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3,318,341

LOOM REVERSING MEANS

Filed July 28, 1965

3 Sheets-Sheet 1

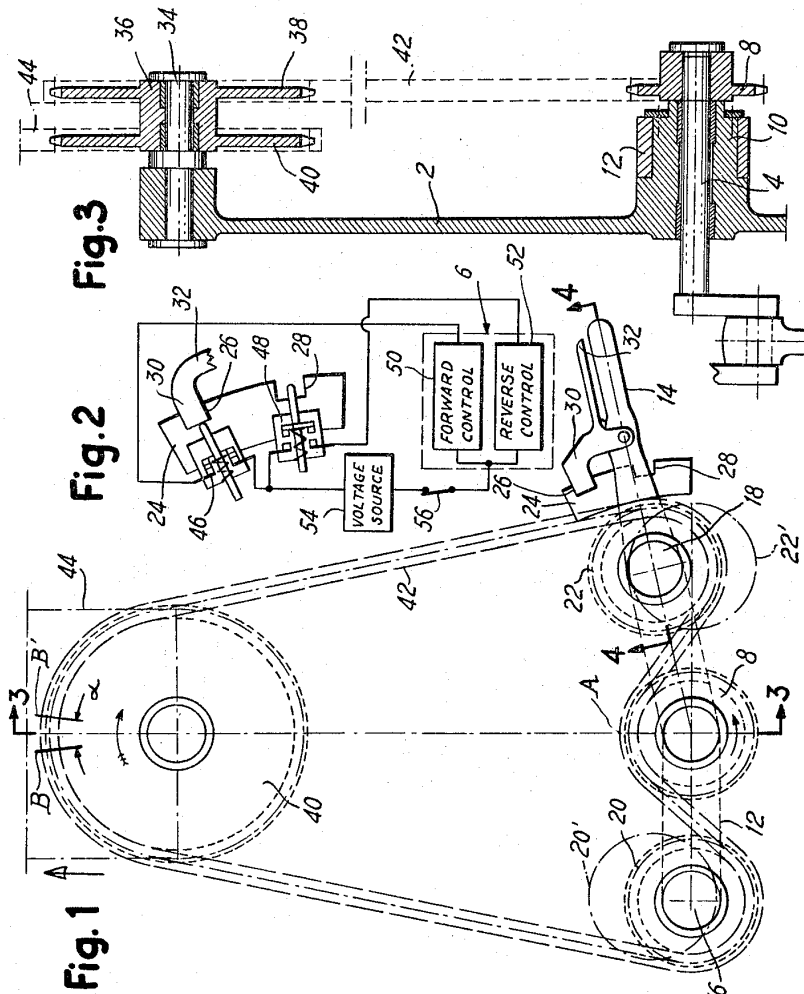


Fig. 1

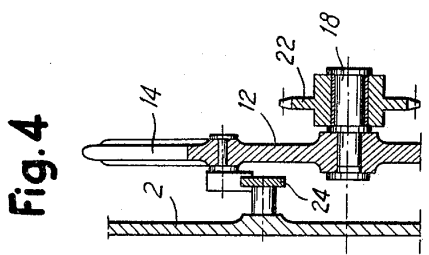


Fig. 2



Fig. 3

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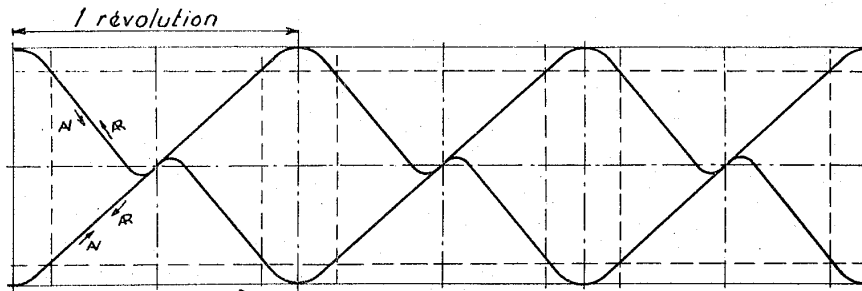
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3 Sheets-Sheet 2

