Dec. 24, 1968 A. FREIHOFER 3,417,793

WEAVING LOOM

Filed June 9, 1966 6 Sheets-Sheet 1

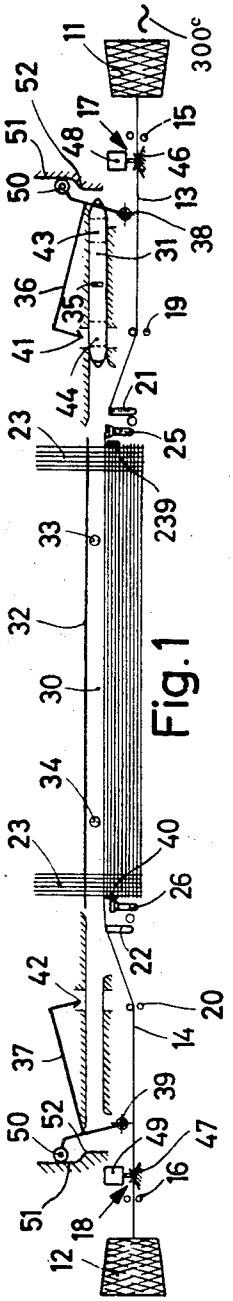

Fig.1

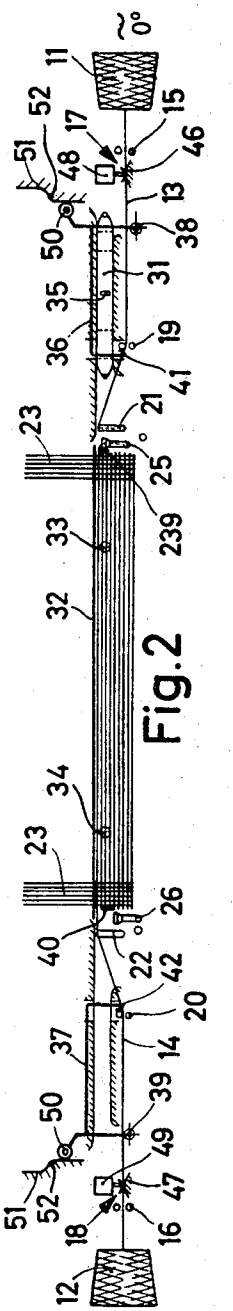

Fig.2

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WEAVING LOOM

Filed June 9, 1966 6 Sheets-Sheet 2

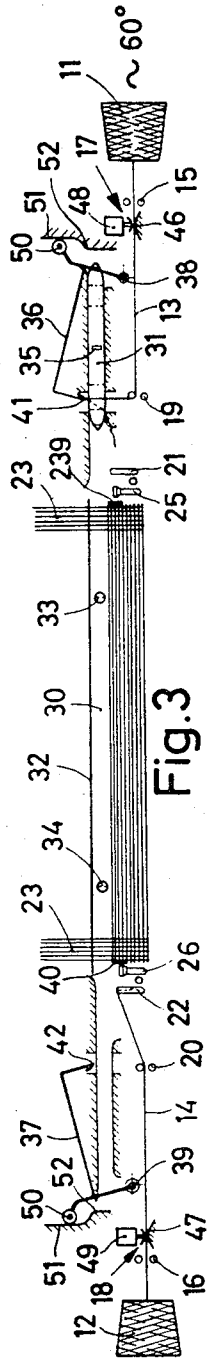

Fig.3

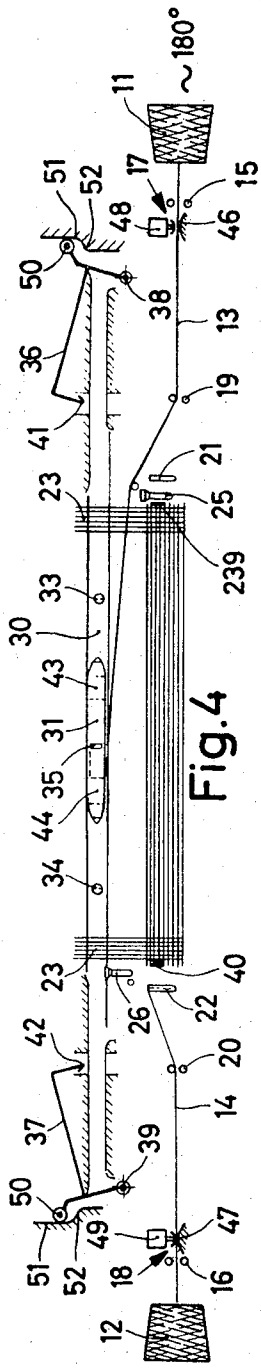

Fig.4

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WEAVING LOOM

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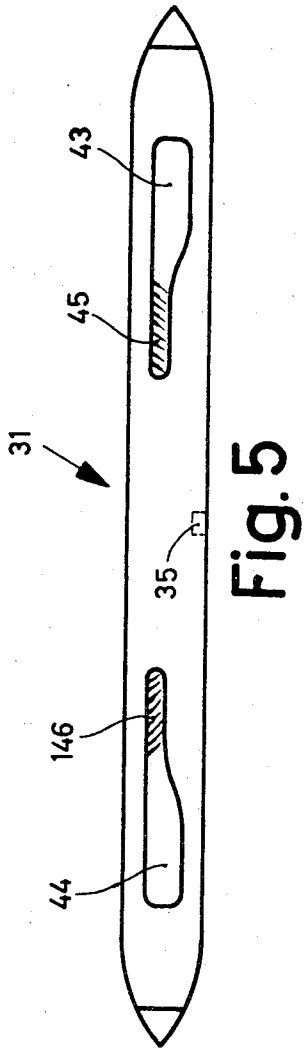

