

[54] WEFT PICKING APPARATUS

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[51] Int. Cl..... **D03d 47/12**

[58] Field of Search..... 139/122 R, 127 R, 145

[57] **ABSTRACT**

Weft picking apparatus for a shuttleless loom including a picking lever carrying a pick roller which is movable to catch a length of weft yarn and project the weft yarn in a loop through a shed, a drive roller element connected with the pick roller, and a ramp or band on which the drive roller element rides such that oscillation of the picking lever rotates the drive roller element to drive the pick roller at a peripheral speed equal to or greater than the speed of the weft yarn passing therearound.

[56] **References Cited**

**UNITED STATES PATENTS**

3,543,808 12/1970 Moessinger ..... 139/127 R

**7 Claims, 10 Drawing Figures**

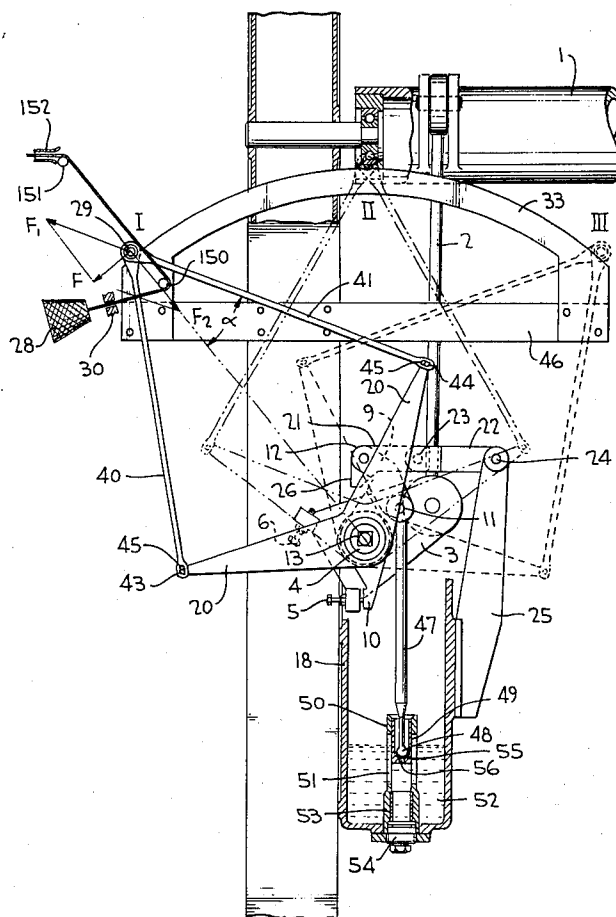
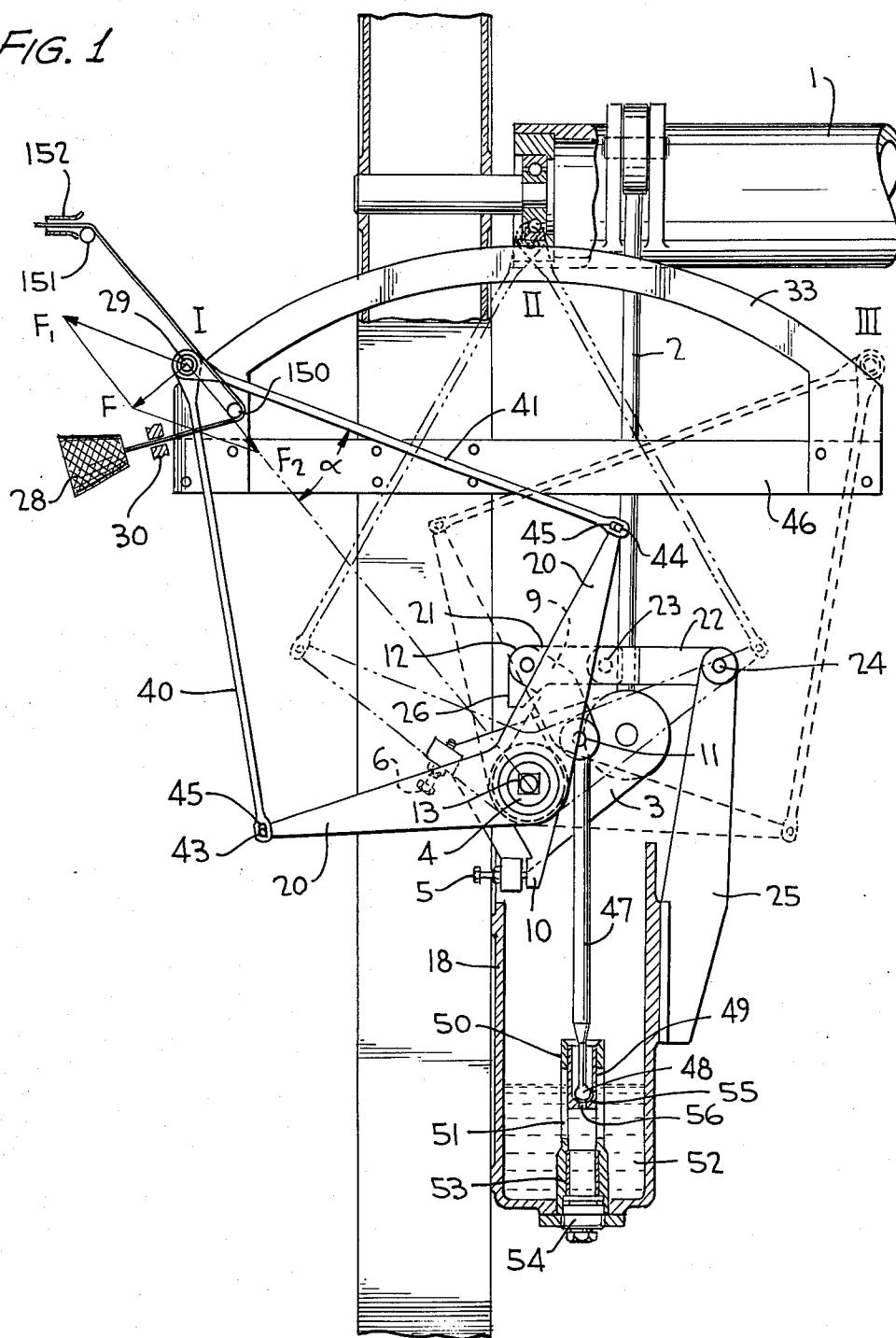


