July 11, 1967 V. SVATÝ ETAL 3,330,305

SHUTTLE RECEIVING AND PICKING APPARATUS FOR GRIPPER SHUTTLE LOOMS

Filed May 4, 1966 4 Sheets-Sheet 1

FIG. 1

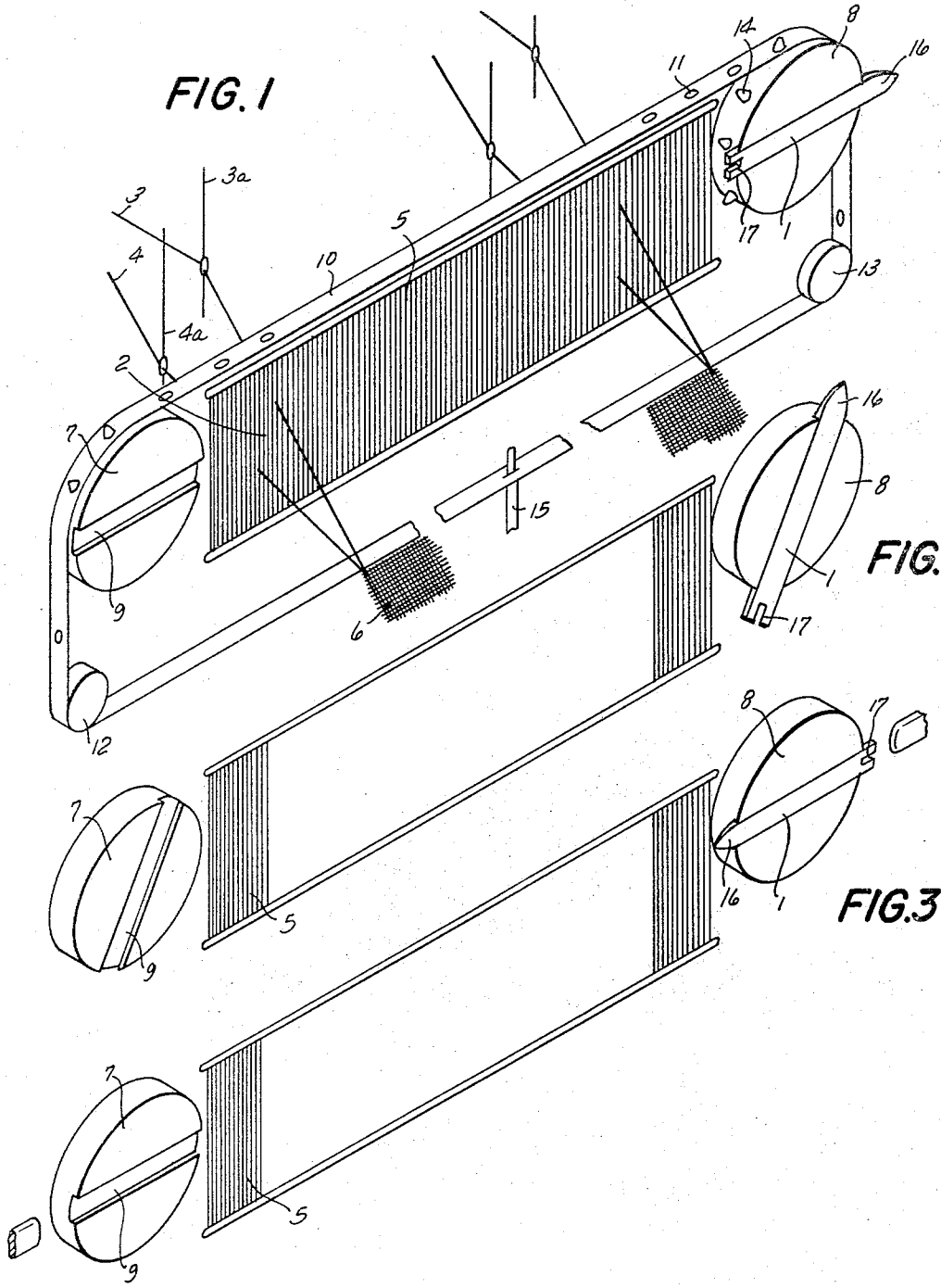

FIG. 2