Fig. 5

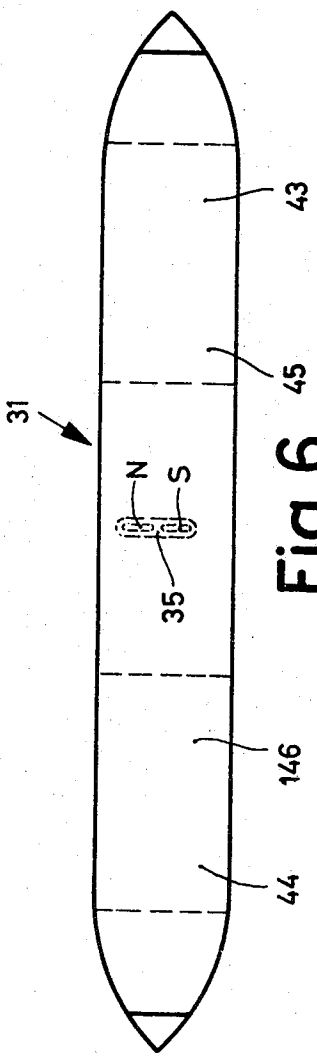

Fig. 6

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WEAVING LOOM

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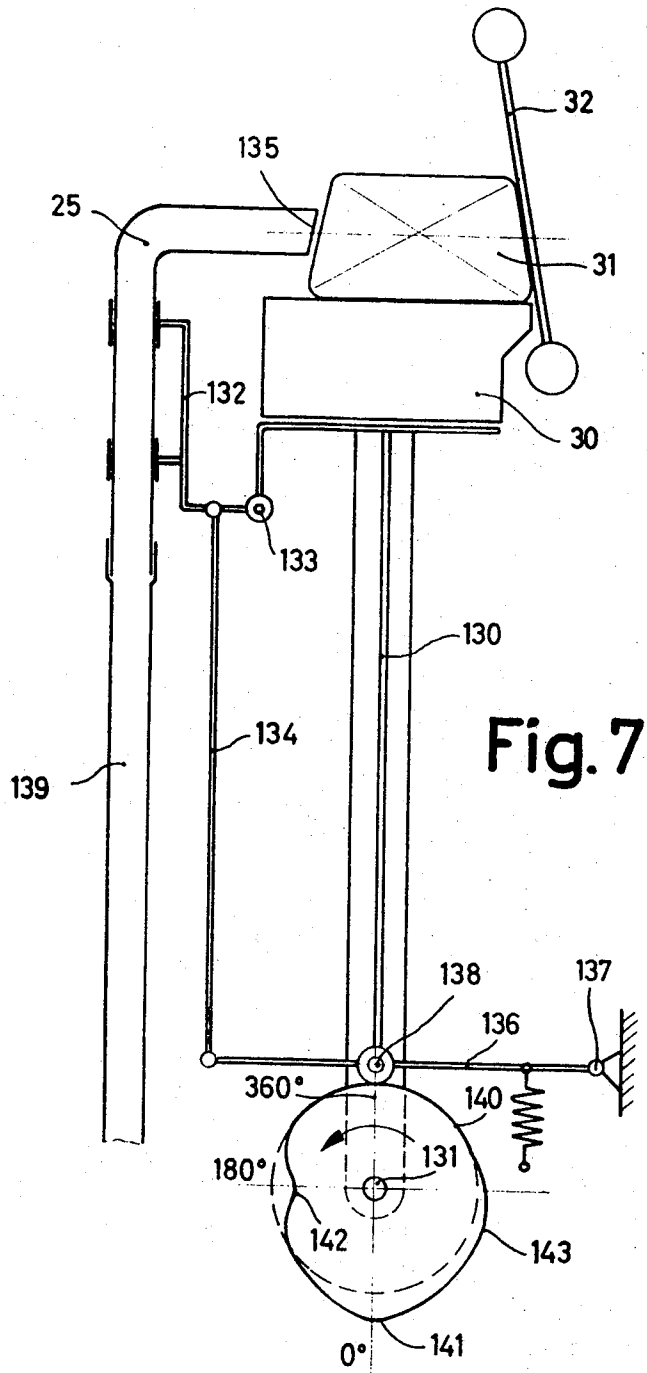