Fig. 7



Admission  
Forward  
Exit Reverse

Exit Forward  
Admission  
Reverse

Fig. 6

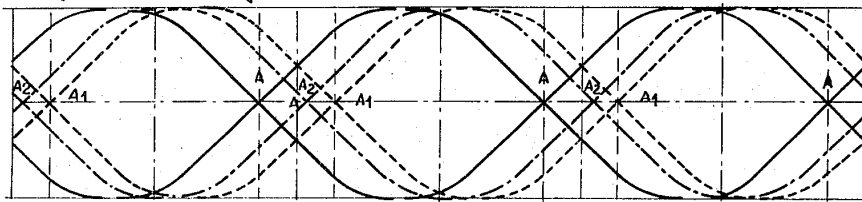
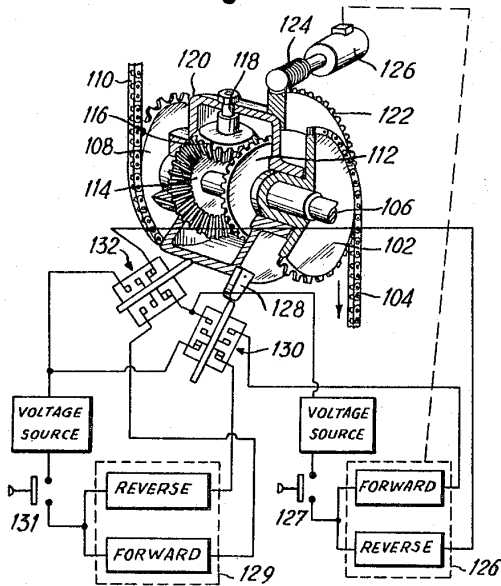


Fig. 5



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3 Sheets-Sheet 3

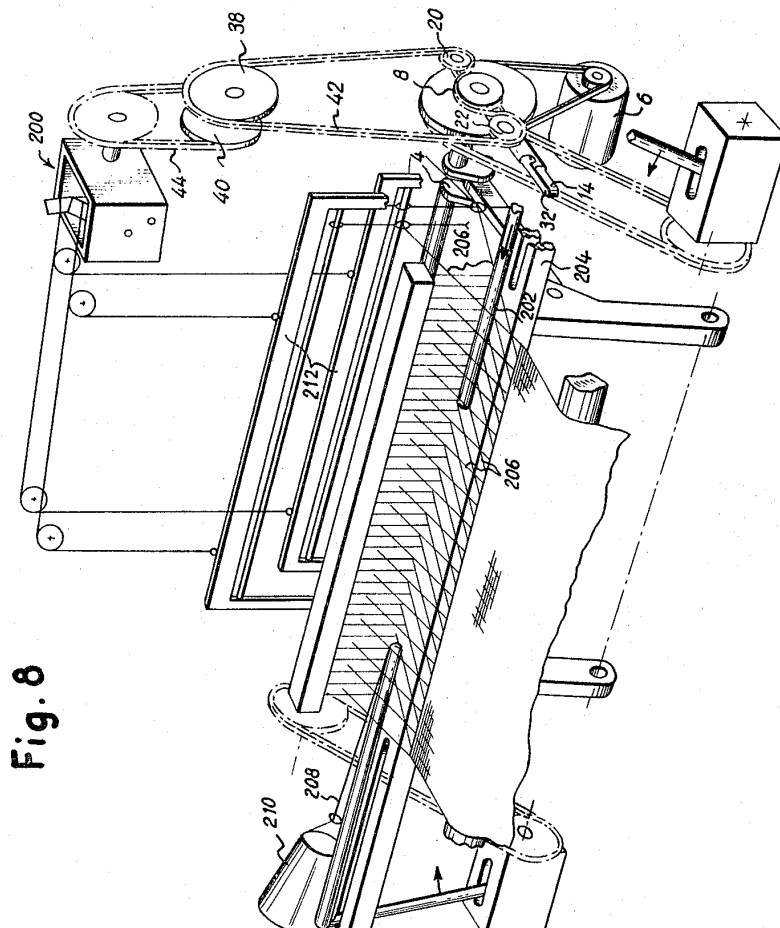


Fig. 8

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1

3,318,341  
**LOOM REVERSING MEANS**  
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 12 Claims. (Cl. 139-1)

This invention relates generally to means for reversing looms of the type including a stationary weft supply located outside the shed, and more particularly to loom reversing means including means for angularly displacing the sprocket gear that drives the heald operating means relative to a sprocket gear that operates in synchronism with the weft insertion means and other ancillary components of the loom.