FIG. 3

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FIG. 4

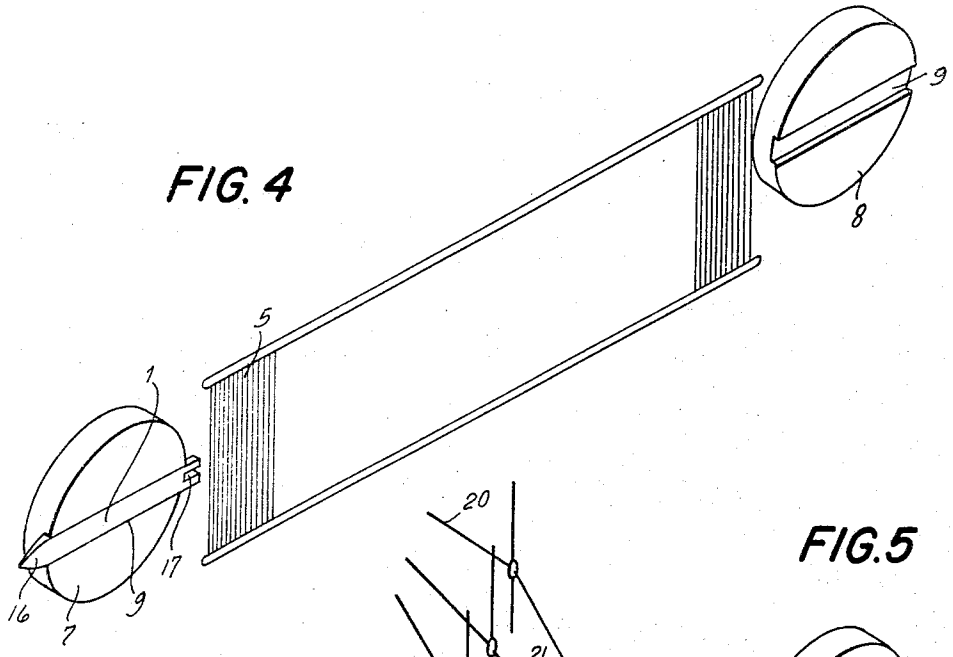

FIG. 5

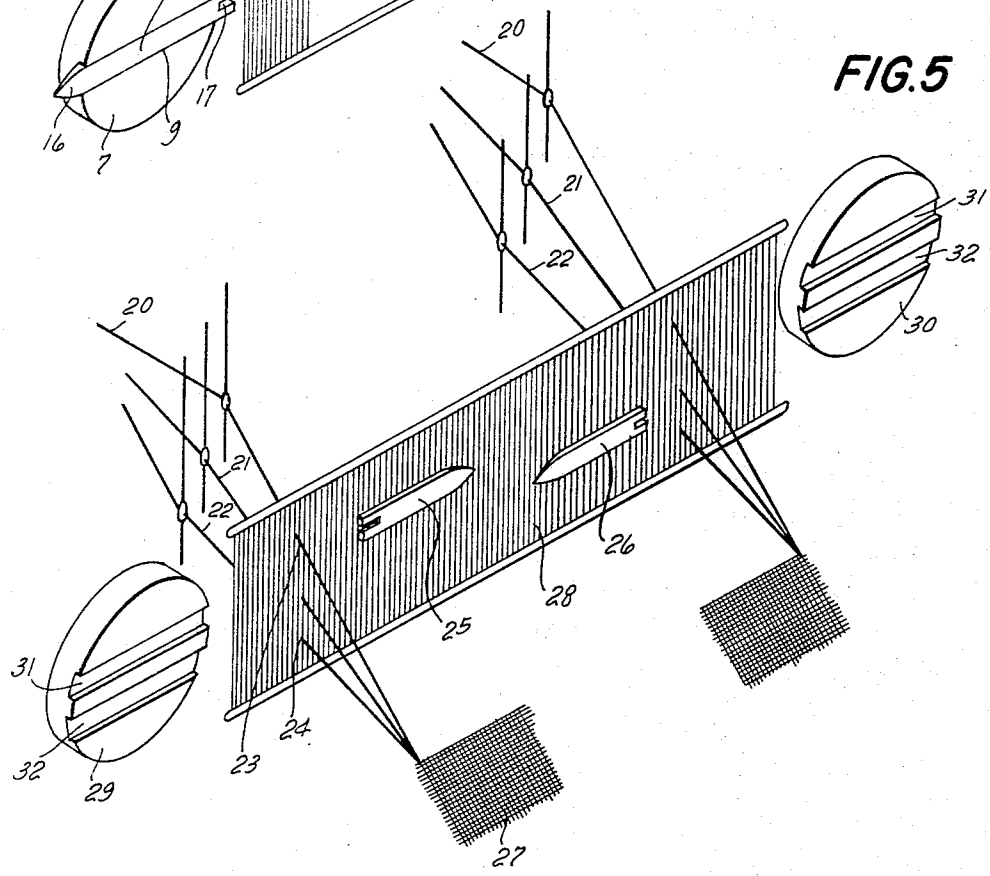

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FIG. 6