Fig. 7

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WEAVING LOOM

Filed June 9, 1966 6 Sheets-Sheet 5

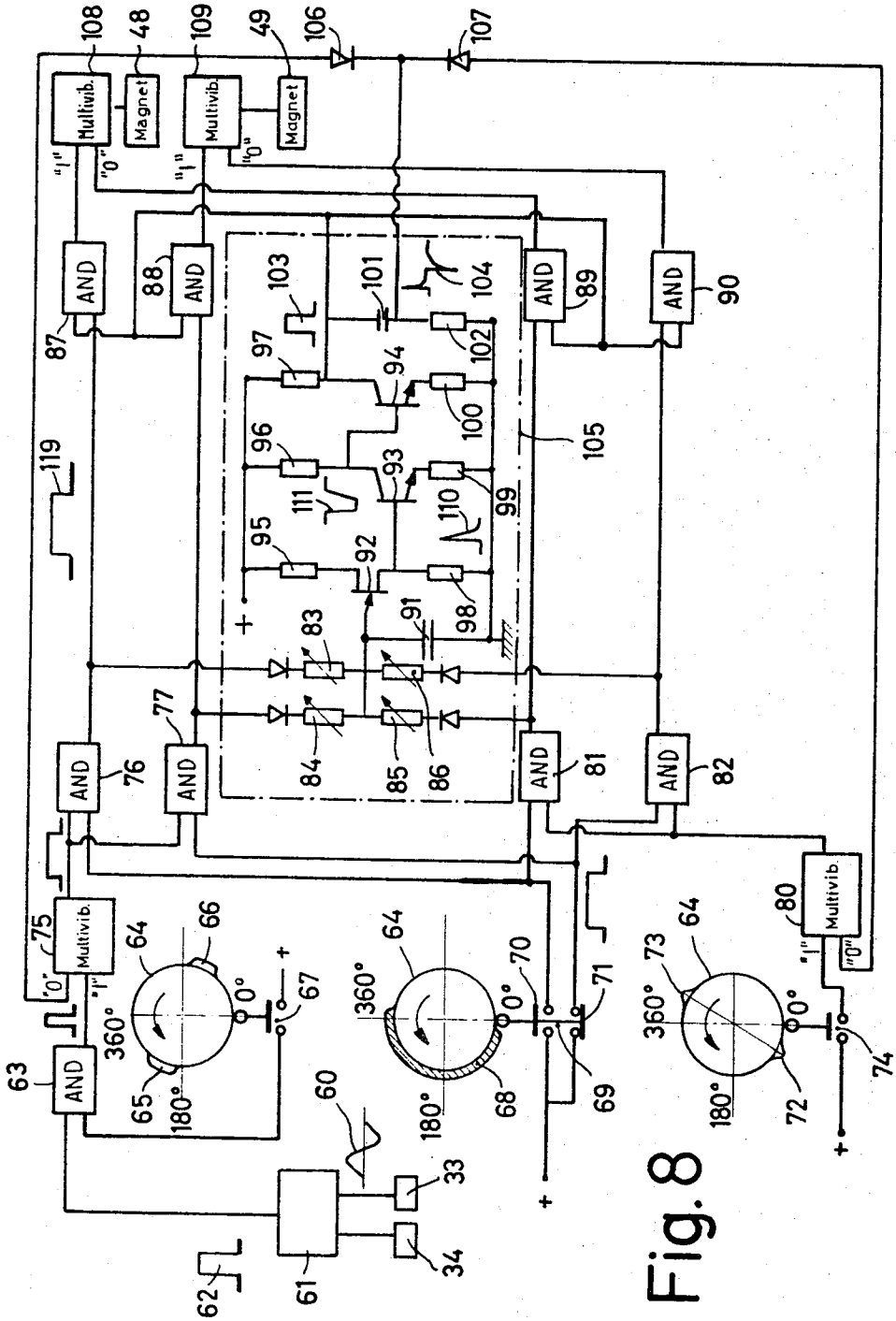

Fig. 8

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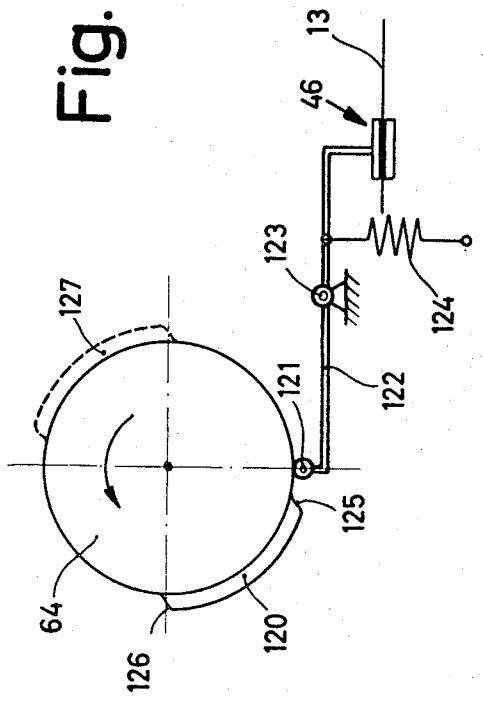
Fig. 9



United States Patent Office

3,417,793
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3,417,793

WEAVING LOOM

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Filed June 9, 1966, Ser. No. 556,499
Claims priority, application Switzerland, June 18, 1965, 8,557/65
22 Claims. (Cl. 139—126)

ABSTRACT OF THE DISCLOSURE

A weaving loom having a yarn supply arranged externally of the shed, yarn picking means for drawing weft yarn from the yarn supply into the shed which retains the yarn with a force that is smaller than the tearing strength of the yarn, braking means for retaining the yarn during selected periods of the working cycle of the loom, which is disposed between the yarn supply and the picking means and control means for actuating the braking means to release the yarn during travel through the shed and thereafter to retain the yarn to remove it from the picking means after it has passed through the shed.

The present invention relates to a weaving loom in which weft yarn is taken off from a yarn supply disposed externally of the shed and is drawn, by a picking means, through a braking device arranged between the yarn supply and the picking means, and then picked into the shed; the yarn being retained by the picking means with a predetermined force.

In conventional weaving looms, a shuttle carrying a bobbin wound with weft yarn, is propelled to and fro through the shed in order to pick the weft yarn into the shed. Such looms require, a special device for winding the weft bobbins. Furthermore, maximum-precision devices are required for effecting the bobbin change which takes place during the operation of the loom. Where weft yarns of various colors are woven, it is also necessary to provide drop-boxes, special changing devices, bobbin-feeding devices and the like.

