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Mizuno et al.

[11] **4,074,728**

[45] **Feb. 21, 1978**

[54] **APPARATUS FOR SELECTIVELY INSERTING WEFT YARNS INTO THE SHED OF A WEAVING LOOM**

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[73] Assignee: **Nissan Motor Company, Limited**, Japan

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**[2] **D03D 47/34**

[52] **U.S. Cl.** **139/435**; 139/453

[58] **Field of Search** ..... 139/55.1, 66 R, 78, 139/80, 429, 435, 450, 453; 66/132, 133

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Primary Examiner—Henry S. Jaudon

Attorney, Agent, or Firm—Robert E. Burns; Emmanuel J. Lobato; Bruce L. Adams

[57] **ABSTRACT**

An apparatus for selectively inserting into the shed of a weaving loom a plurality of weft yarns having different natures, particularly colors, comprising cam means including at least one cam which is formed with lobe and bottom portions alternately arranged about the axis of rotation of the cam and which is driven to turn about the axis through a predetermined angle under the control of weft selector signal supply means such as a pattern card arrangement, wherein cam retaining means is provided to hold the cam in one of the angular positions operative to have each of the weft shooting members held in a position ready to insert the pick of weft yarn into the shed, the retaining means being disengaged from the cam when the cam is being rotated from one of the angular positions thereof into another.

9 Claims, 10 Drawing Figures

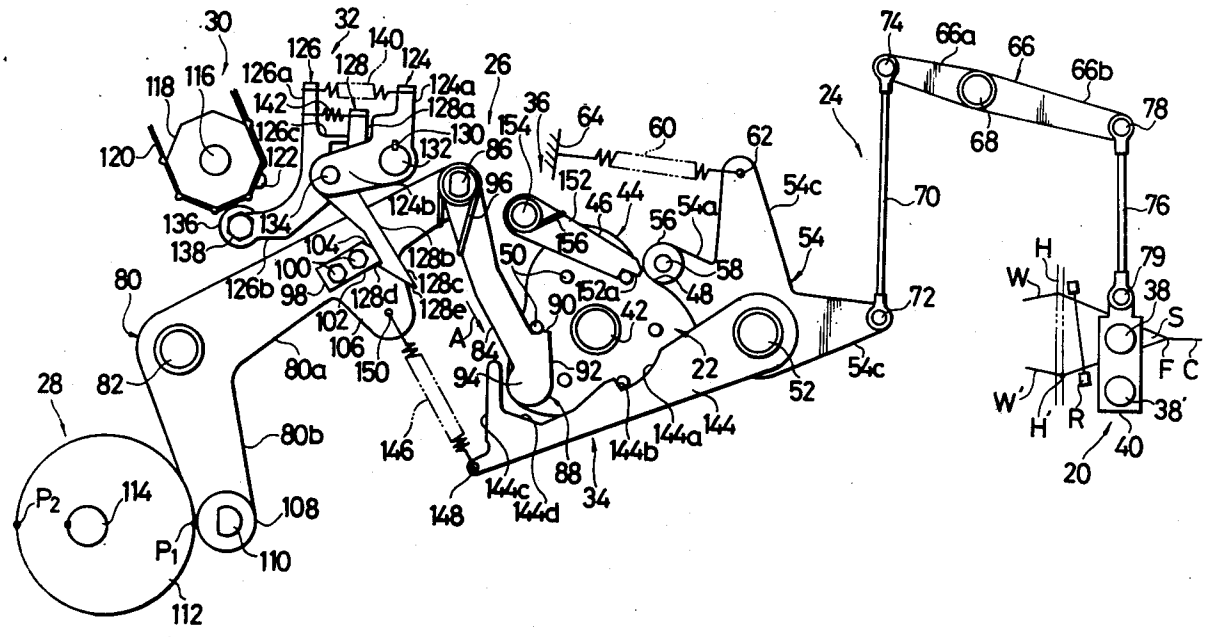
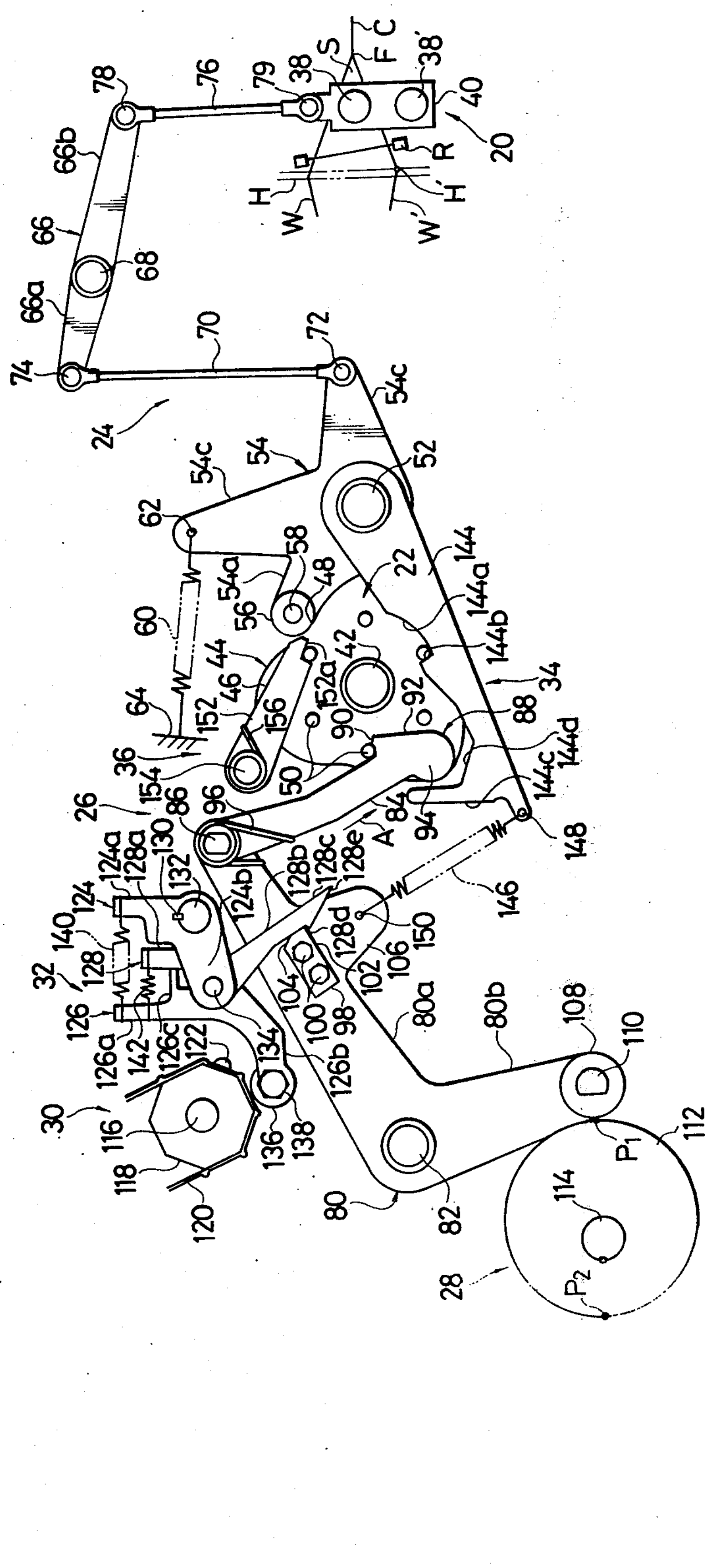


FIG. 1



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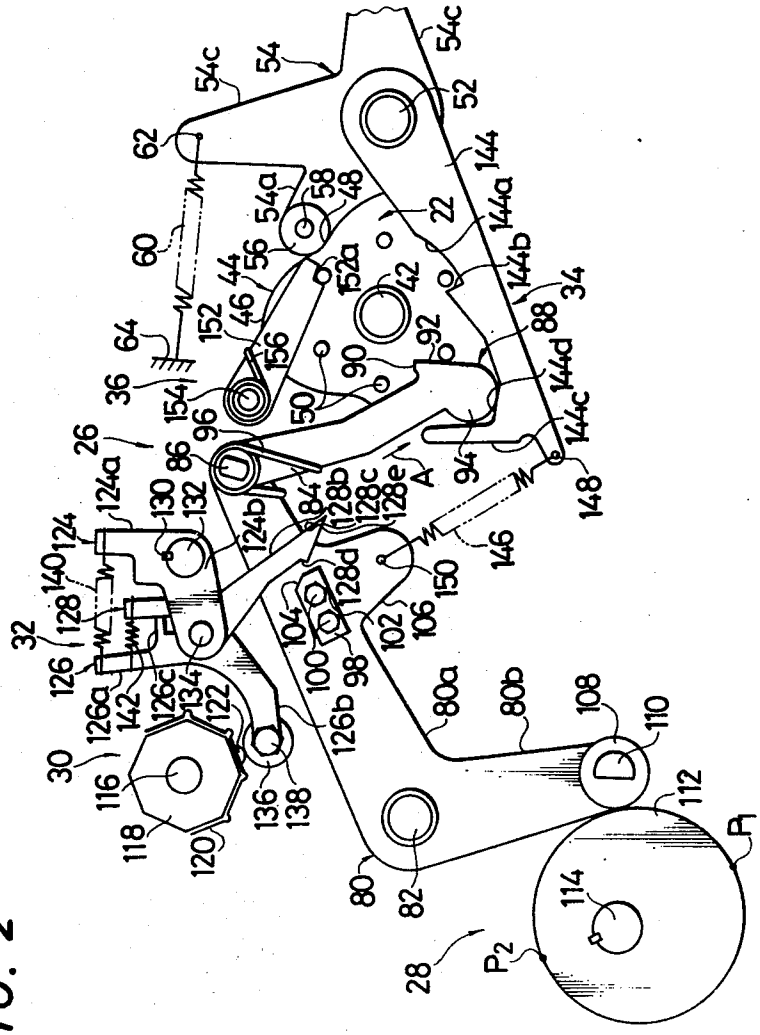
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FIG. 2