FIG. 1



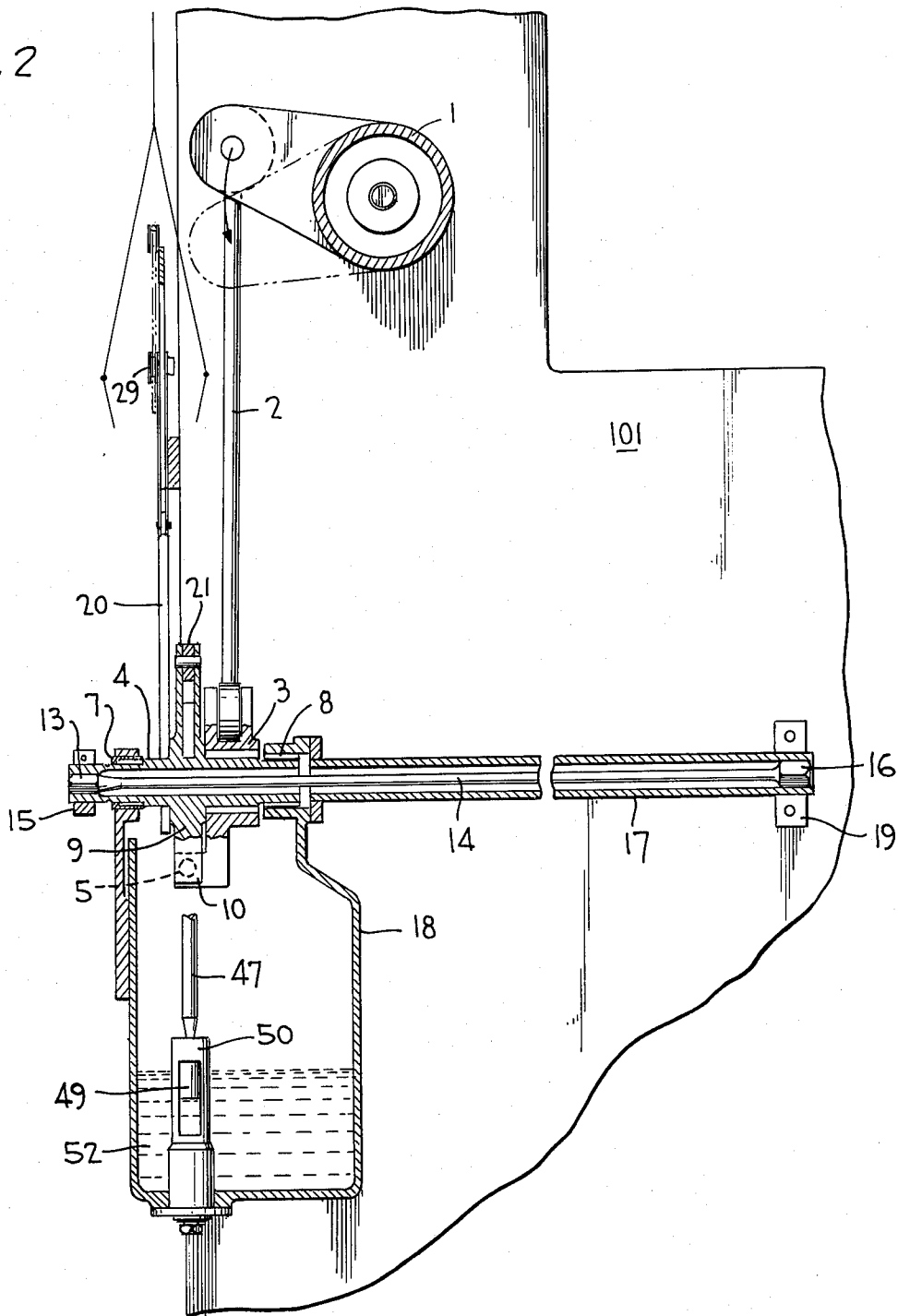
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FIG. 2