In another weaving system, use is made of a gripper shuttle. The length of the yarn to be picked into the shed by this kind of shuttle is pre-determined by pre-cutting to length and the yarn is then picked. The devices for the preparation of yarns of pre-determined lengths are relatively complicated, especially in weaving systems using weft yarns in different colors. These weaving systems must furthermore be provided, as a rule, with special shuttle guideways for guiding the shuttle on its path through the shed. The guide members must periodically be moved through the warp threads.

A picking system using a type of gripper shuttle is also known in which a yarn clip is mechanically opened by a member advancing into the shed as the shuttle travels past the member. This, however, involves undesirable mechanical impacts. Furthermore, the system is suitable only for extremely coarse yarn, since it is necessary to exert a permanent braking effect on the yarn during the picking of the warp.

According to yet a further process, the picking member for the warp yarn is combined with two brakes to predetermine the length of the yarn. With this arrangement, the yarn is drawn about a deflecting point provided on the picking member so that it is rubbed or chafed at this deflection point. This has a detrimental effect on the yarn. Furthermore, the provision of two brakes has the disadvantage that they are required to operate extremely accurately if rupturing of the yarn or the formation of uneconomically long warp ends is to be avoided. Advantageously, the problems of the above-enumerated systems are obviated by means of the present invention.

This present invention thus contemplates a weaving loom having a yarn supply disposed externally of the shed, a picking means for drawing weft yarn from the yarn supply, the yarn being retained by the picking means with a force that is smaller than the tearing strength of the yarn, braking means arranged between the yarn supply and the picking means for stopping or retaining the yarn and a control device for actuating the braking means to stop or retain the yarn during picking thereof into the shed.

The apparatus of the weaving loom of this invention also has the advantage of its relatively simple design and the advantage that it can be fitted on conventional loom constructions. Furthermore, when weaving with various weft yarns, no restriction of the speed of operation is necessary. The loom operates, in principle, as a pick-a-pick machine, i.e., weft yarns following each other in succession are obtained from different spools, by which means, irregularities in the yarn properties are compensated.

The invention will now be discussed with reference to its different specific embodiments and with reference to drawings in which:

FIGURES 1 through 4 each show diagrammatically in plan view the weaving loom of this invention at four different situations in its working cycle;

FIGURE 5 shows one embodiment of a shuttle suitable for use in the loom according to the invention in elevation;

FIGURE 6 shows the top view of the shuttle shown in FIGURE 5;

FIGURE 7 shows one embodiment of an arrangement for receiving the yarn drawn out of the shuttle;

FIGURE 8 shows an electrical wiring diagram for controlling the length of the weft yarn to be picked by the shuttle;

FIGURE 9 shows a control device to determine the length of the weft yarns which operates on a mechanical basis.

FIGURES 1 to 4, inclusive, show the parts of the weaving loom necessary for an understanding of the mode of operation of the present invention. Reference numerals **11** and **12** designate large supply bobbins for weft yarn or thread arranged on both sides on the machine frame of the loom. From the bobbins, the yarns or threads **13** and **14** travel through the eyelets **15** and **16**, respectively (which are secured to the machine frame), through the yarn braking devices **17** and **18**, respectively, and further through yarn guides **19** and **20**, respectively. The thread **13**, as shown in FIGURE 1, ends in the suction nozzle **21** which serves as a yarn holding means;

whereas the thread **14** is drawn over the suction nozzle **22** which also serves as a yarn holding means. The holding nozzles **21** and **22** are also secured to the machine frame. Thread **14** extends through the shed formed by the warp threads **23**. For the sake of clarity, only the warp threads **23** on the sides of the entire warp shed are shown. The free end of the thread **14** is retained by the suction nozzle **25** which serves as a yarn receiving device. The nozzle **26**, having structure corresponding to the nozzle **25**, is arranged on the left-hand side and also forms a yarn receiving device. The nozzles **25** and **26** which are perpendicularly arranged on the movable sley **30** are removable relatively thereto. Disposed on the sley **30**, the front or fabric-side boundary of which is shown only in FIGURE 4, is the shuttle **31** serving as the weft yarn picking means.