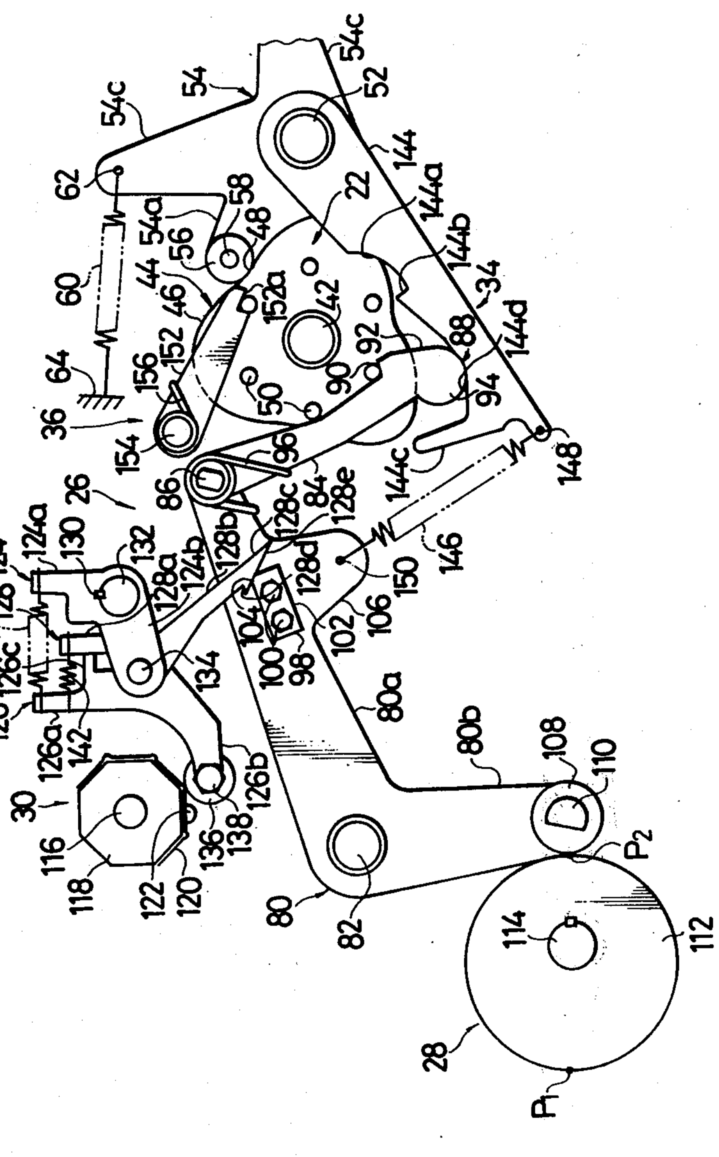
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FIG. 3

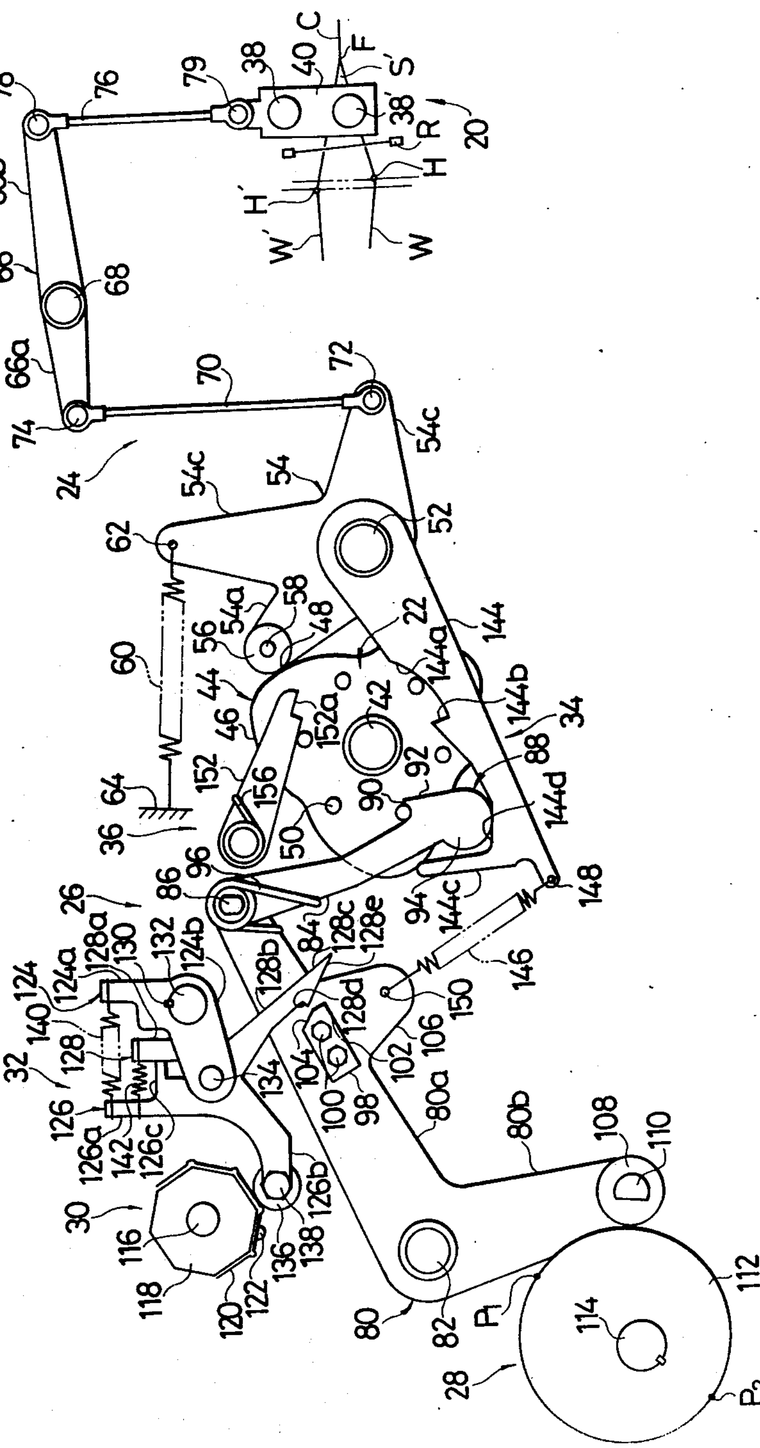
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FIG. 4

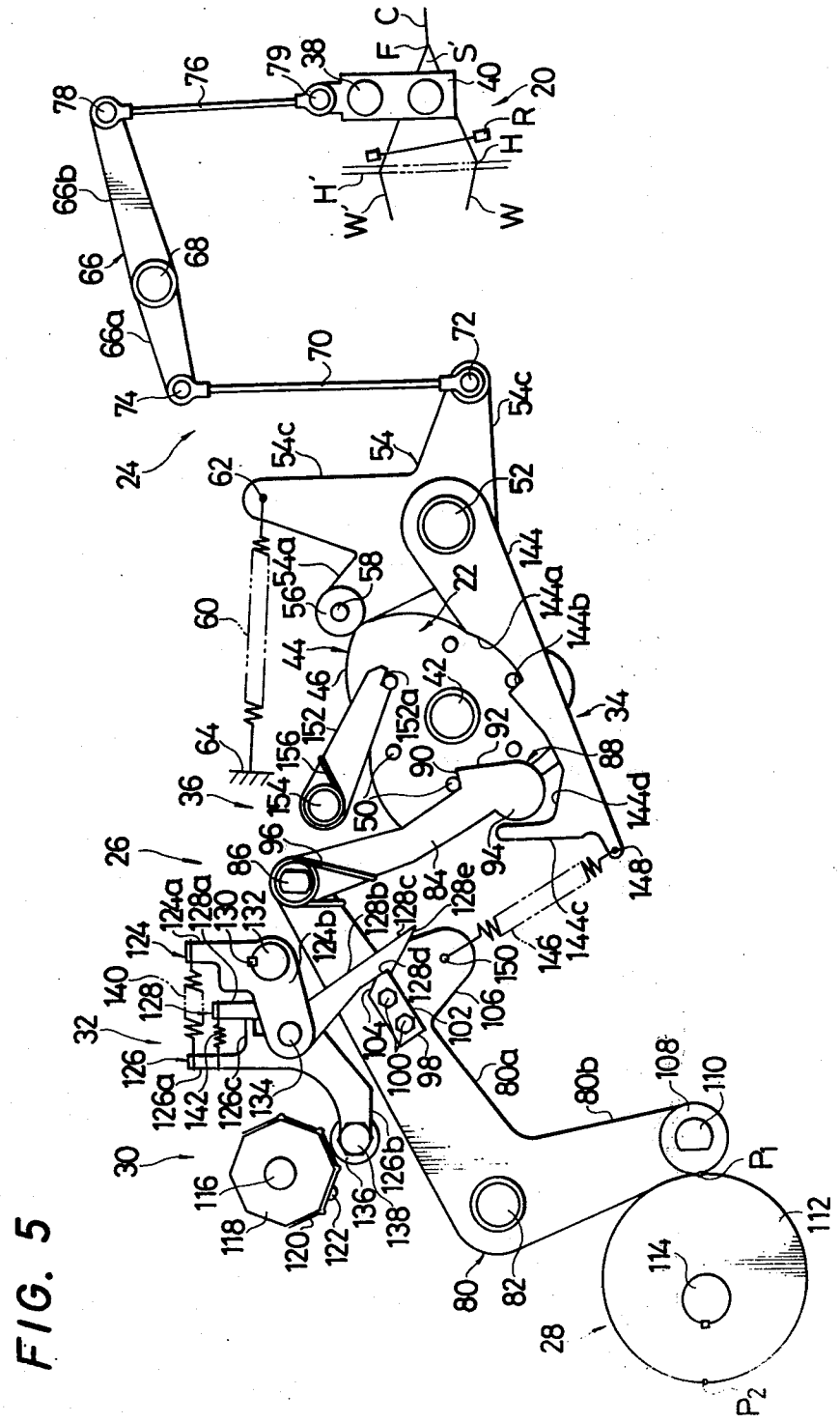
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FIG. 5