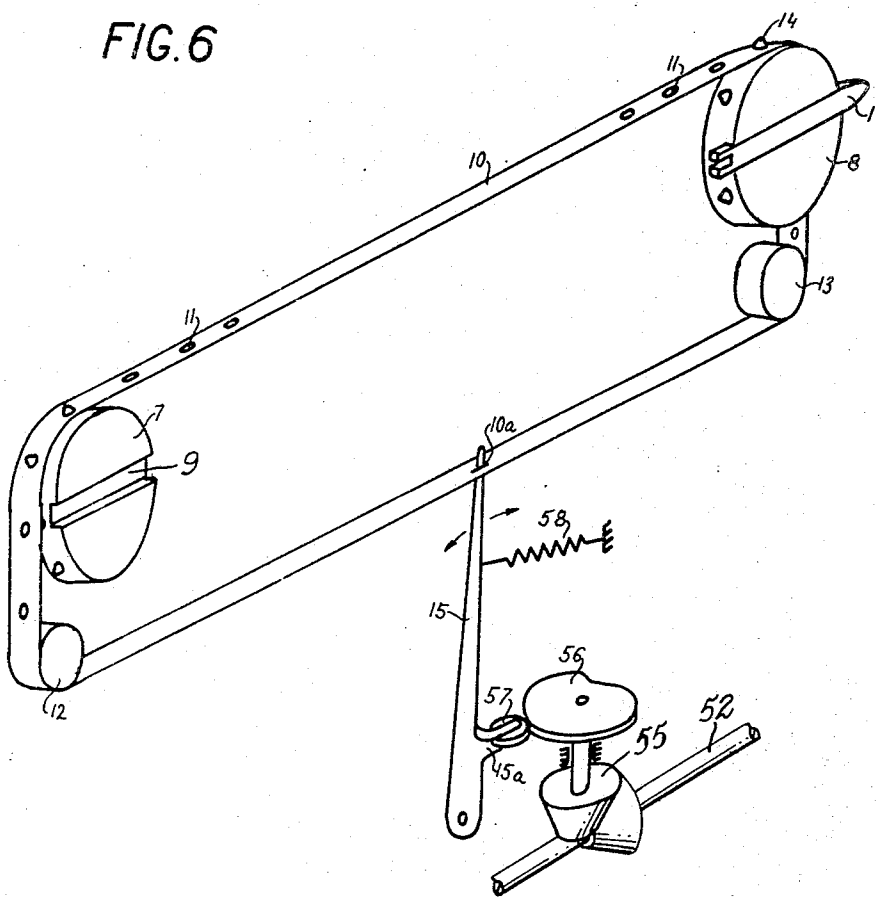

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FIG. 7

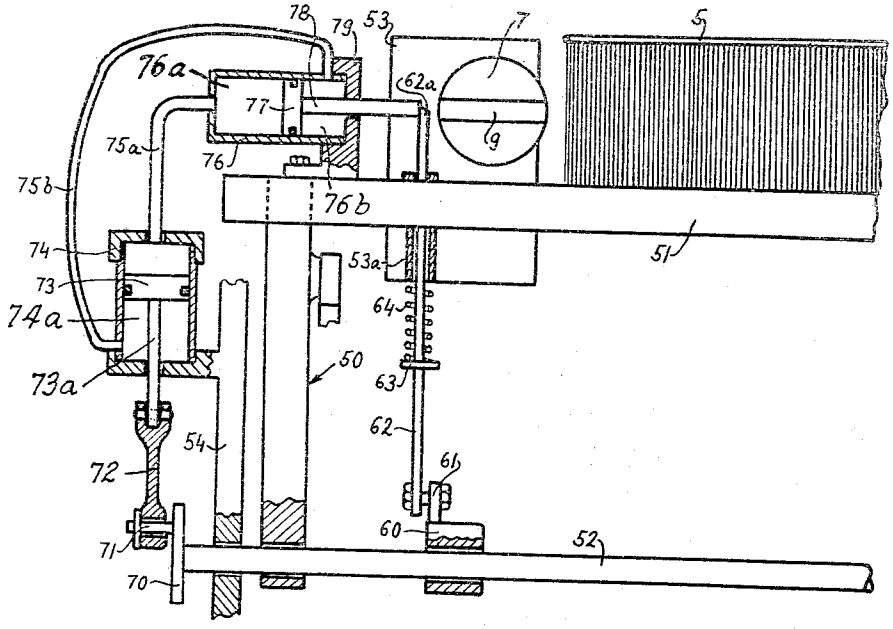
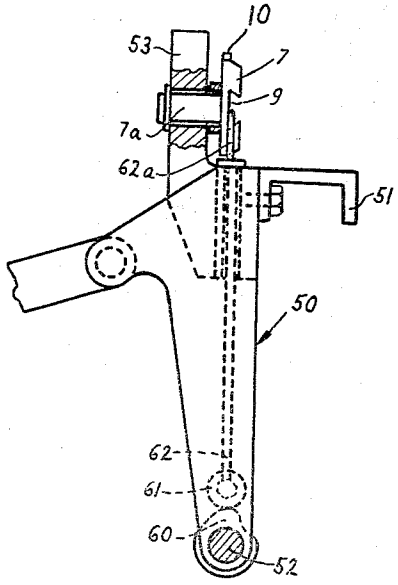