One embodiment of a shuttle which can be used in accordance with the present invention is shown in greater detail in FIGURES 5 and 6. The shuttle **31** has, on its sliding face, a member **35** which is counter-sunk into the face and which is made of ferro-magnetic material, for example, iron. Furthermore, the shuttle is formed with two apertures **43** and **44** which extend laterally through the body of the shuttle. The apertures become narrow towards the center of the shuttle **31** for the purpose of guiding a thread drawn through the aperture **43** or **44** against the zone **45** or **146**, respectively. Disposed in these constricted or narrow zones **45** and **146** are bristles which are capable of retaining yarn disposed therein with a pre-determined force. It is possible, nevertheless, to draw the yarn out of the shuttle **31**, i.e., the predetermined force is smaller than the tearing strength of a weft yarn or thread, e.g., threads **13** and **14**.

Secured to the sley **30** is the reed **32** (note FIGURE 7). Furthermore, the sley contains devices **33** and **34**, the electrical properties of which can be varied by a ferromagnetic material. In the present example, each of the devices **33** and **34** comprises a permanent magnet surrounded by a wire coil. The magnet is U-shaped, i.e., it is a horseshoe magnet and is so fitted into the sley that its poles point upwardly, i.e., the magnet forms an upright U. With this arrangement, the plane in which the portion of the magnet U is located extends perpendicularly with respect to the longitudinal direction of the sley **30**.

In the plan or top view of the picking means shown in FIGURE 6, the iron member **35** of the shuttle **31** is so disposed so as to be arranged precisely above one of the magnet devices **33** or **34** when it is positioned appropriately on the sley. The ends or the uppermost faces of the poles are designated as N and S in FIGURE 6. These are narrow in the direction parallel to the longitudinal development of the sley **30**, in order that the change in the magnetic flux produced by the movement of iron member **35**, and the voltage produced therewith in the coil wound about the magnet, may be as large as possible. If, then, the shuttle, with the ferro-magnetic material **35** attached on its underside, moves over the magnetic devices **33** and **34**, then an electrical voltage variation is set up in the coils of each of these devices, respectively.

Furthermore, the drawing-in devices **36** and **37**, each having a hook **41** and **42**, respectively, are provided on both sides of the loom. These are pivotal about the pivots **38** and **39**, respectively, which are carried by the sley **30** and serve to draw the weft threads **13** and **14** into the shuttle **31**. Reference numerals **239** and **40** designate two scissor members for cutting the weft threads **13** and **14**, respectively. The yarn brake devices **17** and **18** each have yarn clips **46** and **47**, respectively, which are adapted to be actuated by the controllable magnets **48** and **49**, respectively.

If a working cycle of the loom is divided into 360°, then FIGURES 1 to 4 represent the situations at the respective approximate values of 300°, 0°, 60°, and 180°.

In the case of the 300° condition shown in FIGURE 1, the shuttle **31** has just arrived from the left to the right-hand side of the loom. The yarn **14** picked by the shuttle during its travel is retained by the closed clip **47** of the braking device **18**, the magnet **49** thereof being appropriately actuated. Due to the nipping of the yarn **14** by the clip **47**, the yarn end retained by the shuttle **31** is drawn out of the shuttle. As shown in FIGURE 1, the drawn-out end is suctionally attracted and retained by the nozzle **25**. Also on the right-hand side, the magnet **48** of the braking device **17** is actuated in such manner that the clip **46** is closed.