FIG. 6

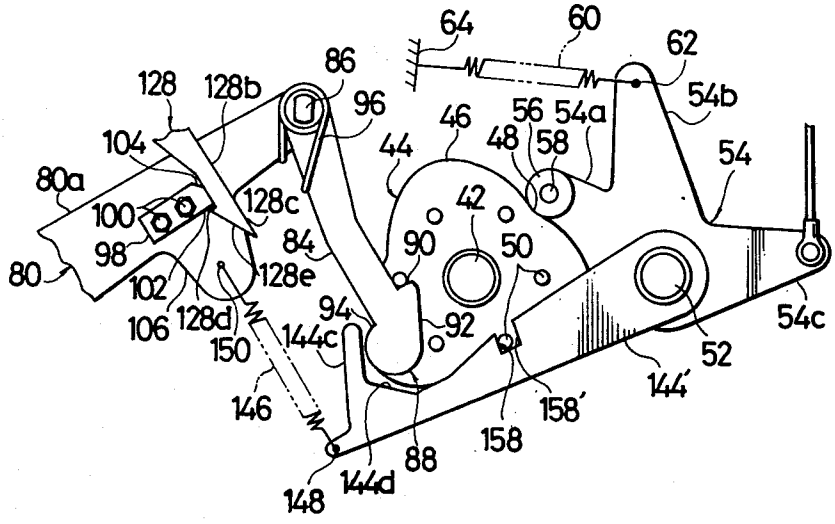
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FIG. 7

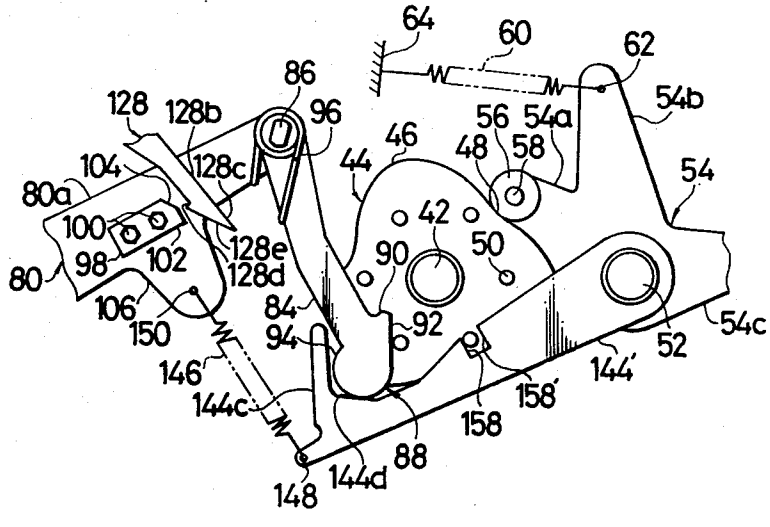
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FIG. 8

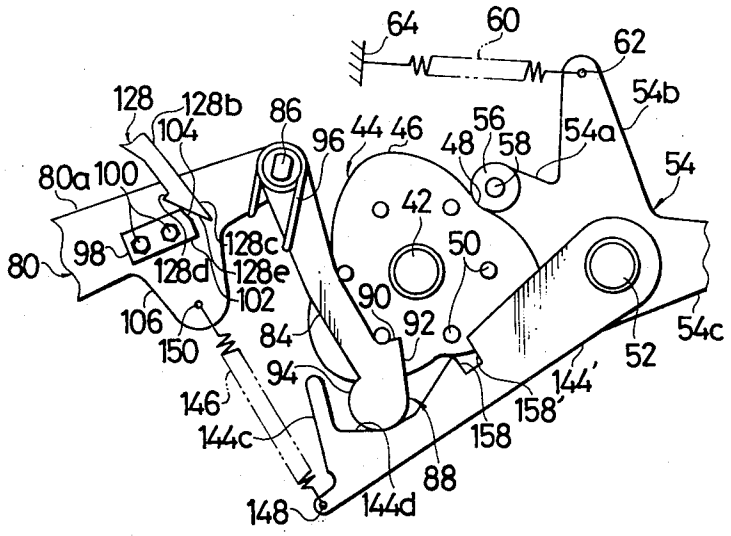
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FIG. 9

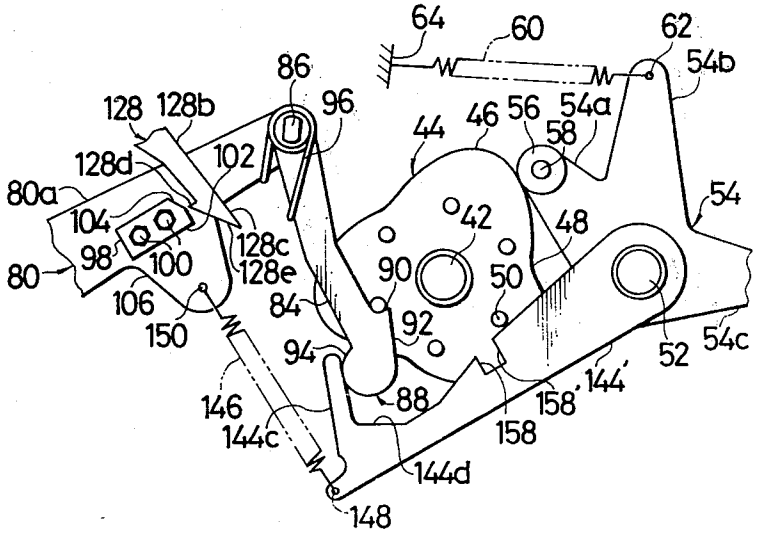
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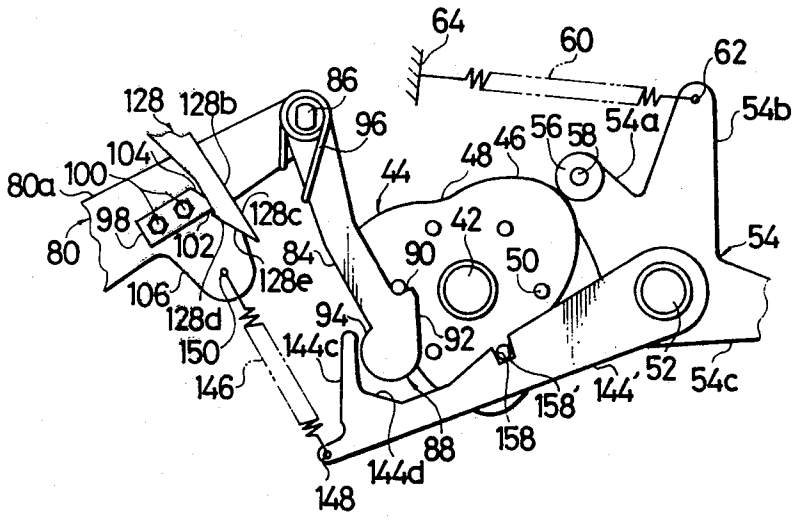
FIG. 10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APPARATUS FOR SELECTIVELY INSERTING WEFT YARNS INTO THE SHED OF A WEAVING LOOM

BACKGROUND OF THE INVENTION

The present invention relates to weaving looms and more particularly to an apparatus for selectively inserting weft yarns into the shed in a weaving loom of the type which is capable of using a plurality of weft yarns having different natures, particularly colors. The weaving loom to which the present invention appertains is, furthermore, typically of the shuttleless type utilizing a jet stream of fluid for shooting the pick of weft yarn into the weaving shed, although the the present invention is applicable to any other type of weaving looms.

A representative example of the apparatus of the above described nature uses a cam unit including at least one lobular cam having lobe portions and bottom portions alternately arranged about the axis of rotation of the cam. The cam is driven to turn about the axis thereof under the control of suitable weft selector signal supply means such as for example a pattern card arrangement storing signals representative of a predetermined schedule in accordance with which a weft yarn to be inserted into the weaving shed is selected out of the weft yarns respectively detained in a plurality of weft shooting members or nozzles. A cam follower roller is in rolling contact with the cam surface of the cam and is operatively connected to the weft shooting nozzles by a suitable link mechanism so that any of the weft shooting nozzles is moved into a position ready to shoot into the weaving shed the pick of the weft yarn which has been detained therein as the cam follower roller is raised and lowered over the axis of rotation of the cam in each cycle of operation of the loom.

When the cam is rotated about the axis thereof from an angular position receiving the cam follower roller on one of its lobe portions into an angular position receiving the cam follower roller on one of its bottom portions, the cam follower roller is lowered over the axis of rotation of the cam. As the cam is thus moved closer to the latter angular position, the cam tends to be rotated at an increasing velocity about the axis thereof and is thus liable to turn beyond the angular position receiving the cam follower roller on one of its bottom portions. When, conversely, the cam is rotated from the angular position having an cam follower roller on one of its bottom portions into an angular position having the cam follower roller received on one of its cam lobe portions, the cam tends to turn at a decreasing velocity about the axis thereof and is thus liable to fail to accurately reach the angular position receiving the cam follower roller on one of its cam lobe portions. Such tendencies are pronounced when the cam is driven at an increased velocity.

SUMMARY OF THE INVENTION

A major object of the present invention is to provide the cam means of the above described general nature with such means that will eliminate the above mentioned tendencies and that are thus capable of reliably enabling the cam to turn from one of the aforesaid angular positions to another and to be retained in one of such positions when the cam is held at rest.

In accordance with the present invention, such an object is accomplished basically in an apparatus which comprises, in combination, a weft insertion unit including at least two weft shooting members each movable into a position aligned with the shed, weft selector cam means including at least one lobular cam rotatable about a fixed axis and formed with a plurality of cam lobe portions substantially equiangularly spaced apart from each other across bottom portions about the fixed axis and having substantially equal radii from the axis, the bottom portions having from the axis substantially equal radii smaller than the radii of the cam lobe portions, a link mechanism operatively connecting the cam to the weft insertion unit for moving one of the weft shooting members into the position aligned with the shed when engaging one of the cam lobe portions and another weft shooting member into the aforesaid position when engaging one of the bottom portions of the cam, cam actuating means operative to drive the cam to turn in a predetermined direction about the axis thereof from an angular position having one of its cam lobe portions engaged by the link mechanism into an angular position having one of its bottom portions engaged by the link mechanism or from the latter angular position into the former in each cycle of operation of the loom, weft selector signal supply means storing signals representative of a predetermined schedule in accordance with which the weft yarns are to be selectively inserted into the shed, locking means responsive to the signals delivered from the signal supply means for locking the cam actuating means in a condition inoperative to drive the cam in response to one signal from the signal supply means and releasing the cam actuating means from the inoperative condition in response to another signal from the signal supply means, and cam retaining means engageable with the cam means for holding the cam in any of the angular positions of the cam when the locking means is in locking engagement with the cam actuating means. The cam means may further comprise pins projecting from one end face of the cam substantially in parallel with the fixed axis of the cam and arranged substantially in symmetry about the axis, the number of the pins doubling the number of the lobe portions of the cam, the cam actuating means being engageable with the pins and movable with respect to the axis of the cam for turning each of the pins through an angle equal to to the central angle between every neighboring two of of the pins about the fixed axis and thereby driving the cam to rotate through the above mentioned angle about the aforesaid fixed axis in each cycle of operation provided the cam actuating means is disengaged from the locking means.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of the apparatus according to the present invention will be more clearly understood from the following description taken in conjunction with the accompanying drawings in which like reference numerals and characters designate corresponding parts, elements and structures throughout the figures and in which:

FIGS. **1** to **5** are schematic side elevations showing various operational conditions of a first preferred embodiment of the apparatus according to the present invention; and

FIGS. **6** to **10** are fragmentary side elevations showing different operational conditions of a second embodiment of the apparatus according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The constructions and operations of the embodiments of the apparatus according to the present invention will be hereinafter described with reference to the accompanying drawings. In the drawings, the majority of conventional parts and structures constructing a weaving loom into which each of the embodiments of the present invention is to be incorporated is omitted for the sake of clarity. The relative positions of the individual parts and structures constituting each embodiment in the loom will however be apparent to those skilled in the art from the directions in which the webs (designated by W and W') of warp yarns extend. The webs W and W' of warp yarns are alternately raised and lowered across a warp line L by means of weaving healds H and H', respectively, and form a shed S which is closed at the fell F of a woven cloth C. As is customary in the art, the warp line L is assumed to be substantially horizontal. Designated by R is a weaving reed which is adapted to hold the webs W and W' of warp yarns in position forming the shed S and to beat up the pick of a weft yarn (not shown) to the fell F of the woven cloth C after the pick of the weft yarn is shot into the shed S, as is well known in the art.

Referring to FIGS. **1** to **5** of the drawings, a first preferred embodiment of the present invention is shown largely comprising a weft insertion unit **20**, a weft selector cam unit **22**, a link mechanism **24** provided between the weft insertion unit **20** and the cam unit **22**, cam actuating means **26** for actuating the cam unit **22** into various operational positions, intermittent-motion drive means **28** for driving the cam actuating means **26**, a pattern card arrangement **30** serving as program-controlled weft selector signal supply means, locking means **32** locking and releasing the cam actuating means **26** in response to the signal delivered from the pattern card arrangement **30**, and first and second cam retaining means **34** and **36** for securely holding the cam unit **22** in an angular position into which the cam unit is moved by the cam actuating means **26**.

The embodiment of the apparatus according to the present invention as herein illustrated is assumed, by way of example, to be arranged to be capable of dealing with two weft yarns of different natures, particularly colors and, thus, the weft insertion unit **20** is shown comprising first and second weft shooting nozzles **38** and **38'** mounted on a common nozzle carrier **40**. The nozzle carrier **40** is vertically movable in close proximity to one lateral end of the weaving shed S between a lower first position having the first weft shooting nozzle **38** located to have its center axis aligned with the weaving shed S and flush with the warp line L as illustrated in FIG. **1** and an upper second position having the second weft shooting nozzle **38'** located to have its center axis aligned with the weaving shed S and flush with the warp line L as illustrated in FIGS. **4** and **5**. Each of the weft shooting nozzles **38** and **38'** is adapted to detain therein a pick of weft yarn leading from a yarn supply package through a weft drawing and measuring arrangement (not shown) as is customary. Though not shown in the drawings, the nozzle carrier **40** has further mounted thereon a fluid feed duct leading from a source of fluid under pressure. When the nozzle carrier **40** is moved into the above mentioned first or second position thereof, communication is provided between the duct and one of the weft shooting nozzles **38** and **38'** and the pick of the weft yarn which has been detained in the particular one of the nozzles is shot into the weaving shed S by the jet stream of fluid ejected from the nozzle.

On the other hand, the weft selector cam unit **22** comprises a fixed horizontal shaft **42** and a lobular cam **44** which is rotatable of the shaft **42** about the center axis of the shaft **42**. The lobular cam **44** has a plurality of arcuate cam lobe portions **46** which have equal radii from the center axis of the shaft **42** and equal central angles about the axis of the shaft **42** and which are substantially equiangularly spaced apart from each other about the center axis of the shaft **42** across intermediate bottom portions **48** which also have equal radii from the center axis of the shaft **42**. The cam lobe portions **46** of the cam **44** are assumed, by way of example, to be provided as three in number as illustrated in the drawings so that the vertices of the cam lobe portions **46** are angularly spaced apart 120° from each other about the center axis of the shaft **42**, and, as a consequence, there is established a central angle of approximately 60° between the vertex of each of the cam lobe portions **46** and each of the bottom portions **48** into which the lobe portions **46** merge. It is, however, apparent that the number of the cam lobe portions **46** as above described is merely for the purpose of illustration and can be selected arbitarily without respect to the number of the weft yarns to be used.

The cam **44** is provided with pins **50** which project from one end face of the cam **44** substantially in parallel with the center axis of the shaft **42** and which are arranged substantially symmetrically about the center axis of the shaft **42**. The pins **50** are provided in a number doubling the number of the lobe portions **46** of the cam **44** and are, thus, shown to be six in number because the cam **44** is assumed to have three lobe portions **46** as above described.

The link mechanism **24** provided between the above described weft insertion unit **20** and cam assembly **22** comprises a horizontal stationary shaft **52** having a center axis substantially parallel with the center axis of the above mentioned cam shaft **42**. A bell crank lever **54** has an intermediate fulcrum portion rotatably mounted on the stationary shaft **52** and has first, second and third arm portions **54***a*, **54***b* and **54***c* extending from the fulcrum portion and angularly spaced apart from each other about the center axis of the shaft **52**. The first arm portion **54***a* of the bell crank lever **54** has mounted at its leading end a cam follower roller **56** which is rotatable about the center axis of a pin **58** mounted on the arm portion **54***a* and having a center axis substantially parallel with the respective center axes of the shafts **42** and **52**. The cam follower roller **56** is engageable with the cam **44** or, more specifically, rollable on one of the cam lobe portions **46** or one of the bottom portions **48** of the cam **44** depending upon the angular position of the cam **44** with respect to the bell crank lever **54** as will be described in more detail. The cam follower roller **56** is forced against the cam surface of the cam **44** by suitable biasing means operative to urge the bell crank lever **54** to turn counter-clockwise in the drawings, such biasing means being shown comprising a preloaded helical tension spring **60** which is anchored at one end to the third arm portion **54***c* of the bell crank lever **54** by a pin **62** and at the other end to a suitable stationary member or structure **64** which may be part of the loom construction. When the cam **44** is rotated about the center axis of the cam shaft **42**, the cam follower roller **56** on the first arm portion **54***a* of the bell crank lever **54** is alternately

raised and lowered over the cam shaft **42** and consequently the bell crank lever **54** is oscillated between clockwise and counter-clockwise extreme rotational positions, respectively, in the drawings about the center axis of the shaft **52** as the cam follower roller **56** is alternately brought into rolling contact with each of the cam lobe portions **46** and each of the bottom portions **48** of the cam **44**. The counter-clockwise and clockwise extreme rotational positions of the bell crank lever **54** in the drawings are herein referred to as first and second angular positions, respectively, of the bell crank lever **54** about the center axis of the stationary shaft **52**. As the bell crank lever **54** is rotated about the center axis of the shaft **52** toward the first and second angular positions, the second arm portion **54***b* thereof has its leading end moved upwardly and downwardly, respectively.

The link mechsnism **24** further comprises a rocker **66** having an intermediate fulcrum portion rotatably mounted on a horizontal stationary shaft **68** having a center axis substantially parallel with the center axis of the shaft **52** carrying the bell crank lever **54**. The rocker **66** has first and second arm portions **66***a* and **66***b* extending generally horizontally from the intermediate fulcrum portion of the rocker **66** and having respective leading ends located over the leading end of the second arm portion **54***b* of the bell crank lever **54** and the nozzle carrier **40** of the weft insertion unit **20**, respectively, as shown. A generally vertical connecting rod **70** is pivotally connected at one end to the leading end of the second arm portion **54***b* of the bell crank lever **54** by a pivotal pin **72** and at the other end to the leading end of the first arm portion **66***a* of the rocker **66** by a pivotal pin **74**. Likewise, a generally vertical connecting rod **76** is pivotally connected at one end to the leading end of the second arm portion **66***b* of the rocker **66** by a pivotal pin **78** and at the other end to the nozzle carrier **40** of the weft insertion unit **20** by a pivotal pin **78**. When, thus, the bell crank lever **54** is rotated into the previously mentioned first and second angular positions, viz., the counter-clockwise and clockwise extreme rotational positions thereof in the drawings about the center axis of the shaft **52** and has the leading end of its second arm portion **54***b* moved into the uppermost and lowermost positions, the rocker **66** is driven to turn clockwise and counter-clockwise, respectively, in the drawings about the center axis of the shaft **68** so that the nozzle carrier **40** is moved into the lower first and upper second positions, respectively. The first and second weft shooting nozzles **38** and **38'** are thus moved into the positions aligned with the weaving shed S when the bell crank lever **54** is moved into the first and second angular positions, respectively, thereof about the center axis of the shaft **52**.

On the other hand, the cam actuating means **26** comprises a bell crank lever **80** having an intermediate fulcrum portion rotatably mounted on a horizontal stationary shaft **82** having a center axis which is substantially parallel with the center axis of the cam shaft **42**. The bell crank lever **80** has first and second arm portions **80***a* and **80***b* extending generally upwardly and downwardly, respectively, from the fulcrum portion of the bell crank lever and angularly spaced apart from each other about the center axis of the shaft **82**. The bell crank lever **80** has supported at the leading end of its first arm portion **80***a* an elongated cam actuating member **84** by a pivotal pin **86** having a center axis which is substantially parallel with the respective center axes of the shafts **42** and **82**. The cam actuating member **84** is thus rotatable on the first arm portion **80***a* of the bell crank lever **80** about the center axis of the pivotal pin **86** and is movable, together with the bell crank lever **80**, relative to the cam shaft **42** on a vertical plane perpendicular to the center axes of the shafts **42** and **82** and in the direction of arrow A, viz., generally downwardly and sidewise to the cam shaft **42** from an uppermost position shown in FIG. **1** to a lowermost position shown in FIG. **3**. The cam actuating member **84** extends generally downwardly away from the pivotal pin **86** and has a lowermost hook portion **88** formed with a notch **90** facing the pivotal pin **86**, a guide surface **92** slanting from the lower end of the hook portion **88** and terminating at the notch **90**, and a rounded projection **94** opposite to the guide surface **92**. The notch **90** and guide surface **92** of the hook portion **88** are located and movable in the circular path of the pins **50** on the cam **44** about the center axis of the cam shaft **42** so that the hook portion **88** is capable of receiving one of the pins **50** either in the notch **90** as shown in FIG. **1** or on the guide surface **92** as shown in FIG. **2** depending upon the relative angular positions of the cam **44** and the cam actuating member **84** about the center axes of the cam shaft **42** and the pivotal pin **86**, respectovely. The projection **94** of the hook portion **88** protrudes generally perpendicularly away from the cam shaft **44**. The cam actuating member **84** thus configured is urged to turn counter-clockwise in the drawings about the center axis of the pivotal pin **86** and accordingly has the hook portion **88** biased toward the cam shaft **42** by suitable biasing means such as a helical torsion spring **96** which is wound up around the pivotal pin **86** and which has one end portion clamped on the first arm portion **80***a* of the bell crank lever **80** and the other end portion clamped on the upper end portion of the cam actuating member **84** as shown.