It is known in the prior art (as evidenced, for example, by the U.S. patent to Alfred Cuiengnet No. 3,095,015 of June 25, 1963) that in looms of the aforementioned type, the shed closes on the weft insertion means at the moment the weft thread is released. Consequently, it is not usually possible to drive the entire loom in the reverse direction since such reverse motion would generally result in the penetration of a closed shed by the weft insertion means.

The object of the present invention is to provide a weaving loom of the type having a stationary weft supply located outside the shed and including novel means for permitting the complete reversal of motion of the batten, weft-insertion means and other ancillary components of the loom. The invention is characterized by the provision of means for momentarily displacing the movement of the healds between either of two given (e.g., "forward" and "reverse" enabling) positions relative to the loom drive means, whereby reverse motion of the loom is permitted.

As disclosed in the aforementioned Cuiengnet Patent No. 3,095,015, the heald operating means are driven from the loom motor by means including an endless chain and a heald drive sprocket gear. Other means of the loom (for example, the weft insertion means) are driven either directly by the loom motor or from the loom motor via a loom sprocket gear and other endless chain means coupled therewith. In accordance with a more specific object of the present invention, means are provided for adjusting the instantaneous angular relationship between the sprocket gear that drives the heald operating means and the motor-driven sprocket gear associated with the weft insertion means, whereby the timed relationship between the operation of the healds and the weft insertion means may be varied to permit operation of the loom in the reverse direction without penetration of the weft inserters into a closed shed.

According to a first embodiment of the invention, the loom sprocket gear and the sprocket gear that drives the heald operating means are connected by an endless chain that passes over a pair of auxiliary or guide sprocket gears arranged on opposite sides of the loom sprocket gear. The chain is so mounted that the direction of rotation of the loom sprocket gear is opposite that of the other sprocket gears. The guide sprocket gears are mounted on a lever that is pivotally movable about the axis of rotation of the loom sprocket. Latching means are provided for locking the lever in either of two angularly displaced positions. The lever embodiment of the invention is so designed that when the loom motor is de-energized and the loom sprocket gear is stationary, pivotal movement of the lever between the two positions established by the latching means causes a corresponding angular displacement of the drive sprocket gear of the heald operating means relative to the loom sprocket. As a result of this angular displacement of the heald driving sprocket, when the loom is driven in the reverse direction

2

(for unweaving of the fabric to remove a broken thread, for example) the timed relationship between the heald operating means and the weft insertion means is such as to permit penetration of the shed by the weft inserting means during unweaving rather than having such members inserted into a closed shed.

In accordance with a second embodiment of the invention, differential gearing means are provided for adjusting the instantaneous angular relationship between the drive sprocket of the heald operating means and the loom sprocket associated with the weft insertion means, whereby the loom may be driven in the reverse direction. The differential gearing means includes a pair of bevel sun gears connected with the two sprocket gears, respectively, and planetary bevel gears connecting the sun gears. The planetary bevel gears are carried by a planet carrier that is driven between two predetermined angularly displaced positions by auxiliary motor means. This differential gearing arrangement is such that when the loom motor is de-energized to immobilize the loom sprocket gear and the auxiliary motor is operated to angularly displace the planetary gear carrier, the drive sprocket gear for the heald operating means is angularly displaced relative to the sprocket gear associated with the weft insertion means or other ancillary means of the loom.

According to a more specific object of the invention, switch means are provided for disabling operation of the loom motor in the forward and reverse directions when the loom sprocket gear and the heald driving sprocket gear do not have the appropriate angular relationship, respectively. In the lever embodiment of the invention, a pair of normally open switch means which normally disable the forward and reverse controls of the loom motor are arranged for actuation by the lever latch means to enable the corresponding loom motor operation when the lever is in one of the two latched positions. In the differential gearing embodiment of the invention, normally-open switch means are arranged for operation by stop means carried by the planetary gear carrier to enable the loom motor only when the heald operating sprocket gear and the loom sprocket gear have the appropriate angular relationship.