During the further operation of the loom, the reed **32** beats up (in the 0° working phase shown in FIGURE 2) the picked yarn **14** into the selvedge and a change takes place in the shed formed of the warp threads **23**. The scissor members **239** and **40** cut the warp thread **14** at both selvedges. The end which, as this takes place, becomes free on the left-hand side is drawn into the holding nozzle **22**. The short yarn end hanging from the yarn receiving nozzle **25** is drawn-off by the suction of the nozzle. Furthermore, in the front position of the sley **30**, the drawing-in device **36** is rotated anti-clockwise until its hook **41** engages through the aperture **44** extending horizontally through the shuttle **31** (FIGURE 2). As this takes place, the hook **41** grasps the thread **13** offered by the yarn guide **19** and draws it, since the clip **46** is closed, out of the yarn holding means **21** and through the aperture **44** in the shuttle **31**, as shown in FIGURES 2 and 3. The movement of the drawing-in device **37**, which takes place simultaneously with the movement of device **36** has no effect, since no thread is transferred to the device by the yarn or thread guide means **20**.

Due to the projection of the shuttle **31** towards the left, which follows immediately after the 60° working phase, the thread is drawn taut in the shuttle and may be partly drawn through it, because the clip **46** is still closed. Meanwhile, due to the provision of the bristles in zones **45** and **146**, the thread is subjected to a tensile force predetermined by the nature of the bristles. Simultaneously with the projection of the shuttle **31** or a short instant of time after this takes place, the clip **46** is opened by actuation of the electro-magnet **48**. As shown in FIGURE 4, the shuttle **31** subsequently, during its travel, draws the weft thread **13** off from the large supply **11** and through the shed. At the instant at which the ferro-magnetic plate **35** in the shuttle **31** moves over the magnetic device **34**, a voltage pulse is produced therein. Consequently, the electro-magnet **48** is actuated by means of the circuit arrangement shown in FIGURE 8, so that the clip **46** is closed and the weft thread **13** is retained thereby. In this way, the thread **13** is drawn out of the shuttle or yarn picking device **31** and leaves it at the front side, i.e., at the side of the shuttle facing the selvedge. The yarn receiving nozzle **26** secured on the sley **30** and movable forwardly and rearwardly relatively thereto has meanwhile moved rearwardly relatively to the sley **30**, i.e., towards the path of the shuttle (FIGURE 4). It receives the end of the thread **13** emerging from the shuttle which is travelling past, so that the said thread is disposed, taut in the shed, between the clip **46** and the nozzle **26**.

The condition obtaining in this working phase is that analogous to the condition of FIGURE 1 except the shuttle **31** is not on the right-hand side, but on the left-hand of the sley **30**, i.e., the working condition corresponds to the 300° phase, with the shuttle **31** on the left-hand side.

As already mentioned, the suction nozzles **25** and **26** forming yarn receiving devices are preferably carried by the sley **30** and are movable relatively to the sley **30** perpendicularly to its longitudinal direction. In the working phase of FIGURE 4, the nozzle **26** has been moved into a position relatively to the sley **30** which is such that, when the shuttle **31** passes through, the selvedge-side

or front lateral face thereof travels directly past the aperture in the nozzle **26**. In this way, reliable grasping of the thread end drawn out of the shuttle **31** is assured. In the working cycle shown in FIGURE 2, with respect to the beating-up of the weft thread **14** which has been drawn in, the nozzle **25** is still nearer to the reed **32**. Since an effort is made to keep the free piece of thread hanging out of the shed and retained by the nozzle **25** in FIGURES 1 and 2 as short as possible, it would be drawn partially out of the nozzle **25** if the spacing between the nozzle **25** moving forwardly with the sley **30** and the reed **32** for beating-up the weft thread **14** were not further diminished relatively to the spacing between the nozzle **25** and the reed **32** during the through-travel of the shuttle. This action would diminish the holding force of the nozzle **25**.

When the weft thread **14** is cut by means of the scissors **239** and **40**, the nozzle **25** is positioned directly before an imaginary extension of the selvedge and in this position it sucks away the short retained end of thread. It is, however, necessary that the thread **14** coming from the yarn supply **12** should be grasped by the yarn holding means **22** and not inadvertently drawn by the suction of the yarn receiving nozzle **26**. Thus, for the cutting step, the nozzle **26** is in a relatively forward position or a position moved-away from the reed **32**, so that during this step the nozzle **26** is positioned further forward than the yarn holding means **22**.