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FIG. 5

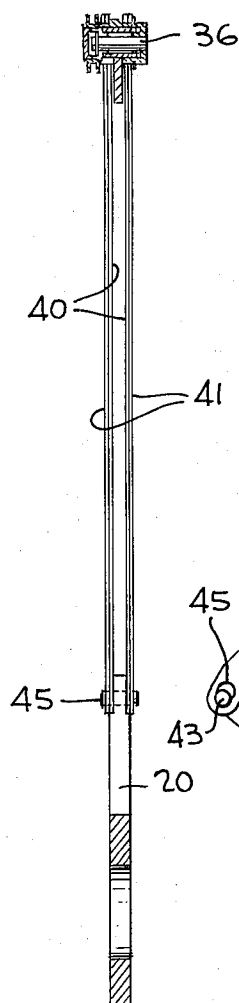


FIG. 3

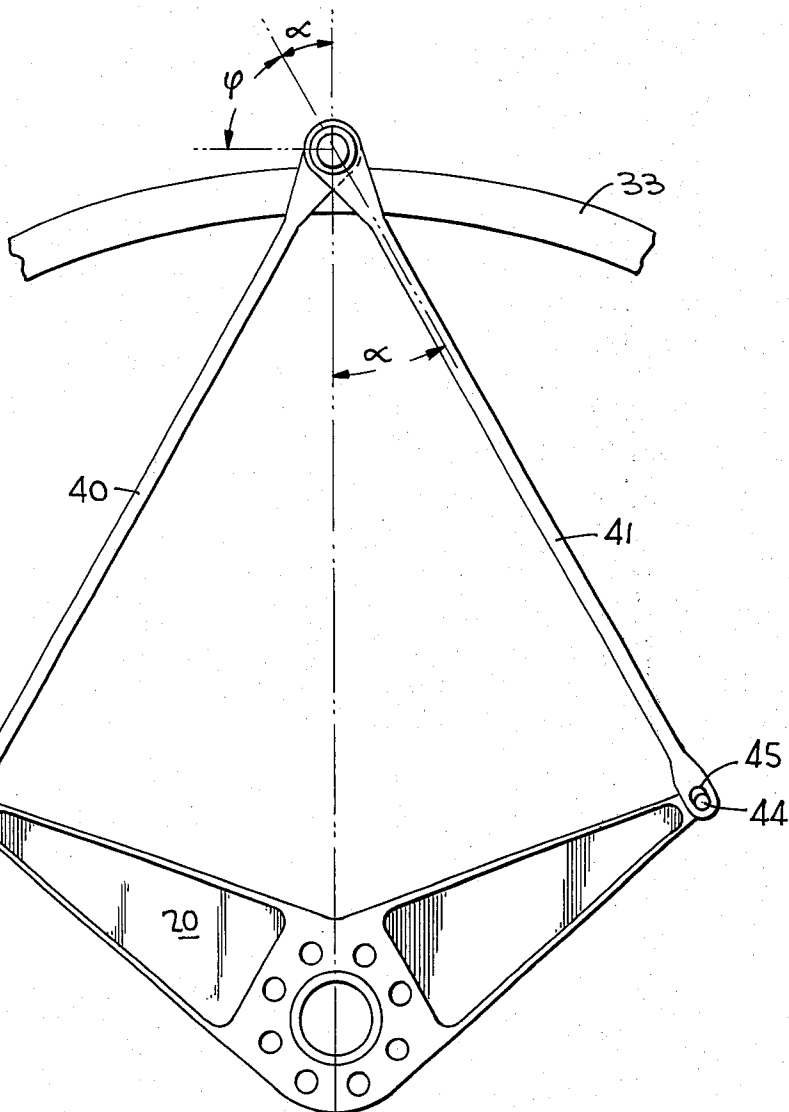
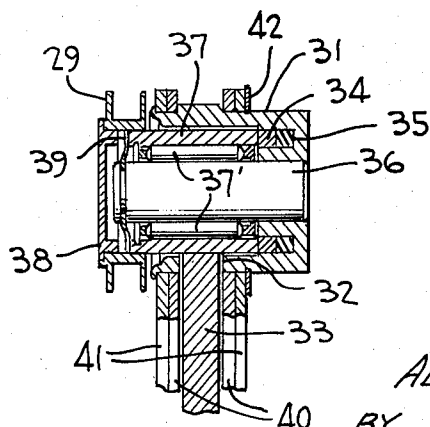