The bell crank lever **80** has a land **98** fixedly mounted on one face of the first arm portion **80***a* thereof by suitable fastening means such as bolts **100**. The land **98** has a substantially flat surface portion **102** which is found on or may be slightly inclined to or deviated from a plane passing through the center axis of the stationary shaft **82** carrying the bell crank lever **80**. The land **98** is further formed with a guide surface portion **104** which is inclined to the above mentioned surface portion **102**. For the reason which will be understood as the description proceeds, the first arm portion **80***a* of the bell crank lever **80** is formed with a projection **106** which is directed generally downwardly from the arm portion **80***a* as illustrated. The bell crank lever **80** has further mounted at the leading end of its second arm portion **80***b* a roller **108** which is rotatable on a shaft **110** secured to the arm portion and having a center axis which is substantially parallel with the center axis of the stationary shaft **82** on which the bell crank lever **80** is mounted.

The intermittent-motion drive means **28** comprises an eccentric cam **112** securely mounted on a rotatable cam shaft **114** having a horizontal center axis substantially parallel with the center axis of the shaft **82** carrying the bell crank lever **80**. The eccentric cam **112** has higher and lower semicircular lobe portions having respective vertices P_1 and P_2 which are diametrically opposed to each other across the center axis of the cam shaft **114**. The cam shaft **114** is operatively connected to a drive source through suitable torque transmission means such as gear arrangement though not shown in the drawings and is driven to rotate about the center axis of the cam

shaft **114** at a velocity which is synchronized with the velocities at which other rotatable or otherwise movable members and structures of the loom are driven. The eccentric cam **112** is herein assumed to be driven to make a full turn about the axis of the shaft **114** per weaving cycle of the loom, by way of example. The roller **108** on the second arm portion **80***b* of the above described bell crank lever **80** is engageable with the cam **112** and is thus rollable alternately on the higher and lower lobe portions of the cam **112** depending upon the angular position of the cam **112** about the center axis of the cam shaft **114** relative to the bell crank lever **80**. The roller **108** on the bell crank lever **80** thus serves as a cam follower for the eccentric cam **112**. When the eccentric cam **112** is rotated about the center axis of the cam shaft **114** with its higher and lower lobe portions alternately brought into rolling contact with the cam follower roller **108** on the bell crank lever **80**, the cam follower roller **108** is alternately raised and lowered over the cam shaft **114** so that the bell crank lever **80** is caused to oscillate between counter-clockwise and clockwise extreme rotational positions shown in FIGS. **1** and **3**, respectively, about the center axis of the stationary shaft **82**. The clockwise and counter-clockwise extreme rotational positions of the bell crank lever **80** are herein referred to as first and second limit angular positions, respectively, of the bell crank lever **80** about the center axis of the shaft **82**. When the bell crank lever **80** is thus oscillated between the first and second angular positions about the axis of the shaft **82**, the pivotal pin **86** at the leading end of the first arm portion **80***a* of the bell crank lever **80** is moved in an arc generally toward and away from the cam shaft **42** carrying the lobular cam **44**. This causes the cam actuating member **84** to move generally upwardly and downwardly sidewise to the cam shaft **42** so that the hook portion **88** of the cam actuating member **84** is moved in the path of the pins **50** on the lobular cam **44** and drives the cam **44** to turn clockwise in the drawings about the center axis of the cam shaft **42** through engagement between the notch **90** of the hook portion **88** of the cam actuating member **84** and one of the pins **50** on the cam **48**, as will be described more clearly.

The pattern card arrangement **30** as the weft selector signal supply means comprises a shaft **116** having a center axis substantially parallel with the center axis of the shaft **82** carrying the bell crank lever **80**, a sprocket wheel **118** rotatable about the center axis of the shaft **116** and having a suitable number of teeth or guide faces, an endless chain **120** passed on the sprocket wheel **118** and a peg **122** mounted on predetermined one of the guide faces of the sprocket wheel **118**. The sprocket wheel **118** is operatively connected to the previously mentioned driving source through suitable torque transmission means such as gear arrangement though not shown in the drawings and is driven to turn about the center axis of the shaft **116** at a velocity related to the rotational velocity of the cam shaft **114** carrying the eccentric cam **112**. For the purpose of description, the sprocket wheel **118** is herein assumed to have eight guide faces and to be driven to make a one-eighth turn about the center axis of the shaft **116** per full turn of the eccentric cam **112** about the center axis of the cam shaft **114**.

The locking means **32** is adapted to lock the previously described bell crank lever **80** and accordingly the cam actuating member **84** in response to the signal delivered from the above described pattern card arrangement **30**. The locking means **32** in its entirety is located in conjuction with the cam actuating means **26** and the pattern card arrangement **30** and largely comprises a stationary support member **124**, a rocking member **126** and a clamping member **128**. The support member **124** is fixedly mounted by means of a key **130** on a horizontal stationary shaft **132** having a center axis substantially parallel with the center of the shafts **116** and **82** of the pattern card arrangement **30** and the bell crank lever **80** and has an upper first arm portion **124***a* directed upwardly from the shaft **132** and a lower second arm portion **124***b* directed generally downwardly sidewise to the shaft **132**. The support member **124** has mounted at the leading end of its second arm portion **124***b* a pivotal pin **134** having a center axis substantially parallel with the center axis of the shaft **132**. The rocking and clamping members **126** and **128** have respective intermediate fulcrum portions rotatably mounted on the pivotal pin **134** and are rotatable independently of each other about the center axis of the pin **134**. The support member **124**, rocking member **126** and clamping member **128** are positioned relative to each other in such a manner that the clamping member **128** is interposed between the support member **124** and rocking member **126** and has one face thereof in slidable contact with the support member **124** and the other face thereof in slidable contact with the rocking member **126**. The rocking member **126** has an upper first arm portion **126***a* extending upwardly from the fulcrum portion of the member **126**, a lower second arm portion **126***b* extending generally downwardly sidewise to the pivotal pin **134** from the fulcrum portion, and a land or projection **126***c* formed on the upper first arm portion **126***a*. The lower second arm portion **126***b* has its leading end located and movable in proximity to the sprocket wheel **118** of the pattern card arrangement **30** and has mounted thereat a roller **136** which is rotatable on a shaft **138** mounted on the arm portion **126***b* and having a center axis substantially parallel with the center axes of the shaft **116** of the pattern card arrangement **30** and the shaft **134** supporting the support member **124**. The rocking member **126** as a whole is urged to turn clockwise in the drawings about the center axis of the pivotal pin **134** and thus has the roller **136** forced onto the sprocket wheel **118** of the pattern card arrangement **30** by suitable biasing means such as a preloaded helical tension spring **140** which is anchored at one end to the upper first arm portion **124***a* of the support member **124** and at the other end to the upper first arm portion **126***a* of the rocking member **126**. The rocking member **126** is thus rotatable about the center axis of the pivotal pin **134** between an upright first angular position and an inclined second angular position rotated counter-clockwise in the drawings against the force of the tension spring **140** as the roller **136** on the rocking member **126** rolls on the sprocket wheel **118** of the pattern card arrangement **30**. On the other hand, the clamping member **128** has an upper first arm portion **128***a* extending upwardly from the fulcrum portion of the clamping member and a lower second arm portion **128***b* extending from the fulcrum portion generally downwardly sidewise to the center axis of the pivotal pin **134**. The lower second arm portion **128***b* of the clamping member **128** has a latch portion **128***c* which is formed with an edge **128***d* facing the fulcrum portion of the clamping member and with a guide surface **128***e* slanting from the lower end of the latch portion **128***c* and terminating at the above mentioned edge **128***d*. The edge **128***d* of the latch portion **128***c* is engage-

able in a surface-to-surface fashion with the previously mentioned surface portion **102** of the land **98** on the bell crank lever **80** and, furthermore, the guide surface **128***e* of the latch portion **128***c* is slidable on the previously mentioned guide surface portion **104** of the land **98** depending upon the angular positions of the bell crank lever **80** and the clamping member **128** about the center axes of the shaft **82** and the pivotal pin **82**, respectively. The previously mentioned projection **126***c* of the upper first arm portion **126***c* of the rocking member **126** is configured in such a manner as to be engageable with the upper first arm portion **128***a* of the clamping member **128** which is positioned in side-by-side relationship to the rocking member **126**. The clamping member **128** is urged to turn about the center axis of the pivotal pin **134** counter-clockwise of the drawings relative to the rocking member **126** by suitable biasing means such as a preloaded hilical tension spring **142** which is anchored at one end to the upper first arm portion **126***a* of the rocking member **126** and at the other end to the upper first arm portion **128***a* of the clamping member **128**. For the purpose of having the springs **140** and **142** securely anchored to the members to which the springs are connected, each of the members **126**, **128** and **130** may be formed with a notch or notches.