Other objects and advantages of the present invention will become apparent from a study of the following specification when considered in conjunction with the accompanying drawing, in which:

FIGURE 1 is a somewhat schematic front elevational view, with certain parts removed for clarity, of a first embodiment of the invention for adjusting the instantaneous angular relationship between the heald driving sprocket and the loom sprocket gears;

FIGURE 2 is a detailed view of the means for latching the adjusting lever of FIGURE 1, the electrical safety system being illustrated schematically;

FIGURES 3 and 4 are sectional views taken along lines 3-3 and 4-4 of FIGURE 1, respectively;

FIGURE 5 is a perspective view, with certain parts broken away for clarity, of a differential gearing embodiment for adjusting the instantaneous angular relationship between the heald drive sprocket and the loom sprocket gears;

FIGURES 6 and 7 are timing curves illustrating the relative displacements of the forward-motion and reverse-motion heald means and the forward-motion and reverse-motion weft insertion means, respectively; and

FIG. 8 is a detailed front perspective view, with certain parts removed, of a loom including the control means of FIGS. 1-4.

Referring first to the lever embodiment of the invention illustrated in FIGURES 1-4 and 8, the weaving loom includes a frame 2 (FIGURES 3 and 4) containing a

3

bore in which is journaled the main crank shaft 4 that is driven by a reversible electric loom motor 6 (FIGURE 2). Keyed to the shaft 4 is a loom sprocket gear 8 that is normally driven at a constant speed in the forward or reverse directions of rotation by the loom motor. Pivotaly mounted intermediate its ends on the tubular extension 10 of the bearing of main shaft 4 is a rigid lever 12 having at one end a handle 14. Journaled on parallel pins 16 and 18 carried by lever 12 on opposite sides of the pivot extension 10 are a pair of auxiliary or guide sprockets 20 and 22, respectively. Rigidly secured to the frame 2 adjacent lever handle 14 is a sector plate 24 containing a pair of notches 26, 28 for alternately receiving the locking finger 30 of a latch 32 that is pivotaly connected to the lever handle.

Journaled on a pin 34 carried by the frame 2 is a double sprocket member 36 that includes a pair of integrally connected sprocket gears 38 and 40. Sprocket gears 8, 20, 22 and 38 are coplanar and are interconnected by an endless sprocket chain 42 as shown in FIGURE 1. The chain 42 is so arranged that sprocket gears 20, 22, 38 and 40 are rotatably driven in a direction opposite to the direction of rotation of loom sprocket gear 8. As is generally known in the loom art, sprocket gear 40 drives conventional heald operating means 200 (FIG. 8) via a second endless sprocket chain 44. The loom-motor-driven main crank shaft 4 drives conventional loom means, such as the weft insertion means 202 (FIG. 8). As is conventional in the art, the weft insertion means 202 travel on the batten or slay 204 inside the shed formed by the warp threads 206, the weft thread 208 being withdrawn from the stationary supply 210. Healds 212 are operated by the heald operating means 200 in a conventional manner.

As shown in FIGURE 2, a pair of normally-open switches 46 and 48 are mounted on plate 24 adjacent notches 26 and 28, respectively, for operation by the finger portion 30 of latch 32. The switches are connected in series with the forward and reverse control means 50 and 52, respectively, of the loom drive motor 6. The motor 6 is energized from a voltage source 54 via start switch 56.

In operation, assume that lever 12 is in the illustrated latched (i.e., "forward" enabling) position, whereupon switch 46 is closed by latch finger 30. The loom motor 6 rotates in the forward direction and drives main crank shaft 4 and loom sprocket gear 8 in the counterclockwise direction shown by the arrow in FIGURE 1. Owing to the arrangement of sprocket chain 42, sprocket gears 20, 22, 38 and 40 are driven in the clockwise direction. The heald sprocket gear 40 now drives the heald operating means via endless sprocket chain 44.