FIG. 4



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FIG. 9

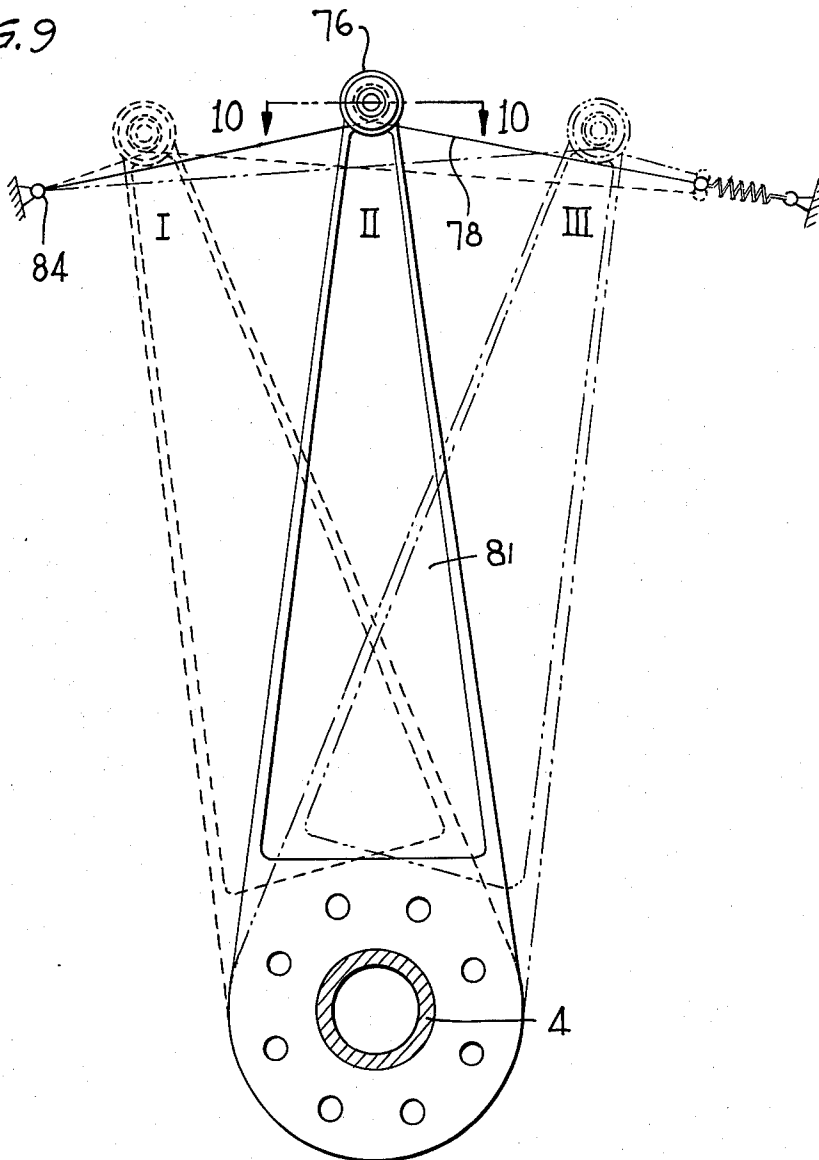
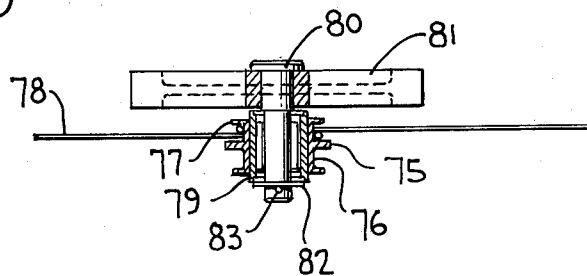