On the other hand, the previously mentioned first cam retaining means **34** comprises an elongated lever **144** having one end portion rotatably mounted on the stationary shaft **52** supporting the bell crank lever **54** of the previously described link mechanism **24**. The lever **144** has an intermediate portion which is located and movable in proximity to the lower end of the lobular cam **44** and which formed with a notch or recess located and movable in the circular path of the pins **50** on the cam **44**. The notch or recess in the lever **144** is defined partly by a guide surface portion **144***a* facing the cam shaft **42** and slanting radially outwardly with respect to the direction of movement of the pins **50** on the cam **44** and a lateral edge portion **144***b* at which the guide surface portion **144***a* terminates. The guide surface portion **144***a* and the lateral edge portion **144***b* are shaped and located to be capable of receiving on either of them any one of the pins **50** depending upon the relative angular positions of the cam **44** and the lever **144** about the center axes of the cam shaft **42** and the shaft **52**, respectively. When one of the pins **50** on the cam **50** is received on the lateral edge portion **144***b* of the lever **144** as shown in FIG. **1**, the cam **44** is prevented from rotating clockwise of the drawings about the center axis of the cam shaft **42**. The lever **144** has a leading end portion located below the hook portion **92** of the previously described cam actuating member **84** and has formed on the leading end portion a projection **144***c* extending upwardly from the leading end portion. The projection **144***c* is angularly spaced apart from the intermediate portion of the lever **144** and has formed therebetween a curved notch portion **144***d* which is shaped and located to be engageable with the rounded projection **94** of the hook portion **88** of the cam actuating member **84** depending upon the relative angular positions of the cam actuating member **84** and the lever **144** about the center axis of the shaft **82** carrying the bell crank lever **80** and the center axis of the shaft **52** carrying the lever **144**, respectively. The lever **144** thus configured and arranged is urged to turn about the center axis of the shaft **52** clockwise of the drawings, viz., toward the center axis of the cam shaft **42** by suitable biasing means connected between the lever **144** and the bell crank lever **80** of the cam actuating means **26**, the biasing means being shown comprising a preloaded helical tension spring **146** which is anchored at one end to the leading end of the lever **144** by a spring retaining pin **148** and at the other end to the previously mentioned projection **106** of the upper first arm portion **80***a* of the bell crank lever **80** by a spring retaining pin **150**. The tension spring **146** is, thus, operative not only to urge the lever **144** clockwise of the drawings but to urge the bell crank lever **80** to turn clockwise of the drawings about the center axis of the shaft **82** so that the cam follower roller **108** mounted on the lower second arm portion **80***b* of the bell crank lever **80** is forced against the cam surface of the eccentric cam **112**. If desired, the biasing means thus interconnecting the bell crank lever **80** and the lever **144** may be replaced with separate springs respectively connected to the bell crank lever **80** and the lever **144**, though not shown in the drawings.

While the first cam retaining means **34** is thus adapted to prevent clockwise rotation of the lobular cam **44** about the center axis of the cam shaft **42** when engagement is established between the lever **144** and one of the pins **50** on the cam **44**, the second cam retaining means **36** is arranged to prevent the lobular cam **44** from turning in the opposite direction about the center axis of the cam shaft **42**. The second cam retaining means **52** comprises a lever **152** which is rotatable on a stationary shaft **154** having a center axis substantially parallel with the center axis of the cam shaft **42**. The lever **152** has a leading end portion located and movable in proximity to the upper end of the rotational position of the lobular cam **44** and has a notch **152***a* formed in the leading end portion. The notch **152***a* is located and movable in the circular path of the pins **50** on the cam **44** and is thus capable of receiving therein any one of the pins **50** depending upon the relative angular positions of the cam **44** and the lever **152** about the center axes of the cam shaft **42** and the shaft **154**, respectively. When, thus, one of the pins **50** on the cam **44** is captured in the notch **152***a* of the lever **152** as shown in FIG. **1**, the cam **44** is prevented from rotating counter-clockwise of the drawings about the center axis of the cam shaft **42**. The lever **152** is urged to turn clockwise of the drawings by suitable biasing means such as a preloaded helical torsion spring **156** which has one end portion securely wound up on the shaft **154** and the other end portion clamped to the lever **152** as illustrated.

The operation of the embodiment of the present invention thus constructed and arranged will be hereinafter described with reference to FIGS. **1** to **5**.

Throughout the operation of the apparatus, the eccentric cam **112** of the intermittent-motion drive means **28** is kept driven to rotate about the center axis of the cam shaft **114** at a fixed velocity related to the velocities at which the other rotatable and otherwise movable members and structures of the loom are driven, as previously mentioned. The rotation of the eccentric cam **112** is transmitted to the shaft **116** of the pattern card arrangement **30** and drives the sprocket wheel **118** to rotate about the center axis of the shaft **116** at a velocity equal to one eighth of the rotational velocity of the eccentric cam **112** as also mentioned previously. The sprocket wheel **118** therefore makes a one-eighth turn about the center axis of the shaft **116** and accordingly the individual guide faces of sprocket wheel **118** are brought into contact with the roller **124** on the rocking member **114** of the locking means **32** one after another

as the eccentric cam **112** makes a full turn about the center axis of the cam shaft **114**.

When the eccentric cam **112** is thus driven for rotation about the center axis of the cam shaft **114** and has its higher and lower cam lobe portions alternately brought into rolling contact at their respective vertices P_1 and P_2 with the cam follower roller **124** on the bell crank lever **80**, the cam follower roller **108** is alternately raised and lowered over the cam shaft **114** so that the bell crank lever **80** carrying the cam follower roller **108** is caused to oscillate between the previously mentioned first and second angular positions thereof about the center axis of the stationary shaft **82** on which the bell crank lever **80** is mounted. If, under these conditions, the sprocket wheel **118** of the pattern card arrangement **30** happens to have an angular position having one of its guide faces in contact with the roller **136** on the rocking member **126** of the locking means **32**, the rocking member **126** is held in the previously mentioned upright first angular position thereof about the center axis of the pivotal pin **134** on the support member **124** by the force of the tension spring **140**, as illustrated in FIG. **1**. When the rocking member **126** assumes the first angular position as above described, the clamping member **128** has its upper first arm portion **128***a* held in contact with the projection **126***c* of the upper first arm portion **126***a* of the rocking member **126** and has about the center axis of the pivotal pin **134** an angular position having the edge **128***a* of its latch portion **128***c* located to be engageable with the land **98** on the upper first arm portion **80***a* of the bell crank lever **80**. When the bell crank lever **80** is rotated about the center axis of the shaft **82** into the second angular position, viz., the counter-clockwise extreme rotational position thereof against the force of the tension spring **146** with the eccentric cam **112** contacted by the cam follower roller **108** at the vertex P_1 of its higher cam lobe portion as shown in FIG. **1**, the edge **128***d* of the latch portion **128***c* of the clamping member **128** is slightly spaced apart from the previously mentioned surface portion **102** of the land **98**. When the eccentric cam **112** is further rotated about the center axis of the cam shaft **114** and the vertex P_1 of the higher cam lobe portion thereof is moved past the cam follower roller **108**, the bell crank lever **80** is forced to turn clockwise in the drawings about the center axis of the shaft **82** from the second angular position illustrated in FIG. **1** by the force of the tension spring **146** until the land **98** on the bell crank lever **80** receives the edge **128***d* of the latch portion **128***c* of the clamping member **128** on its surface portion **102** as shown in FIG. **5**. The angular portion of the bell crank lever **80** thus achieved when the land **98** has its surface portion **102** received on the edge **128***d* of the latch portion **128***c* of the clamping member **128** is herein referred to an allowance angular position of the bell crank lever **80** about the center axis of the shaft **82**. When the clamping member **128** is held in the angular position having the edge **128***d* of its latch portion **128***c* located to be engageable with the surface portion **102** of the land **98**, the bell crank lever **80** is slightly oscillated about the center axis of the shaft **82** between the second angular position and the above mentioned allowance angular position thereof as the eccentric cam **112** is rotated into and out of the angular position having the higher lobe portion contacted at its vertex P_1 with the cam follower roller **108** on the bell crank lever **80**.

When the bell crank lever **80** is thus rotated into the second angular position thereof, the cam actuating member **84** extending generally downwardly from the leading end of the upper first arm portion **80***a* of the bell crank lever **80** is moved into the uppermost position thereof and has one of the pins **50** on the lobular cam **44** received in the notch **90** of its hook portion **88**. When the lobular cam **44** is thus held in an angular position having one of the pins **50** received in the notch **90** of the hook portion **88** of the cam actuating member **84**, one of the remaining pins **50** is received on the lateral edge portion **144***b* of the lever **144** of the first cam retaining means **36** and at the same time one of the still remaining pins **50** is captured in the notch **152***a* of the lever **152** of the second cam retaining means **52**, as illustrated in FIG. **1**. The cam **44** is therefore locked in the above mentioned angular position and is prevented from being rotated in either direction about the center axis of the shaft **42** even when the bell crank lever **80** is rotated about the center axis of the shaft **82** clockwise of the drawings into the above mentioned allowance angular position by the force of the tension spring **146** so that the cam actuating member **84** is slightly moved downwardly from the uppermost position thereof and accordingly has the notch **90** slightly disengaged from the pin **50** which has been received in the notch **90** When the bell crank lever **80** is being moved between the second and allowance angular positions about the center axis of the shaft **82** as above described, the hook portion **88** of the cam actuating member **84** is located short of the lever **144** of the first cam acutating means **36** so that the curved notch portion **144***d* of the lever **144** is kept disengaged from the rounded projection **94** of the hook portion **88** of the cam actuating member **84** as shown in FIG. **1** even though the lever **144** is urged by the tension spring **146** toward an angular position to receive the rounded projection **94** in the notch portion **144***d* thereof.