In the event that a weaving condition should now occur for which a reversing operation of the loom is desired, switch 56 is opened to de-energize the loom motor 6. Latch 32 is operated to withdraw finger 30 from notch 26, whereupon lever 12 is pivoted in the clockwise direction from the illustrated forward-motion position to the reverse-motion position in which finger 30 is opposite notch 28. Latch 32 is operated (for example, by spring means, not shown) to effect engagement of finger 30 with notch 28 to lock lever 12 in this pivotaly displaced position. During this clockwise pivotal movement of lever 12, the auxiliary sprocket gears 20 and 22 carried thereby are displaced to the positions 20' and 22' illustrated in phantom in FIGURE 1. This displacement of the auxiliary sprockets results in a corresponding slight angular displacement of sprockets 38 and 40 in the clockwise direction (angle " $\alpha$ " in FIGURE 1). More particularly, assuming that point A is stationary on the stationary loom sprocket gear 8, point B on sprocket gear 38 will be displaced to point B' as a result of the pivotal movement of the lever 12. The length of the chain 42 is substantially constant, the only variation being the slight

4

change resulting from the sum of the very small free movements afforded between the links of the chain. Owing to the aforementioned angular displacement of sprocket 38 (and heald drive sprocket 40 integral therewith) chain 44 is longitudinally displaced a corresponding slight distance (as indicated by the arrow in FIGURE 1) to rotate through a small angle the heald operating means 200. Thus it is apparent that as a result of the pivotal movement of the lever 12, the heald operating means are rotated through a corresponding small angle relative to the various means of the loom (for example, the weft insertion means) driven by main shaft 4, whereby reverse motion of the loom is permitted. Since switches 46 and 48 are open and closed, respectively, loom motor 6 is prevented from being inadvertently operated in the forward direction and may be operated only in the reverse direction upon closing of switch 56 and actuation of the reverse control means 52.

Following the operation of the loom in the reverse direction, switch 56 is opened to de-energize the loom motor, lever 12 is unlatched and returned to the illustrated position, switches 46 and 48 are again closed and opened, respectively, and the loom is again enabled for forward operation. During this pivotal movement of lever 12 in the counterclockwise direction, sprockets 38 and 40 are angularly displaced in the counterclockwise direction through the angle  $\alpha$ , and the heald operating means are returned to the original angular relationship relative to loom sprocket gear 8.

FIGURE 5 discloses an alternative embodiment of the invention including a differential gearing arrangement for effecting the aforementioned angular displacement between the loom sprocket gear and the heald-operating sprocket gear. The loom sprocket gear 102, which is driven simultaneously with the other loom means via drive chain 104, is journaled on the stationary shaft 106 which is secured to the loom frame. Similarly, the heald driving sprocket 108, which drives the heald operating means (not shown) via endless chain 110, is rotatably mounted on stationary shaft 106. Also journaled on shaft 106 are a pair of bevel gears 112 and 114 that are secured to sprocket gears 102 and 108, respectively. Interconnecting bevel gears 112 and 114 are a plurality of planetary bevel gears 116 that are journaled on pins 118 carried by planetary gear carrier 120. This carrier 120 is rotatably supported on the sleeves that interconnect the sprocket gears 102 and 108 with the corresponding bevel gears 112 and 114, respectively. The carrier is axially rotated by the cooperation between a worm sector 122 secured thereto and a worm drive 124 driven by reversible auxiliary electric motor 126.

Extending radially from the carrier 120 is a stop 128 which alternately operates switch means 130 and 132 secured to the loom frame. These switch means each include normally closed first switch contacts which normally enable operation of the auxiliary motor 126, and normally open second switch contacts which normally disable the loom drive motor 129. The motors 126 and 129 are energized from appropriate voltage sources via switches 127 and 131, respectively.