FIG. 10



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## WEFT PICKING APPARATUS

## BACKGROUND OF THE INVENTION

## 1. Field of the Invention

The present invention pertains to weft picking apparatus for shuttleless looms and, more particularly, to such weft picking apparatus for shooting or projecting a loop of warp yarn through a shed.

## 2. Discussion of the Prior Art

In the past it has been proposed to insert the filler or weft yarn in the shed of a loom by using the effect of a whip or picker stick which includes a lever having an end carrying a filler yarn whose length is equal to the width of the shed. The yarn is accelerated over its entire length along with the end of the lever, which is then slowed down when the speed required by the yarn is obtained, such that the yarn continues its forward movement, forming a loop which is projected and unrolled through the shed.

The above-described weft insertion concept has not gone beyond the laboratory or testing stage because the conditions necessary for the safety of the insertion of weaving yarns, which are fine and flexible, cannot be met. That is, the shooting or throwing of a yarn in the direction of its point of attachment on the shooting lever, as is the case with a whip, causes the yarn to hit the lever relatively forcefully thereby losing a certain amount of its power. The movement of a light and flexible yarn, such as is used in weaving, is essentially different from the movement of the cord of a whip in that the whip cord has a certain stiffness, at least over the first few centimeters close to the rod, and in a whip this stiffness holds the cord away from the point of attachment and prevents the cord from rubbing against the rod whereas such is not the case with the fine and flexible yarns used in weaving.

The following three conditions must be met in order to permit the insertion of relatively fine weft yarns in a loom:

1. The yarn must be guided in a manner to insure that the movement of the yarn follows a very specific directional path during acceleration by the picker stick.

2. The point of fixation of the yarn must be eccentric with respect to the path of movement.

3. The shape of the loop of weft yarn traveling through the shed is determined by the movement of the picker stick during acceleration of the yarn, and the two branches or sides of the loop of weft yarn must be maintained sufficiently separated.

To give shape to the loop, the weft yarn is passed over a pick shaft or roller (small wheel) placed at the extremity of the picking lever; however, since the acceleration of the yarn is very great at the shoot, the pressure of the yarn around the pick roller is not sufficient to accelerate the pick roller, thereby resulting in slippage between the yarn and the pick roller to increase the tension, which is already high, at the held end of the yarn loop. In order to prevent friction of the yarn slipping around the pick roller, it has been proposed to rotatably drive the pick roller; however, until the present, no means has been devised to drive the pick roller at a speed equal to or greater than the speed of the yarn passing over the pick roller.

## SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide weft picking apparatus having a pick roller

rotatably driven at a speed equal to or greater than the speed of weft yarn passing over the pick roller.

The present invention is generally characterized in weft picking apparatus for a shuttleless loom including means for retaining a weft yarn supplied from a position external of a shed-forming area, a feeding assembly for delivering the weft yarn from the supply to the retaining means, a pick roller for catching the weft yarn between the supply and the retaining means, a support for the pick roller permitting rotation thereof and movable to oscillate the pick roller to impart an acceleration to the weft yarn to project the weft yarn in a loop through the shed, and drive means including a ramp having a configuration of a segment of a circle having a center coinciding with the axis of the support and a drive roller element carried by the support and riding on the ramp to rotatably drive the pick roller as the support is moved, the drive roller element having a diameter equal to or less than the diameter of the pick roller whereby the peripheral speed of the pick roller is at least equal to the speed of the weft yarn passing around the pick roller.

