatable thereon, means to shift each of said levers from one end position to another end position and cause said levers when in their end positions to occupy three relative positions with respect to each other, and a shuttle box lifter chain operatively connected to the shuttle boxes trained around said sprocket wheel and operatively connected to the other lever, said levers being so proportioned that when they are moved by said means from one relative position in which they cause the lifter chain to locate the first shuttle box in active position to a second relative position they cause the lifter chain to locate the second shuttle box in active position and effective when shifted by said means to a third relative position they cause the lifter chain to locate the third shuttle box in active position, said box lifter chain moving along the same path for the various shifts of the shuttle boxes.

6. In a loom having three shuttle boxes shiftable to place each box in active shuttle receiving position and wherein a bobbin chute of less height than the height of a box is between the first and second boxes causing the distance between the centers of the first and second boxes to be greater than the center to center distance of the second and third boxes but less than twice said center to center distance, two levers one of which has a chain sprocket wheel rotatable thereon, means to shift said levers to three relative positions, and a shuttle box lifter chain operatively connected to the shuttle boxes trained around said sprocket wheel and operatively connected to the other lever, said levers being so proportioned that when they are moved by said means from one relative position in which they cause the lifter chain to locate the first shuttle box in active position to a second relative position they cause the lifter chain to locate the second shuttle box in active position and locate the first box and chute above the active position and effective when shifted by said means to a third relative position in which they cause the chain to locate the third shuttle box in active position and locate the first and second boxes and the chute above said active position, said box lifter chain moving along the same path for the various shifts of the shuttle boxes.

7. The loom set forth in claim 6 wherein the end of the lifter chain remote from the shuttle boxes is secured in fixed position and wherein the other lever has rotatable thereon and movable therewith a chain sprocket wheel around which the lifter chain is trained, said sprocket on said other lever capable of occupying three different positions with respect to the sprocket on said one lever, one for each of said three positions of the levers.

8. The loom set forth in claim 6 wherein said means when shifting said one lever alone while the other lever remains at rest causes the chain to move the boxes a distance equal to twice said center to center distance plus the distance between the first and second boxes, and said means when shifting said other lever alone while said one lever remains at rest causes the lifter chain to move the boxes a distance equal to said center to center distance plus the distance between the first and second boxes.

9. The loom set forth in claim 6 wherein said means when shifting said one lever alone while the other lever remains at rest causes the lifter chain to move the boxes a distance equal to said center to center distance plus the distance between the first and second boxes and said means when moving said other lever alone while said one lever remains at rest causes the lifter chain to move the boxes a distance equal to said center to center distance.

10. In a weft replenishing loom, two vertically aligned and shiftable shuttle box members which on non-replen-

ishing beats of the loom are adjacent to each other and shift without relative motion as a unit but which on replenishing beats of the loom have a relative vertical motion in which the upper member rises away from the lower member to a transfer station and opens a space between them for egress of a spent bobbin moving downwardly from the upper member, a cutter for the thread of the spent bobbin normally in non-cutting position, and two cooperating parts, one on each member, effective due to said relative vertical motion of the members to move the thread cutter to thread cutting position.

11. In a weft replenishing loom, two vertically aligned and shiftable shuttle box members which on non-replenishing beats of the loom are adjacent to each other and shift without relative motion as a unit but which on replenishing beats of the loom have a relative vertical motion in which the upper member moves upwardly away from the lower member to a transfer station to open a space between them for egress of a spent bobbin moving downwardly from the upper member, a weft thread cutter for a thread in the upper member normally in non-cutting position moving vertically and remaining in register with the upper box member, and two cooperating parts, one moving vertically with the cutter and the other mounted on and moving with the lower member, effective due to said relative vertical motion of the members to move the thread cutter to thread cutting position.

12. In shuttle box structure for a weft replenishing loom having primary and secondary box shifting mechanisms, a gang of at least two shuttle boxes for operation by the primary mechanism, a single shuttle box



above the gang for operation by the secondary mechanism, lifting elements secured to and depending from the single box for operative connection with the secondary mechanism to effect upward motion of the single box relative to the gang, guide means on the gang for said elements, said gang having a back which extends above the top box of the gang and partially supports the top box above the gang to provide a space between the gang and top box, and a spent bobbin deflector secured to the gang located in said space.

13. The structure set forth in claim 12 wherein the gang has a pin for shuttle binders and the pin assists in securing the deflector in fixed relationship to the gang.

14. In a weft replenishing loom having a reserve bobbin magazine and shifting shuttle boxes on at least one end thereof, a separable shuttle box cell forming part of said shuttle boxes but movable upwardly with respect to the remainder of the shuttle boxes to a transfer position for a weft replenishing operation with respect to a shuttle therein, a weft detector at the opposite end of the loom to detect the condition of weft in a shuttle at said opposite end and controlling operation of the magazine and in the event of exhaustion of weft in the shuttle causing movement of said cell to said transfer position and effecting replenishment of the shuttle therein on the next beat of the loom following indication of exhaustion of weft in the shuttle at said other end.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 2,333,904 | Turner | Nov. 9, 1943 |
| 2,777,473 | Litchfield | Jan. 15, 1957 |