In operation, when the elements are in the positions illustrated in FIGURE 5 and the chain 104 is driven by the loom motor in the direction indicated by the arrow, loom sprocket gear 102 and bevel gear 112 connected thereto are rotated in the clockwise direction upon stationary shaft 106. Assuming that auxiliary motor 126 is de-energized whereby planetary gear carrier 120 is maintained stationary, bevel gears 116 and 114 are driven by sun gear 112 to rotate sprocket gear 108 in the counterclockwise direction and thereby drive chain 110 in the direction indicated by the arrow. In the event that it should be desired to operate the loom in the reverse direction (for an unweaving operation, for example) the loom motor is de-energized and the auxiliary motor 126 is energized to drive carrier 120 in the clockwise direction

5

from the illustrated "forward" motion position, whereupon the auxiliary motor enabling contacts and the loom motor disabling contacts of switch means 130 are closed and opened, respectively. The carrier 120 is rotated until switch means 132 are actuated by projection 128 to disable the auxiliary motor 126 and to enable the loom motor 129. During this movement of the carrier 120 relative to the stationary sprocket gear 102, bevel gears 116 and 114 are driven to slightly displace the heald driving sprocket 108 through an angle relative to sprocket gear 102 that is a function of the extent of angular movement of the carrier 120. The heald-operating means are now in the "reverse" motion position relative to the weft insertion means. Upon operation of the reverse control means of loom motor 129, the loom components (such as the weft insertion means) and the heald operating means, are driven in the reverse direction.

Upon completion of the loom unweaving operation, the loom motor is de-energized, and the auxiliary motor 126 is operated in the reverse direction, whereupon the loom motor reverse control means are disabled and the auxiliary forward control means are enabled. The auxiliary motor 126 rotates planetary carrier 120 in the counterclockwise direction until switch means 130 are actuated by projection 128 to de-energize the auxiliary motor and to enable the forward control means of the loom motor as shown. During this return movement of the planetary carrier relative to the stationary loom sprocket gear 102 and bevel gear 112, sprocket gear 108 is driven by bevel gears 114 and 116 to its original angular relationship relative to loom sprocket gear 102. The loom motor may then be energized to resume driving of the loom in the forward direction.

The effect of the angular displacement of the heald drive sprocket relative to the loom sprocket gear in each of the two embodiments described above is apparent from an examination of the timing curves of FIGURES 6 and 7. In FIGURE 6, the movement of the healds in the forward direction is illustrated in by the solid line. It will be noted that the point of intersection A of the healds occurs as the weft inserters (FIGURE 7) leave the shed. To permit operation in the reverse direction, it is necessary merely to displace the point of intersection to the point A<sub>1</sub> shown by the broken line in FIGURE 6. The weft inserters then enter a shed on a line at right angles to A and pass out of the shed at the new point of intersection A<sub>1</sub>. Actually, since no weaving takes place, this point of intersection is not absolutely necessary, and consequently the point A<sub>2</sub> is preferably selected such that the opening of the shed is sufficient for the introduction of the weft inserters, that the uncrossing is appropriate, and that the closing of the shed takes place slightly after the weft inserters have left in order to spare the warp threads.

The displacement of the weft inserters is shown in FIGURE 7 wherein the co-ordinates which correspond to the displacements and to the times are chosen so as to show the correlation between the weft insertion means and the heald movements.

While in accordance with the provisions of the patent statutes, the preferred forms and embodiments of the invention have been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made in the apparatus described without deviating from the invention set forth in the following claims.

What is claimed is:

1. In a loom apparatus of the type including a shed, a stationary weft supply located outside the shed, a loom motor, first loom means driven by said motor, and heald operating means adapted to be driven by said motor in a given timed relationship relative to said first loom means; the invention which comprises

a loom sprocket gear connected with said first loom means for simultaneous driven movement therewith;

6

means including a second sprocket gear for driving said heald operating means;

adjustable means affording a continuous and positive mechanical connection between said second sprocket gear and said loom sprocket gear to thereby effect driving of said heald operating means, said adjustable means being operable to vary the instantaneous angular relationship of said second sprocket gear relative to said loom sprocket gear; and

operating means for operating said adjusting means to establish one of two predetermined angular relationships between said loom sprocket gear and said second sprocket gear.