Another object of the present invention is to connect a drive roller element with a pick roller and to move the drive roller element over a ramp as a picking lever is oscillated in order to provide the pick roller with a peripheral speed at least equal to the speed of the weft yarn passing therearound.

The present invention has another object in that a band having a fixed end and another end attached to a spring is utilized to rotate a drive roller element connected with a pick roller in response to oscillation of a picking lever in order to provide the pick roller with a peripheral speed at least equal to the speed of the weft yarn passing therearound.

A further object of the present invention is to decrease friction between a pick roller and a weft yarn during shooting or projecting of a loop of the weft yarn through a shed.

Some of the advantages of the present invention over the prior art are that by utilizing the weft picking apparatus of the present invention an extremely compact and precise loom may be constructed, there is no danger of weft yarn breakage or wear due to friction, and the length of the loop of weft yarn projected may be varied in accordance with the required width of the fabric to be woven.

Other objects and advantages of the present invention will become apparent from the following description of the preferred embodiments taken in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 are front and side elevations partially in sections of the weft picking apparatus according to the present invention.

FIG. 3 is a front elevation of the support and drive assembly of FIG. 1.

FIG. 4 is a cross section of the weft picking head of FIG. 1.

FIG. 5 is a side elevation of the support and drive assembly of FIG. 3.

FIG. 6 is a front elevation of another embodiment of the support and drive assembly of the weft picking apparatus of the present invention.

FIG. 7 is a cross section of the weft picking head of FIG. 6.

FIG. 8 is a side elevation of the support and drive assembly of FIG. 6.

FIG. 9 is a side elevation of a further embodiment of a support and drive assembly for use with the weft picking apparatus of the present invention.

FIG. 10 is a cross section of the weft picking head of FIG. 9.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

The apparatus of the present invention, as illustrated in FIGS. 1 and 2 includes a sleigh 1 which is connected with a main drive shaft by a system of connecting rods and handles (not shown), and as sleigh 1 is oscillated, a connecting rod 2, which is connected to the sleigh, is moved to control a rocking lever 3 which turns freely on a pick shaft 4. Rocking lever 3 has adjustment screws 5 and 6 associated therewith, and pick shaft 4, which rotates in bearings 7 and 8, has a multiple extending lever 9 which carries an abutment or stop 10 and hinged axles 11 and 12.

A twist bar 14, of square section at each extremity, has an extremity 13 fitted in a mating housing of pick shaft 4 and held tightly by means of a split ring 15. The other extremity 16 of twist bar 14 extends through and engages a tube 17 rigidly secured to a support box 18 and by means of a strap 19 to a frame 101. The attachment of tube 17 in the desired position permits adjustment of the desired picking force. A picking lever 20 extends transversely from the longitudinal axis of pick shaft 4 and is secured thereto.

When sleigh 1 is in the high position, the rocking lever 3 rotates on pick shaft 4; and screw 5, which contacts abutment 10, drives pick shaft 4 in its movement and, consequently, places twist bar 14 under tension. The weft picking apparatus is locked in the picking position by a knuckle-joint formed by joints 21 and 22, connected at 23. Joint 22 pivots at 24 on a fixed support 25, and joint 21 pivots at 12 on multiple lever 9. During the return movement of sleigh 1, screw 5 of rocking lever 3 is moved away from abutment 10 while screw 6 is moved to contact a head 26 of joint 21, freeing the knuckle-joint and providing the picking motion under the effect of the energy accumulated in twist bar 14 during the preceding phase.

Weft yarn 27, which is pulled from a spool 28, passes over guides 150 and 151, and the free end of yarn 27 is sucked into a retainer tube 152. When the required weft length has been unrolled, a clip 30 is actuated to stop the yarn between spool 28 and guide 150, and a pick roller 29 drives the yarn 27 between yarn guides 150 and 151 forming a loop.

The head of the weft picking apparatus is illustrated in FIG. 4 and includes a housing 31 having an opening 32 for the passage of a ramp 33, and in the bottom of housing 31 is placed an abutment 34 and a leak-proof seal 35. Ramp 33 has a configuration of a segment of a circle having a center coinciding with the rocking axis of lever 20, as shown in FIGS. 1 and 3. An axle 36 is rigidly connected to housing 31 and carries a needle bearing bushing 37' freely in the housing, and pick roller 29 having a dust-guard 38 is carried by the needle bearing. The longitudinal travel of needle bearing bushing 37, which constitutes a drive roller element to rotatably drive the pick roller, is limited by a clip 39 on one side and by abutment 34 on the other side.