FIG. 8



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United States Patent Office 3,330,305 Patented July 11, 1967

3,330,305

SHUTTLE RECEIVING AND PICKING APPARATUS FOR GRIPPER SHUTTLE LOOMS

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Filed May 4, 1966, Ser. No. 554,257
Claims priority, application Czechoslovakia, Mar. 9, 1964, 1,355/64
7 Claims. (Cl. 139—125)

The present invention is a continuation-in-part application of our copending application Ser. No. 437,833 filed March 8, 1965.

The present invention relates to a weft inserting apparatus and method, and more particularly to an apparatus and method for operating a shuttle provided at one end with a gripper for the weft thread which is to be inserted into a warp shed.

Gripper shuttles are known to which the weft thread is supplied by a thread supply guide when the shuttle is at one side of the loom outside of the shed, whereupon the shuttle is picked through the shed and draws the gripped weft through the same until arriving at the other end of the shed. It is, of course, necessary to return the gripper shuttle to the initial position, and the prior art provides two different constructions serving this purpose.

In accordance with one type of gripper shuttle looms, the gripper shuttle is always inserted into the shed from one side of the loom, and when the gripper shuttle has arrived at the other side of the shed, it is transported along a path outside of the shed back to its initial position. Before the shuttle is transported, the gripper releases the inserted weft thread, and the weft thread is inserted again into the gripper of the shuttle before the shuttle enters the shed. This weft inserting apparatus employs a shuttle with only one gripper.

In a second type of gripper shuttle looms, the shuttle has two grippers. From a first supply of thread, a weft thread is inserted on one side of the loom into one gripper of the shuttle, whereupon the same travels through the shed and drags a first weft thread through the same. When the shuttle arrives at the other end of the shed, the weft thread is released by the respective gripper, while another weft thread is inserted from a second supply into the second gripper whereupon the shuttle travels in the opposite direction through the shed inserting a weft thread from the second supply.

Looms of the first type have the disadvantage that several grippers must be used which simultaneously circulate about an endless path so that one shuttle, for example, passes through the shed while another, or several other shuttles travel outside of the shed toward the initial inserting position. The transporting operation is slow, and rather complicated. Another disadvantage is that only one weft supply is used for the weft threads, so that no weft change is possible, unless a special weft change device is used for inserting weft threads into the gripper of the shuttle.

The looms of the second type are of simpler construction, since no transporting mechanism is required, and the use of two shuttles permits a weft change. On the other hand, the shuttles of these looms have to be provided with two grippers permitting weft insertion on both sides of the loom, and furthermore, the shuttle must have two pointed ends for spreading the warp threads of the shed during picks in opposite directions. However, due to the fact that both ends of the shuttle have to be pointed, it is difficult to pick the same by a blow to its trailing end, and on the other hand, the pointed ends render it difficult to place the two grippers in such a manner as not to interfere with the warp threads during travel through the shed. Both types of looms have a common disadvantage. In order to secure the minimum length of weft ends on the selvedges of the fabric, a special, very complicated device must be used. This device shifts the end of the weft thread from the fabric edge, where the weft thread end is gripped by the device, to a threading position so that the weft end must be shifted a distance equal to the distance between the two gripping points of the gripper. If such a device is not provided, the weft end must be returned into the fabric by bending, which is tolerable only for a very limited number of fabrics.

It is the object of the present invention to overcome the disadvantages of known apparatus for inserting wefts into sheds by gripper shuttles, and to provide weft inserting apparatus using a shuttle with a single gripper, and being inserted from both sides of the shed.