2. In a loom apparatus, the invention which comprises a reversible loom drive motor;

a loom sprocket gear driven by said loom motor; heald drive means including a second sprocket gear; adjustable means connecting said second sprocket gear with said loom sprocket gear to effect driving of said heald operating means, said adjustable means being operable to vary the instantaneous angular relationship of said second sprocket gear relative to said loom sprocket gear;

and operating means for operating said adjusting means to establish one of two predetermined angular relationships between said loom sprocket gear and said second sprocket gear;

said adjustable means comprising

a lever arranged for pivotal movement intermediate its ends about a pivot axis collinear with the axis of rotation of said loom sprocket gear, a pair of auxiliary sprocket gears journaled on said lever on opposite sides of, and coplanar with, said loom sprocket gear, respectively, and an endless sprocket chain so mounted on all of said sprocket gears to cause each of said auxiliary and heald sprocket gears to be driven in a direction opposite to the direction of rotation of said loom sprocket gear, whereby when said loom sprocket gear is maintained stationary and said lever is pivoted, the angular relationship between said loom sprocket gear and said second sprocket gear is varied.

3. Apparatus as defined in claim 2 wherein said loom includes a frame, and further wherein said operating means comprises a pair of cooperating latching means mounted on said frame and said lever, respectively, for releasably latching said lever in either of two angularly displaced positions relative to the frame.

4. In a loom apparatus, the invention which comprises a reversible electric loom drive motor;

a loom sprocket gear driven by said loom motor; heald operating means including a second sprocket gear; adjustable means connecting said second sprocket gear with said loom sprocket gear to effect driving of said heald operating means, said adjustable means being operable to vary the instantaneous angular relationship of said second sprocket gear relative to said loom sprocket gear;

operating means for operating said adjusting means to establish one of two predetermined angular relationships between said loom sprocket gear and said second sprocket gear; and

means permitting energization of said loom motor only when said second sprocket gear has one of said two predetermined angular relationships relative to said loom sprocket gear.

5. Apparatus as defined in claim 4 wherein said loom includes a frame; wherein said adjustable means comprises a differential gearing arrangement including a pair of sun gears connected with said loom sprocket gear and said second sprocket gear, respectively, a plurality of planetary gears interconnecting said sun gears, and a planet gear carrier carrying said planetary gears, said carrier being rotatably carried by said frame; and further wherein said operating means comprises means for

7

rotating said planet gear carrier between a pair of angularly displaced fixed positions relative to the frame.

6. Apparatus as defined in claim 5 wherein said differential gearing arrangement is mounted coaxially relative to said second sprocket gear.

7. Apparatus as defined in claim 5 wherein said differential gearing arrangement is mounted coaxially relative to said loom sprocket gear.

8. Apparatus as defined in claim 5 wherein said loom further includes at least one auxiliary guide sprocket gear, and chain means connecting said guide sprocket gears with said loom sprocket gear and said second sprocket gear; and further wherein said differential gearing arrangement is mounted coaxially relative to said auxiliary guide sprocket gear.

9. Apparatus as defined in claim 5 wherein said planet gear carrier rotating means comprises an auxiliary motor mounted on said frame, means for energizing said auxiliary motor to drive the same in a direction causing the carrier to be displaced from one of said fixed positions toward the other, and end-stop switch means for de-energizing said auxiliary motor when the carrier reaches the other of said fixed positions.

10. Apparatus as defined in claim 9, wherein said loom motor energizing means includes safety switch means enabling energization of the loom motor only when said planetary gear carrier is in either of said fixed positions.

11. Apparatus as defined in claim 3, and further including switch means associated with said latching means for energizing said loom motor only when said lever is in either of the two angularly displaced positions relative to the frame.

12. In a loom of the type including a frame supporting a shed, a stationary weft reserve located outside the shed, heald operating means, and weft insertion means, the invention which comprises in combination

reversible electric motor means for driving said weft insertion means;

8

a loom sprocket gear driven by said motor in synchronism with said weft insertion means;

second sprocket gear means for driving said heald operating means;

adjustable means connecting said second sprocket gear with said loom sprocket gear to thereby effect driving of said heald operating means by said motor, said adjustable means being operable to vary the instantaneous angular relationship of said second sprocket gear relative to said loom sprocket gear;

operating means for operating said adjusting means to establish one of two predetermined angular relationships between said loom sprocket gear and said second sprocket gear;

a pair of normally disabled means for operating said loom motor alternately in the forward and reverse directions, respectively;

and a pair of enabling means associated with said pair of loom motor operating means, respectively, each of said enabling means being controlled by said adjustable means and being operable to enable the associated loom operating means when the second sprocket gear is in a given one of said angular relationships relative to said loom sprocket gear, respectively.

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