Two pairs of links 40 and 41 are affixed to housing 31 on one side by crimping and on the other side by a clip 42 and connect the head of the weft picking apparatus with axles 43 and 44 secured to the extremities of the picking lever 20 as illustrated in FIG. 3.

When pick shaft 4 is freed, the force  $F$  (FIG. 1) of the stress pertaining to the mass caused by the acceleration of the weft picking apparatus is broken down into two separate forces: a force  $F_1$  which acts in the direction of links 41 for traction stress; and a force  $F_2$  perpendicular to the rolling surface of ramp 33 affixed on a support 46 which is secured to frame 101. The force  $F_2$  is a function of an angle that is selected such that the product of force  $F_2$  and the modulus of friction of the drive roller element on ramp 33 is sufficient to rotatably drive, without sliding, the masses of roller 29 and needle bearing bushing 37 at a circumferential speed which must be at the minimum equal to that of the unwinding of weft yarn 27. The engaging surfaces of bushing 37 and ramp 33 are preferably toothed in order to prevent slippage therebetween.

If the diameter of roller 29 is slightly larger than the diameter of the drive roller element formed by bushing 37 rolling on ramp 33, the circumferential speed of roller 29 will be higher than the speed of unwinding of yarn 27 and facilitates movement thereof.

Each link 40, 41 connecting the head of the weft picking apparatus in pairs to the picking lever 20 has a small aperture 45 which permits a slight longitudinal movement, or lost motion with respect to axles 43 and 44 (FIG. 3), and links 40 and 41 alternately experience strain depending on whether the weft picking apparatus is in the acceleration phase or in the braking phase.

After reaching the vertical position, the weft picking apparatus is slowed down while the loop of weft yarn 27 continues its trajectory by itself due to the energy accumulated in its mass during acceleration. The braking of the weft picking apparatus, in the example described, is effected by a hydraulic brake.

A connecting rod 47 (FIG. 1), connected to multiple lever 9 of pick shaft 4 by axle 11, has a spherical end 48 and carries a piston 49 sliding in a fixed body 50 on support box 18. Body 50 has large apertures 51 therein to permit the circulation of a fluid 52, and an interchangeable jacket or liner 53, which is held by a detachable cap 54, is inserted within body 50. Inside piston 49 a mating spherical crown 55 having a drainage hole 56 therein receives the spherical end 48 of connecting rod 47. Since the connection between the connecting rod 47 and piston 49 is provided with a certain axial clearance during the braking period, the pressure will force piston 49 against connecting rod 47 and the drainage hole will be closed. On the return stroke, piston 49 is moved slightly from the end of connecting rod 47 due to the axial clearance and stress pertaining to the mass to thereby provide valve action.

When the weft picking apparatus is accelerated, piston 49 moves in front of large apertures 51 and does not have any braking effect; however, when the weft picking apparatus reaches the vertical position, piston 49 completely obstructs apertures 51 and acts as a brake.

Another embodiment of weft picking apparatus according to the present invention is illustrated in FIGS. 6, 7 and 8 and includes a sliding block 57, preferably made of plastic material, which is guided on the sides 58 of a ramp 59 and encloses bearings 60 and 61 sup-



porting a shouldered pin 62 which is integral with a drive roller element 63 and a pick wheel or roller 64. Pin 62 is limited in longitudinal movement by means of a washer 65 and a cotter pin 66.

The connection between block 57 and a picking lever 67 is obtained by means of rods 68 and 69 similar to the spokes of a bicycle wheel which are threaded at the ends affixed in block 57 by means of recessed nuts 70, while at the level of the picking lever 67, each rod is guided at the respective extremities by a shouldered bushing 71 which acts as the lower side plate for a spring 72 affixed by a nut 73. A locknut 74 is used to insure the position of nut 73. During acceleration, rod 68 strains to the traction or pull while the deformations of the unit are absorbed by spring 72 of rod 69, thus eliminating any compression strain in rod 69. The driving of wheel 64 is effected in the same manner as described with respect to the weft picking apparatus illustrated in FIG. 3.