As the sprocket wheel **118** of the pattern card arrangement **30** is further rotated about the center axis of the shaft **116** and has the peg **122** contacted by the roller **136** on the rocking member **126** as illustrated in FIG. **2**, the roller **136** is raised over the shaft **116** so that the rocking member **126** is rotated about the center axis of the pivotal pin **134** counter-clockwise of the drawings from the upright first angular position into the inclined second angular position against the force of the tension spring **140**. If, under these conditions, the eccentric cam **112** happens to have such an angular position having its lower cam lobe portion rolling on the cam follower roller **136** or its higher cam lobe portion rolling on the cam follower roller **136** at a point anterior or posterior to the vertex of

the higher lobe portion, the bell crank lever **80** is held in the allowance angular position thereof and has the land **98** located to have its surface portion **102** closely received on the edge **128***d* of the latch portion **128***c* of the clamping member **128** by the force of the tension spring **146**. The clamping member **128** is thus maintained in situ against the force of the tension spring **142** due to the frictional force established between the surface portion **102** of the land **98** and the edge **128***d* of the latch portion **128***c* of the clamping member **128** and has its upper first arm portion **128***a* disengaged from the projection **126***c* of the first arm portion **126***a* of the rocking member **126** against the force of the tension spring **142**. It is, thus, important that the tension spring **142** be selected so that the force thereof is overcome by the frictional force produced between the

land **98** and the latch portion **128***c* of the clamping member **128** when the latch portion **128***c* is forced against the surface portion **102** of the land **98** by the force of the tension spring **146**. When the eccentric cam **112** then reaches an angular position having the vertex P_1 of its higher cam lobe portion contacted by the cam follower roller **136**, the bell crank lever **80** is rotated about the center axis of the shaft **82** into the second angular position thereof and has the land **98** located to have its surface portion **102** disengaged from the edge **128***d* of the latch portion **128***c* of the clamping member **128**, which is accordingly allowed to turn counterclockwise of the drawings about the center axis of the pivotal pin **122** by the force of the tension spring **142** until the upper first arm portion **128***a* thereof is for a second time brought into abutting engagement with the projection **126***c* of the upper first arm portion **126***a* the rocking member **126** which is held in the inclined second angular position, as shown in FIG. **2**. The bell crank lever **80** is now permitted to oscillate between the first and second angular positions thereof about the center axis of the shaft **82** as the eccentric cam **112** is rotated about the center axis of the cam shaft **114**. As the bell crank lever **80** is thus oscillated between the first and second angular positions thereof, the cam actuating member **84** connected to the upper first arm portion **80***a* of the bell crank lever **80** is moved between the lowermost and uppermost positions, respectively, thereof. When the bell crank lever **80** is turned clockwise of the drawings from the second angular position past the allowance angular position thereof, the cam actuating member **84** is moved downwardly from the uppermost position thereof sidewise to the cam shaft **42** carrying the lobular cam **44**. When the cam actuating member **84** is thus moved downwardly from the uppermost position thereof, the notch **90** of its hook portion **88** is disengaged from the pin **50** which has been received in the notch **90** and the hook portion **88** has its guide surface **92** in sliding contact with the pin **50** which is located posterior to the pin **50** which has been caught in the notch **90**. As the cam actuating member **84** is moved closer to the lowermost position thereof, the hook portion **88** thereof has its rounded projection **94** brought into abutting engagement with the notch portion **144***a* of the elongated lever **144** of the first cam retaining means **34** as illustrated in FIG. **2** and forces the lever **144** downwardly. The lever **144** is thus caused to turn counter-clockwise in FIG. **2** against the force of the tension spring **146** which has been slackened by the clockwise rotation of the bell crank lever **80** toward the first angular position thereof. When the bell crank lever **80** reaches the first angular position thereof and accordingly the cam actuating member **84** reaches the lowermost position thereof, the lever **144** of the first cam retaining means **34** is rotated about the center axis of the shaft **52** into an angular position having its lateral edge portion **114***b* disengaged from the pin **50** which has been received therein and makes the cam **44** rotatable clockwise in the drawings about the center axis of the cam shaft **42**. When the cam actuating member **84** is in the lowermost position thereof, the hook portion **88** thereof has captured in its notch **90** the pin posterior to the pin **50** previously caught in the notch **90** as will be seen from FIG. **3**. As the bell crank lever **80** is rotated counter-clockwise from the first angular position about the center axis of the shaft **82** against the force of the tension spring **146**, the cam actuating member **84** is moved back upwardly from the lowermost position so that the pin **50** captured in the notch **90** of the hook portion **88** of the cam actuating member **84** is moved upwardly and causes the cam **44** to turn clockwise in the drawings from about the center axis of the cam shaft **42**. The cam **44** is in this fashion rotated through 60° from its initial angular position about the center axis of the cam shaft **42** when the bell crank lever **80** makes one oscillatory motion about the center axis of the shaft **82** and accordingly the cam actuating member **84** makes one reciprocating motion. When the bell crank lever **80** is being moved back toward the second angular position about the center axis of the shaft **82** and accordingly the cam actuating member **84** is being moved back toward the uppermost position thereof, the hook portion **88** of the cam actuating member **84** has its rounded projection **94** disengaged from the notch portion **144***d* of the elongated lever **144**, which is therefore allowed to turn about the center axis of the shaft **52** toward its initial angular position by the force of the tension spring **146** so that the pin **50** posterior to the pin **50** previously received on the lateral edge portion **144***b* of the lever **144** slides on the guide surface portion **144***a* of the lever **144** as will be seen from FIG. **4**. When the bell crank lever **80** reaches the second angular position thereof about the center axis of the shaft **82**, the lever **144** resumes its initial angular position about the center axis of the shaft **52** and has received on its lateral edge portion **144***b* the pin **50** newly engaged by the lever **144** so that the cam **44** is retained in the angular position newly reached. By the time the bell crank lever **80** reaches the first angular position thereof as above described, the sprocket wheel **118** of the pattern card arrangement **30** is further rotated about the center axis of the shaft **116** and has the leg **122** moved out of the position engaged by the roller **136** on the rocking member **126**. The rocking member **126** is therefore allowed to rotate clockwise of the drawings back into the upright first angular position about the center axis of the pivotal pin **134** by the force of the tension spring **140** so that the clamping member **128** having its first arm portion **128***a* held in contact with the projection **126***c* of the first arm portion **126***a* of the rocking member **126** is caused to turn clockwise of the drawings about the pivotal pin **134** together with the rocking member **126** and restores its initial angular position having the latch portion **128***c* located to be engageable with the land **98** on the bell crank lever **80**. When the bell crank lever **80** reaches the first angular position thereof, the latch portion **128***c* of the clamping member **128** has its guide surface portion **128***e* received on the guide surface portion **104** of the land **98**, as seen in FIG. **3**. As the bell carnk lever **80** is rotated counterclockwise of the drawings toward the second angular position thereof about the center axis of the shaft **82** against the force of the tension spring **136**, the land **98** on the bell crank lever **80** has its guide surface portion **104** in sliding contact with the guide surface **128***e* of the latch portion **128***c* of the

clamping member **128** and is disengaged from the latch portion **128***c* when the bell crank lever **80** reaches the second angular position illustrated in FIG. **1**. As the bell crank lever **80** is further driven to turn clockwise of the drawings from the second angular position thus reached, the land **98** on the bell crank lever **80** has its flat surface portion **102** received on the edge **128***d* of the latch portion **128***c* of the clamping member **128** as seen in FIG. **5** so that the bell crank lever **80** is locked in a condition slightly rockable about the center axis of the shaft **82** between the second angular position and the previously mentioned allowance angular position thereof as the eccentric cam **112** is driven to have its higher and lower lobe portions alternately brought into rolling contact with the cam follower roller **108** on the bell crank lever **80**.

The lobular cam **44** of the cam unit **22** is in this fashion driven to rotate clockwise in the drawings through 60° about the center axis of the cam shaft **42** every time the sprocket wheel **118** of the pattern card arrangement **30** makes a full turn about the center axis of the shaft **116**, viz., per eight turns of the eccentric shaft **112** about the center axis of the cam shaft **114**. When the lobular cam **44** is thus rotated into an angular position having one of its bottom portions **48** in contact with the cam follower roller **56** on the bell crank lever **54** of the link mechanism **24**, the bell crank lever **54** is turned into the counterclockwise extreme rotational position, viz., the previously mentioned first angular position about the center axis of the stationary shaft **52** so that the nozzle carrier **40** of the weft insertion unit **20** is moved into the lower position thereof having the first weft shooting nozzle **38** located to have its center axis aligned with the weaving shed S and flush with the warp line L as shown in FIG. **1**. The pick of the weft yarn which has been detained in the first weft shooting nozzle **38** is therefore shot into the weaving shed S by a jet stream of fluid spurting out of the nozzle **38** in one cycle of operation of the loom. Upon completion of the above described weaving cycle, the healds H and H' are driven to lower and raise the webs W and W', respectively, of warp yarns from the positions shown in FIG. **1** into the positions shown in FIG. **5** and form a new weaving shed S' between the webs W and W'. Another pick of weft yarn is then inserted into the new shed S' from the weft shooting nozzle **38**. When, on the other hand, the cam **44** assumes an angular position having one of its cam lobe portions **46** in contact with the cam follower roller **56**, the bell crank lever **54** is held in the clockwise extreme rotational position, viz., the previously mentioned second angular position thereof so that the nozzle carrier **40** is held in the upper position thereof and has the second weft shooting nozzle **38'** located to have its center axis aligned with the weaving shed S and flush with the warp line L, as illustrated in FIG. **5**. The pick of the weft yarn which has been detained in the second weft shooting nozzle **38'** is now shot into the weaving shed S in one cycle of operation of the loom. The nozzle carrier **40** is in this fashion moved between the upper and lower positions thereof relative to the weaving shed S and accordingly either of the weft yarns detained in the first and second weft shooting nozzles **38** and **38'** is selectively inserted into the weaving shed S in accordance with the signals delivered from the pattern card arrangement **30**.

FIGS. **6** to **10** illustrate part of a second preferred embodiment of the apparatus according to the present invention. The second embodiment of the present invention is characterized by cam retaining means which is provided in lieu of the first and second cam retaining means **34** and **36** in the first embodiment of FIGS. **1** to **5** and which is thus adapted to achieve the functions of both of the first and second cam retaining means **34** and **36** of the first embodiment. The cam retaining means comprises an elongated lever **144'** which is shaped and arranged essentially similarly to its counterpart in the embodiment of FIGS. **1** to **5** and which is thus rotatable about the axis of the shaft **52** carrying the bell crank lever **54** and formed with a projection **144***c* and an edge portion **144***d* with which the cam actuating member **84** is engageable at the rounded projection **94** of its hook portion **88**. Different from the cam retaining lever **144** in the embodiment of FIGS. **1** to **5**, the lever **144'** of the modified cam retaining means has formed in its intermediate portion engageable with the pins **50** on the cam **44** a notch having spaced parallel edges **158** and **158'**. When the lobular cam **44** is held in an angular position having one of its lobe portions **46** engaged by the cam follower roller **56** on the bell crank lever **54** as shown in FIG. **10** or its bottom portions **48** engaged by the cam follower roller **56** as shown in FIG. **6**, one of the pins **50** which is located closest to the lever **144'** is captured in the notch between the parallel edges **158** and **158'** and is forced onto the bottom edge of the notch by the force of the tension spring **146** urging the lever **144'** to turn clockwise of the drawings about the center axis of the shaft **52**, viz., toward the cam shaft **42**. If the cam **44** is urged to turn clockwise of the drawings, viz., in the normal direction of rotation thereof about the center axis of the cam shaft **42** under these conditions, the pin **50** thus captured in the notch of the lever **144'** is forced against one edge **158** of the notch and prevents the cam **44** from being rotated in the particular direction. If, conversely, the cam **44** is urged to turn in the opposite direction about the center axis of the cam shaft **42** for some reason, then the pin **50** in the notch is forced against the other edge **158'** of the notch and prevents the cam **44** from being rotated in the particular direction. The cam **44** is in this fashion securely held in the above mentioned angular position when held at rest with the locking means **32** in locking engagement with the cam actuating means **26'**. When the clamping member **128** of the locking means **32** is disengaged from the land **98** on the upper first arm portion **80***a* of the bell crank lever **80** of the cam actuating means **26** from the condition illustrated in FIG. **6** and the bell crank lever **80** is driven to turn clockwise of the drawings toward the previously mentioned first angular position thereof as illustrated in FIG. **7**, the cam actuating member **84** has the guide surface **92** of its hook portion **88** in sliding contact with the pin **50** located next to the pin **50** which has been engaged by the notch **90** of the hook portion. As the bell crank lever **80** is rotated closer to the first angular position thereof, the cam actuating member **84** has the hook portion **88** brought into abutting engagement at its rounded projection **94** with the edge portion **144***d* of the cam retaining lever **144'** as shown in FIG. **7** and forces the lever **144'** to turn counter-clockwise in FIG. **7**, viz., away from the cam shaft **42** about the center axis of the shaft **52** against the force of the tension spring **146** which has been slightly slackened by the clockwise rotation of the bell crank lever **80**. When the bell crank lever **80** reaches the first angular position thereof and accordingly the cam actuating member **84** is moved into the lowermost position thereof, the pin **50**