Another object of the invention is to provide a very simple method for weaving by means of a gripper shuttle.

Another object of the invention is to provide a loom with extremely simple, reliable, and sturdy apparatus for reversing a gripper shuttle.

Another object of the invention is to provide apparatus for picking a gripper shuttle which can be added to existent looms without substantial reconstruction.

Another object of the invention is to turn a gripper shuttle after each pick so that the same end of the shuttle leads during travel through the shed in opposite directions.

With these objects in view, the present invention provides a weft inserting apparatus and method which is particularly suited for a loom employing a gripper shuttle.

A shuttle is picked through a shed from one side of the loom to the other so that one end of the shuttle leads, the shuttle is automatically turned on the other side of the loom 180°, and the shuttle is again picked with the same end leading from the other side of the loom to its initial position where it is again turned 180° before the following pick.

One embodiment of the invention comprises a shuttle having a leading end and a trailing end, and preferably a gripper at the trailing end; a pair of turnable shuttle boxes on opposite sides of the loom; and reversing means for turning the shuttle boxes.

The reversing means are operated for turning at least the shuttle box holding a picked shuttle 180°. The shuttle arriving in the shuttle box has its leading end pointing outwardly so that the turned and reversed shuttle is in a position in which the leading end points inwardly toward the other shuttle box. When the shuttle is now moved through the shed, a weft thread held by the gripper of the shuttle is inserted into the shed. The shuttle arriving at the other end, enters the shuttle box with its leading end pointing outwardly, and when the other shuttle box is now turned 180°, the shuttle is again reversed and placed in the proper position for being inserted into the shed in the opposite direction.

In the preferred embodiment of the invention, the two shuttle boxes are connected for simultaneous rotation, and are reciprocated in angular 180° movements. The shuttle boxes preferably have diametrically extending grooves for receiving the shuttle and for holding the same during weft insertion and before the pick.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a fragmentary perspective view of one em-

bodiment of the invention, the loom structure being omitted for the sake of clarity and simplicity;

FIG. 2 is a fragmentary perspective view corresponding to FIG. 1 with some of the elements omitted, and illustrating the apparatus in another operational position;

FIG. 3 is a fragmentary perspective view corresponding to FIG. 2, but illustrating the apparatus in a third operational position;

FIG. 4 is a fragmentary perspective view corresponding to FIG. 2, but illustrating the apparatus in a fourth operational position;

FIG. 5 is a fragmentary perspective view illustrating a modified embodiment of the invention;

FIG. 6 is a fragmentary perspective schematic view illustrating a shuttle box drive according to the invention;

FIG. 7 is a fragmentary front elevation, partially in section, illustrating a part of the loom structure; and

FIG. 8 is a side elevation, partially in section, illustrating the structure of FIG. 7.

Referring now to the drawings, the loom has heddle frames **3***a* and **4***a* controlling warp threads **3** and **4** to form sheds **2**. As shown in FIG. 7, a reed **5** is carried by the horizontal beam **51** of a slay **50** which is mounted for angular movement on a control shaft **52** driven from the main shaft of the loom. Slay **50** carries support portions **53** on opposite sides of the reed **5** provided with bearings for pivot shafts **7***a* of a pair of shuttle boxes **7** and **8**, as shown in FIG. 1.

Shuttle boxes **7** and **8** are of circular configuration and are turnable about parallel axes coinciding with the centers of the circular peripheries thereof. The axes of the shuttle boxes are substantially located in the plane in which a fabric **6** is woven.

Each shuttle box **7** or **8** has a diametrically extending undercut groove **9** in its circular face which is adapted to receive and hold a shuttle **1** having a pointed end **16** and a blunt end provided with a gripper **17** for a weft thread. The shuttle disclosed in the U.S. Patent 3,844,884 may be used.

As best seen in FIGS. 1 and 6, each shuttle box **7** and **8** has a peripheral circular surface provided with projecting sprockets **14** engaging holes in a belt **10** which passes about the peripheries of both shuttle boxes and over guide rollers **12** and **13**, and as best seen in FIG. 1, the upper and lower runs of the endless belt **10** are located above and below the fabric **6** and shed **2** so that no interference with the weaving operation is possible. As best seen on the left side of FIG. 6, belt **10** is narrower in axial direction than each shuttle box **7**, **8** and does not cover the open ends of grooves **9**. Sprockets **14** do not permit axial displacement of belt **10**.