A further embodiment of the weft picking apparatus of the present invention is illustrated in FIGS. 9 and 10 and includes a pick roller or wheel 75 having a groove 76 for receiving weft yarn 27 and a pulley having a groove 77 for receiving a driving band 78. The roller is mounted on a needle bearing bushing 79 having a shouldered axle 80 affixed to the extremity of a picking lever 81 mounted on pick shaft 4. Between I and II the weft picking apparatus is accelerated, and it is slowed down or braked between II and III.

Needle bearing bushing 79 is limited in longitudinal movement by a washer 82 and a cotter pin 83. A very strong driving band 78 with an extremity affixed to a point of attachment 84, makes one turn in groove 77, while the other extremity is held by means of a spring 85 to a fixed point 86. When the pick shaft 4 is freed, lever 81 moves from left to right, and pick wheel 75 is rotatively driven by the jamming of the driving band 78 in groove 77. All of the forces of acceleration will be absorbed by the end affixed at 84 while the other end will be maintained under constant tension through the intermediary of spring 85. Since the operation of the return of the picking lever is effected much slower than the shooting phase, the stress transmitted by the spring 85 or the driving band 78 will be sufficient. The ratio of the diameters of grooves 76 and 77 must be taken into consideration to facilitate the movement of weft yarn 27 as explained in the description of the weft picking apparatus illustrated in FIG. 3. The weft picking apparatus of the present invention may be utilized with any suitable shuttleless loom and yarn holding assemblies, such as that shown and described in U.S. Pat. No. 3,543,808, the specification of which is incorporated herein by references.

What is claimed is:

1. Weft picking apparatus for a shuttleless loom having a supply of weft yarn located outside of a shedforming area comprising:
  - retaining means for the weft yarn;
  - feed means for delivering the weft yarn from the supply to said retaining means;
  - pick roller means for catching the weft yarn between the supply and said retaining means;
  - means rotatably supporting said pick roller means and movable about an axis to oscillate said pick roller means and impart an acceleration to the weft yarn to project the weft yarn in a loop through the

shed; and

drive means including a ramp having a configuration of a segment of a circle having a center coinciding with said axis of said supporting means and a drive roller element carried by said supporting means and riding on said ramp, said drive roller element rotatably driving said pick roller means as said supporting means is moved and having a diameter equal to or less than the diameter of said pick roller means whereby the peripheral speed of said pick roller means is at least equal to the speed of the weft yarn passing around said pick roller means.

2. The weft picking apparatus as recited in claim 1 wherein said ramp and said drive roller element have toothed engaging surfaces.

3. The weft picking apparatus as recited in claim 1 wherein said supporting means includes a connecting rod making an angle with said ramp greater than  $\phi$ , where  $\phi$  is an angle having a tangent equal to the coefficient of friction between said drive roller element and said ramp.

4. The weft picking apparatus as recited in claim 1 wherein said supporting means includes a lever pivotally mounted at said axis and a connecting rod extending from said lever and carrying said drive roller element, said connecting rod being disposed at an angle with said ramp of greater than  $10^\circ$ .

5. The weft picking apparatus as recited in claim 1 wherein said supporting means includes a lever pivotally mounted at said axis having first and second legs extending on either side of said axis, first and second links each having one end supporting said drive roller element and a second end, and lost motion means interconnecting the free ends of said first and second legs of said lever and said second ends of said first and second links, respectively.

6. The weft picking apparatus as recited in claim 5 wherein said supporting means includes a housing having an opening therein to permit said ramp to pass therethrough, and a needle bearing disposed within said housing and carrying said pick roller means.

7. Weft picking apparatus for a shuttleless loom having a supply of weft yarn located outside of a shedforming area comprising

- retaining means for the weft yarn;
- feed means for delivering the weft yarn from the supply to said retaining means;
- pick roller means for catching the weft yarn between the supply and said retaining means;
- means rotatably supporting said pick roller means and movable about an axis to oscillate said pick roller means and impart an acceleration to the weft yarn to project the weft yarn in a loop through the shed; and

drive means including a pulley carried by said supporting means and rotatably driving said pick roller means, a band passing around said pulley having a first fixed end and a second end, and a spring having a fixed end and an opposite end attached to said second end of said band, said pulley being rotated as said supporting means is moved whereby the peripheral speed of said pick roller means is at least equal to the speed of the weft yarn passing around said pick roller means.

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