which has been in contact with the guide surface **92** of the hook portion **88** of the cam actuating member **84** is received in the notch **90** of the hook portion **88** by reason of the force of the spring **96** urging the cam actuating member **84** toward the cam shaft **42** and at the same time the pin **50** which has been captured in the notch of the lever **144'** is withdrawn from the notch, as illustrated in FIG. **8** and makes the cam **44** to turn about the center axis of the cam shaft **42**. When the bell crank lever **80** is then rotated counter-clockwise of the drawings from the first angular position thereof and accordingly the cam actuating member **84** is moved upwardly from the lowermost position thereof, the hook portion **88** of the cam actuating member **84** is disengaged from the edge portion **144***d* of the cam retaining lever **144'** as shown in FIG. **9**. As the cam actuating member **84** is thus moved upwardly, the cam **44** is rotated clockwise of the drawings about the center axis of the cam shaft **42** with the pin **50** received in the notch **90** of the hook portion **88** of the cam actuating member **84** so that the pin **50** located next to the pin **50** which has just been withdrawn from the notch of the lever **144'** is moved closer to the notch of the lever **144'** which is being turned clockwise of the drawings toward the cam shaft **42** about the center axis of the shaft **52** by the force of the tension spring **146**. When the bell crank lever **80** reaches the previously mentioned allowance angular position close to the second angular position thereof, the pin **50** thus approaching the notch of the lever **144'** is received in the notch and locks the cam **44** in the angular position having one of its lobe portions **46** contacted by the roller **56** on the bell crank level **54** as illustrated in FIG. **10**.

While the cam unit **22** of each of the embodiments has been described and shown as comprising only one cam, this is merely for the purpose of illustration and, for this reason, the cam means forming part of the apparatus according to the present invention may comprise two or more cams depending upon the number of the weft yarns to be used. If two or more cams are thus used, each of the cam follower roller **56**, bell crank lever **54**, cam actuating means **26**, pattern card arrangement **30**, locking means **32**, and first and second cam retaining means **34** and **36** or cam retaining means **34** must be provided in a number equal to the number of the cams. Although, furthermore, the apparatus according to the present invention has been described and shown to be utilized for the selective insertion of weft yarns into the weaving shed of a loom, such an apparatus may be used for the control of the weft drawing-off and measuring mechanism and/or the weft retaining mechanism of the loom, if desired.

What is claimed is:

1. An apparatus for selectively inserting weft yarns into the shed in a weaving loom, comprising, in combination, a weft insertion unit including a plurality of weft shooting members each movable into a position aligned in use with a shed of a loom, weft selector cam means including at least one lobular cam rotatable about a fixed axis and formed with a plurality of cam lobe portions substantially equiangularly spaced apart from each other across bottom portions about said axis and having substantially equal radii from the axis, said bottom portions having from said axis substantially equal radii smaller than said radii of said cam lobe portions, a link mechanism operatively connecting said cam to said weft insertion unit for moving one of said weft shooting members into the position aligned with said shed when engaging one of said cam lobe portions and another weft shooting member into said position when engaging one of said bottom portions of said cam, cam actuating means operative to drive said cam to turn in a predetermined direction about said axis thereof from an angular position having one of its cam lobe portions engaged by said link mechanism into an angular position having one of its bottom portions engaged by the link mechanism or from the latter angular position into the former in each cycle of operation of the loom, weft selector signal supply means storing signals representative of a predetermined schedule in accordance with which the weft yarns are to be selectively inserted into said shed, locking means responsive to the signals delivered from said signal supply means for locking said cam actuating means in a condition inoperative to drive said cam in response to one signal from the signal supply means and releasing the cam actuating means from the inoperative condition in response to another signal from the signal supply means, cam retaining means engageable with said cam means for holding said cam in any of said angular positions of the cam when said locking means is in locking engagement with said cam actuating means, and the cam retaining means being disengaged from the cam when the cam is being rotated from one of the angular positions thereof into another.

2. An apparatus as set forth in claim **1**, in which said cam means further comprises pins projecting from one end face of said cam substantially in parallel with said fixed axis and arranged substantially in symmetry about the axis, the number of said pins doubling the number of said lobe portions of said cam, said cam actuating means being engageable with said pins and movable with respect to said fixed axis for turning each of the pins through an angle equal to the central angle between every neighboring two of the pins about said fixed axis and thereby driving said cam to rotate through said angle about said fixed axis in each cycle of operation provided said cam actuating means is disengaged from said locking means.

3. An apparatus as set forth in claim **2**, in which said cam actuating means comprises at least one bell crank lever rotatable about a fixed axis substantially parallel with said axis of said cam and at least one cam actuating member which is rotatable on said bell crank lever about a fixed axis substantially parallel with the axis of rotation of said cam and which is engageable with the pins on the cam, said bell crank lever being rotatable about the axis of rotation thereof between a first angular position having said cam actuating member in a position engaging one of said pins on the cam and a second angular position having the cam actuating member in a position engaging the pin forward of said one of the pins in said direction of rotation of the cam, said bell crank lever being operative to move said pins through said angle per oscillatory motion of the bell crank lever from said first angular position to said second angular position and back from the second angular position into the first angular position thereof.

4. An apparatus as set forth in claim **3**, in which said locking means comprises a clamping member rotatable about a fixed axis substantially parallel with the axis of rotation of said cam, a land on said bell crank lever and engageable with said clamping member depending upon the relative angular positions of the clamping member and said bell crank lever, said clamping member having about the axis of rotation thereof an angular position engageable with the land on said bell crank lever and

being in locking engagement with the land when the clamping member is in said angular position thereof and simultaneously said bell crank lever is in an allowance angular position slightly turned away from said second angular position toward said first angular position thereof about the axis of rotation of the clamping member, a rocking member rotatable about a fixed axis coincident with the axis of rotation of said clamping member, first biasing means connected between said clamping and rocking members for urging the clamping member to turn away from said angular position thereof about the axis of rotation thereof, the biasing force of the first biasing means being variable depending upon the relative angular positions of the clamping and rocking members, said rocking member being rotatable about the axis of rotation thereof between a first angular position producing a smaller biasing force in said first biasing means and a second angular position producing a greater biasing force in the biasing means, second biasing means urging said rocking member toward said first angular position thereof, third biasing means urging said bell crank lever toward said first angular position thereof about the axis of rotation thereof, and stop means fast on said rocking member and engageable with said clamping member for preventing the rocking member from being rotated beyond said first angular position thereof by the force of said second biasing means, said stop means being in engagement with said clamping member irrespective of the angular position of the rocking member when said clamping member is disengaged from said land on said bell crank lever.

5. An apparatus as set forth in claim **4**, in which said land on said bell crank lever has a surface portion engageable with said clamping member, said clamping member being in said locking engagement with said land by surface-to-surface contact with said surface portion of the land and forced against the surface portion by the force of said third biasing means when the clamping member is in said angular position thereof and simultaneously said bell crank lever is in said allowance angular position thereof, said first biasing means being selected so that said smaller biasing force thereof is overcome by the force exerted between said surface portion and said clamping member by said third biasing means.

6. Apparatus as set forth in claim **4**, in which said cam retaining means comprises a cam retaining member having an angular position engageable with one of said pins on said cam and connected by said third biasing means to said bell crank lever for being urged toward said angular position thereof, said cam retaining member being operative to prevent said cam from being rotated in said predetermined direction about said axis of rotation thereof when held in said angular position thereof, said cam actuating member being engageable with said cam retaining member for moving the cam retaining member out of said angular position thereof for permitting said cam to turn in said predetermined direction about the axis of rotation thereof when said bell crank lever is moved into said first angular position thereof against the force of said third biasing means.

7. An apparatus as set forth in claim **6**, in which said cam retaining means further comprises a cam retaining member having an angular position engageable with one of said pins on said cam and urged toward said angular position thereof for being operative to prevent said cam from being rotated about the axis of rotation thereof in the direction opposite to said predetermined direction when held in said angular position thereof.

8. An apparatus as set forth in claim **6**, in which said cam retaining means comprises a cam retaining member having an angular position engageable with said pins on said cam and connected by said third biasing means to said bell crank lever for being urged toward said angular position thereof, said cam retaining member being operative to prevent said cam from being rotated in both directions about the axis of rotation thereof when held in said angular position thereof, said cam actuating member being engageable with said cam retaining member for moving the cam retaining member out of said angular position thereof when said bell crank lever is moved into said first angular position thereof against the force of said third biasing means.

9. An apparatus as set forth in claim **8**, in which said cam retaining member is formed with a notch having two spaced edges, said cam retaining member being receivable one of said pins between said edges for preventing said cam from rotating in one direction about the axis thereof with the pin received on one of said edges and in the other direction about the axis thereof with the pin received on the other of said edges when the cam retaining member is in said angular position thereof.

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