Holes **11** are arranged in two separate groups in the regions of shuttle boxes **7** and **8**, and the lower run of the belt **10** has a single perforation **10***a* engaged by a drive arm **15** which is reciprocated in the longitudinal direction of the belt, that is parallel to the weft threads, by drive means shown in FIG. 6. Control shaft **52** carries a fixed bevel gear **55** meshing with another bevel gear on the shaft of a cam **56** and drive arm **15** has a follower portion **15***a* carrying a cam follower roller engaging the periphery of cam **56** due to the action of a spring **58** which is secured to the stationary frame of the loom. During rotation of control shaft **52**, cam **56** moves drive arm **15** to the left, and permits then movement of the drive arm in an opposite stroke by spring **58**. The lower run of belt **10** will perform a corresponding reciprocating motion, and the entire belt **10** will reciprocate and cause angular reciprocation of shuttle boxes **7** and **8**, and the height of the projecting portion of cam **56** is selected so that shuttle boxes **7** and **8** turn simultaneously an angle of 180° for each stroke of drive arm **15**, and turn in clockwise direction as viewed in FIG. 6 when drive arm **15** moves to the left, and in counterclockwise direction when drive arm **15** moves to the right.

Since control cam **52** is driven from the main shaft of the loom, the angular reciprocation of the shuttle boxes is synchronized with the motions of the heddle frames **3***a* and **4***a*, see FIG. 1, and with the reciprocating motion of reed **5**.

Referring again to FIG. 7, end portion **54** of the loom frame is adapted to mount control shaft **52** for free angular movement, and carries a cylinder **74** in which a piston **73** is mounted for reciprocation. A second cylinder **76** is mounted on beam **51** of the slay by means of bracket **79** which has an opening for the pasage of a piston rod **78** secured to a piston **77** in cylinder **76**.

A crank **70** is secured to control shaft **52** for rotation therewith, and is connected by a connecting link **72** to the piston rod **73***a* of piston **73**. Conduits **75***a* and **75***b* connect cylinder chambers on opposite sides of pistons **73** and **77** with each other. When shaft **52** is rotated, piston **73** is reciprocated and presses a fluid medium, such as air, into chamber **76***a* of cylinder **76** while reducing the pressure in chamber **74***a*, conduit **75***b*, and chamber **76***b* so that piston **77** and piston rod **78** are urged toward the groove of the shuttle box **7**, but cannot move since end portion **62***a* of a rod **62** blocks piston rod **78**. Piston rod **78** is aligned with groove **9** and serves to pick a shuttle located in groove **9** through a warp shed, when rod **62** releases piston rod **78**, as will be explained hereinafter. Consequently, members **70** to **79** constitute picking means, and a corresponding picking means is located on the other side of the loom and driven in timed relation with the illustrated picking device, as will be explained hereinafter.

A cam **60** is secured to shaft **52** and rotates with the same. Rod **62** carries a cam follower roller **61** engaging the periphery of cam **60** unded the action of a spring **64** which abuts slay portion **53** and a fixed abutment **63** on rod **62**. Rod **62** is guided in a tubular guide **53***a* secured to slay portion **53**, and has a free end **62***a* located between picking member **78** and groove **9** of shuttle box **7** with a slanted face opposite groove **9** of shuttle box **7**. Rod portion **62***a* stops movement of a shuttle arriving in groove **9** after traveling through the shed, but when a pick by picking member **78** is to take place, stop portion **62***a* and rod **62** are withdrawn from picking member **78** by spring **64** while cam follower roller **61** engages a low circular portion of cam **60**. The increased pressure in chamber **76***a* now rapidly moves picking member **78** until the same engages and picks the shuttle. The air is pushed out of chamber **76***b* through conduit **75***b* into chamber **74***a* in which the pressure was reduced. Crank **72** continues its turning movement and pulls piston **73** down into chamber **74***a* so that air is pressed through conduit **75***b* into chamber **76***b* and piston **77** is pushed back.

Referring now to FIGS. 1 to 4, in the position of FIG. 1, a pick from the left to the right has just been completed, and shuttle **1** was received by groove **9** of shuttle box **8** in a position in which its pointed end **16** points outwardly and away from the fabric and the other shuttle box **7**. The pointed end of the shuttle was stopped by the timely raising of stop portion **62***a*, not shown in FIGS. 1 to 4, which was raised by the respective cam **60** into the region of the outer end of groove **9** in shuttle box **8**. During this pick from the left to the right, the shuttle moved with its pointed end **16** leading through a shed **2**, dragging a weft thread held by gripper **17** at its trailing end through the shed so that the reed **5** will now beat the inserted weft into the fell of fabric **6**.

In this position of the shuttle, the inserted weft thread is cut off, and a new weft thread inserted into the gripper, preferably by apparatus disclosed in the copending application Svaty Serial No. 437,506, or by other well known apparatus, and it will be understood that the insertion of a weft thread into a gripper shuttle is not an object of the present invention.

When a weft thread has been inserted into the gripper

of the outwardly pointing shuttle, drive means **56**, **57**, **15**, **10** turn both shuttle boxes simultaneously in counterclockwise direction first to the intermediate position of FIG. 2 and then to the position of FIG. 3 in which grooves **9** are again aligned with each other and with a picking member **78**, so that shuttle **1** in shuttle box **8** is reversed and points inwardly toward the other shuttle box **7** and the fabric. The trailing end of the shuttle holds a weft thread clamped in its gripper **17**, and is located aligned with and in the proximity of the respective picking member **78**. Control shaft **52** turns to a position in which the pistons **73** and **77** of the picking means are actuated and rod **62** releases picking member **78** so that picking member **78** is moved against the blunt end of shuttle **1** in shuttle box **8** and drives the same across the shed so that the shuttle travels from the right to the left as viewed in FIG. 3 and enters groove **9** of shuttle box **7** whereby the insertion of the weft thread gripped by the shuttle is completed.

Cam **60** causes at the right moment raising of the stop portion **62***a* adjacent shuttle box **7** so that the shuttle is stopped. Suitable brake means of known construction may slow down the shuttle before it is stopped. The force of the picking blow is selected so that the shuttle is slowed down sufficiently by the brake means, and does not bounce back from the slanted face of rod **62**.

The gripped weft thread is cut off, and a new weft thread inserted into the gripper in a manner which is not an object of the invention. Thereupon, drive arm **15** performs a reciprocating stroke to the left so that both shuttle boxes **7** and **8** are turned 180° and the turning of shuttle box **7** reverses the position of the shuttle therein, so that the pointed end of the shuttle points toward the shed, and the gripper end is located in the region of the picking means **78** so that during the following pick toward the right as viewed in FIG. 4, the pointed end of the shuttle leads and the gripper end holding the weft end trails. This operation is repeated during each following pick so that the drive means, and particularly drive arm **15**, belt **10** and shuttle boxes **7** and **8** constitute reversing means for turning one shuttle in the embodiment of FIG. 1, and two shuttles in the embodiment of FIG. 5 an angle of 180° after each pick so that one end of each shuttle leads during all picks and the other end of the shuttle trails during all picks.

FIG. 5 illustrates a modified embodiment of the invention which is applied to looms with double sheds. Warps **20** and **21** form a first shed **23**, and warps **21** and **23** form a second shed **24**, the warps being operated by conventional heddle frames. A reed **28** beats inserted wefts into the fabric **27**. Two shuttle boxes **29** and **30** are mounted on opposite sides of the loom and the fabric for turning movement, as described with reference to FIGS. 1 to 4, each shuttle box having two parallel grooves **31** and **32** normally extending in weft inserting direction and being, respectively, located at the levels of the sheds **23** and **24**. A pair of gripper shuttles **25** and **26** is provided which are picked in opposite directions and respectively cooperate with grooves **31** and **32** of the two shuttle boxes **29** and **30**.

The shuttle boxes are provided with projecting sprockets, not shown, as described with reference to FIG. 1, and turned 180° by reciprocating reversing drive means, as described with reference to FIG. 1 and FIG. 6.

At the beginning of the operation, shuttle **25** is located in slot **31** of turnable shuttle box **29**, and shuttle **26** is located in groove **32** of shuttle box **30**. The shuttles are simultaneously picked by picking means aligned with the respective grooves, and travel with the pointed ends leading in opposite directions through the sheds **23** and **24**. At the end of the pick, and when the two weft threads dragged by the shuttles have been, respectively, inserted into sheds **23** and **24** by the grippers of the shuttles, shuttle **25** enters groove **31** of shuttle box **30**, and shuttle **26** enters groove **32** of shuttle box **29** where the shuttles are stopped. Drive means **15** is now operated to perform a reciprocating stroke so that the shuttle boxes are turned 180°, and grooves **31** are located at the level of shed **34** while grooves **32** are located at the level of shed **23**. The 180° angular displacement of the shuttle boxes has caused a corresponding turning of the shuttles so that the pointed end of shuttle **25** in shuttle box **30** points toward shuttle box **29**, and the pointed end of shuttle **26** in groove **32** points toward shuttle box **30**. The shuttles are picked simultaneously to move in opposite directions through the respective sheds, whereupon drive means **15** performs the next reciprocating stroke to reverse the position of the shuttle boxes and shuttles.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of weft inserting apparatus differing from the types described above.

While the invention has been iliustrated and described as embodied in an apparatus for reversing a gripper shuttle after each pick, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A weft inserting apparatus for a loom, comprising, in combination, at least one shuttle; picking means located on opposite sides of the loom for picking said shuttle in opposite directions through a warp shed; a pair of shuttle boxes mounted for turning movement on opposite sides of the loom, each of said shuttle boxes having a straight groove for receiving said shuttle; reciprocating drive means for turning said shuttle boxes 180° between positions in which said straight grooves are aligned, and being operable for turning the shuttle box holding a picked shuttle, so that the same one end of said shuttle leads during all picks; a pair of stop means having inoperative positions, and stop positions located at the outer ends of said grooves for stopping said shuttle received in said grooves after a pick; and control means for moving said stop means between said inoperative and stop positions in timed relation with the turning of said shuttle boxes.

2. An apparatus as claimed in claim **1** wherein said control means include a control shaft having a pair of cams, and a pair of spring biased cam follower means cooperating with said cams and respectively carrying said stop means.

3. A weft inserting apparatus for a loom, comprising, in combination, at least one shuttle; a pair of shuttle boxes mounted for turning movement on opposite sides of the loom, each of said shuttle boxes having a straight groove for receiving said shuttle; reciprocating drive means for turning said shuttle boxes 180° between positions in which said straight grooves are aligned, and being operable for turning the shuttle box holding a picked shuttle so that the same one end of said shuttle leads during all picks; a pair of picking means, each picking means including a pair of cylinders, a pair of pistons in said cylinders, conduit means connecting cylinder chambers located on opposite sides of said pistons, one of said pistons being reciprocated from said drive means so that the other piston is correspondingly reciprocated by a fluid medium

in said cylinders, and a picking member secured to the other piston and being located outwardly of the respective shuttle box; and a slay supporting the cylinder enveloping said other piston.

4. An apparatus as claimed in claim 3 wherein said drive means include a control shaft for reciprocating said first-mentioned piston in timed relation with the movement of said slay; and including a cam secured to said control shaft, and stop means operated by said cam in timed relation with said picking means and having a stop position located between said picking member and said shuttle box, and an inoperative position permitting movement of said picking member toward said shuttle box and shuttle therein.

5. An apparatus as claimed in claim 4 wherein said stop means block movement of said picking members in said stop position, and are retracted to said inoperative position to release said picking members when the pressure in said other cylinders is increased.

6. A weft inserting apparatus for a loom, comprising, in combination, at least one shuttle; picking means located on opposite sides of the loom for picking said shuttle in opposite directions through a warp shed; a pair of shuttle boxes mounted for turning movement on opposite sides of the loom, each of said shuttle boxes having a straight groove for receiving said shuttle, said shuttle boxes having circular peripheral surfaces and sprockets on said peripheral surfaces and reciprocating drive means for turning said shuttle boxes 180° between positions in which said straight grooves are aligned, and being operable for turning the shuttle box holding a shuttle so that the same one end of said shuttle leads during all picks, said drive means including an endless belt passing over said peripheries of said shuttle boxes and having holes engaged by said sporckets, the axial width of said belt being less than the axial width of said peripheral surfaces of said shuttle boxes so that portions of said peripheral surfaces are not covered by said belt, said grooves having open ends located on said uncovered portions of said peripheral surfaces, and a reciprocating drive arm engaging said belt for reciprocating the same and performing a stroke of such length that said shuttle boxes are simultaneously turned 180°.

7. A weft inserting apparatus for a loom, comprising, in combination, a pair of shuttles; a pair of shuttle boxes mounted for turning movement about parallel turning axes on opposite sides of said loom, each of said shuttle boxes having a pair of parallel straight grooves spaced the same distance from each other and disposed symmetrically to said turning axes, respectively; and reciprocating drive means for simultaneously turning said shuttle boxes 180° between reversed positions in which said pairs of parallel grooves are aligned along a pair of parallel weft inserting paths; and a pair of picking means located on opposite sides of the loom for simultaneously picking said shuttles out of the shuttle boxes on one side of the loom along said paths in opposite directions through different sheds and into the grooves of the shuttle box on the other side of the loom, said drive means operating in synchronism with said picking means so that said shuttle boxes are simultaneously turned while said shuttles are located in said shuttle boxes so that said shuttles move alternately along said paths.

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