An arrangement for producing the movement of the yarn receiving devices **25** and **26** is shown by way of example in FIGURE 7. The sley **30** is carried by the sley supports **130** which oscillate about the pivot **131**. Disposed on the sley **30** is the shuttle **31** and the reed **32**. The yarn receiving device having nozzle **25** is secured to the holding means **132** which is pivotally mounted on the pivot **133**. The pivot **133** is secured to the sley **30**. By means of the rod **134** which is adapted to be moved upwardly and downwardly the holding means **132** can be pivoted about the pivot **133**. With this arrangement, the position of the nozzle **25**, with its aperture **135**, can be varied perpendicular to the sley **30** by movement of means **132**. Rod **134** is pivotally connected with the lever **136** which is secured to the pivot **137** on a portion of the machine frame.

As shown in FIGURE 7, lever **136** carries a roller **138** that travels on the guide cam **140**. The guide cam rotates on the pivot **131** of the sley at half the speed of the crank shaft of the loom, i.e., it completes a full rotation during the time in which the shuttle **31** carries out a reciprocating movement. The tubing **139** connects the yarn receiving nozzle **25** to a suction device (not shown).

The periphery of the guide cam **140** is divided into two 360° working cycles each of which corresponds to the previously described graduation of the working cycle of the loom. On rotation of the guide cam **140**, the roller **138** and lever **136** move upwardly and downwardly. The resultant upward and downward movement of the rod **134** produces movement of the nozzle **25** perpendicularly to the sley **30**.

The raised portion **141** of the guide cam **140** in the 0° position of the crank shaft of the loom effects the closest approach of nozzle **25** to the reed **32** at the instant at which the reed beats up the yarn **14**. After this, the nozzle **25** moves until, at 180° (see also FIGURE 4), its greatest distance away from the reed **32** is reached, so that the nozzle **25** may be positioned externally of the zone of the thread **13** to be drawn in. This maximum distance is produced by the recess **142** in the cam **140**. Then (see the position of the nozzle **25** in FIGURES 1, 2 and 3) the nozzle remains in a central position until, for the purpose of receiving the thread end emerging from the shuttle **31**, its aperture is moved directly to the side of the shuttle remote from the reed. This position is determined by the zone **143**. It is obvious that the control of the nozzles **25** and **26** can be carried into effect with two identical guide cams which are offset on the pivot **131** by the amount of half a rotation.

It is thus apparent that, with the aid of the device described, a weft thread from the large supply source **11** and a weft thread from the large supply source **12** are alternatingly drawn in, i.e., the drawing-in of the weft yarn corresponds to the pick-a-pick process.

The opening of the clips **46** and **47** takes place preferably directly after the commencement of picking of the shuttle **31**, but may alternatively take place before this commencement. The control of the opening of the clips **46**, **47** may be effected by a shaft having half the speed of rotation of the main driving shaft of the loom. This may be done, for example, by an arrangement whereby the shaft actuates an electrical contact which in turn energives magnet **48** or **49**, to cause opening of the clip **46** or **47** respectively. A mode of control whereby the opening (and also the closing) of the clips **46**, **47** is effected mechanically is hereinafter described with reference to the embodiment shown in FIGURE 9.

An advantageous manner of obtaining the desired rotational movement of the drawing-in devices **36** and **37** (carried by the sley **30**) about their pivots **38** and **39** consists, for example, of a roller **50** which is connected with the drawing-in device and which rolls along a travel cam **51** (as shown diagrammatically in FIGURES 1 to 4). During the movement of the sley **30** into the foremost position, i.e., into the weft thread beating-up position, the roller **50** rolls on the projecting portion **52** and, as it does so, rotates the drawing-in device **36** anti-clockwise about its pivot **38**. The yarn guides **19** and **20** are so controlled that they transfer the yarn retained by them to the drawing-in devices **36** and **37** only when the shuttle **31** is on their side.

It will be appreciated that the thread retaining means **21**, **22**, **25**, **26** are designed as suction nozzles all of which are usually connected with a common source of suction.

When the shuttle **31** draws the weft thread **13** or **14** into the shed, then, as already mentioned, the thread is drawn off from the yarn supply source **11** or **12**, jammed at a pre-determined position of the shuttle **31** by a clip **46** or **47** and in this way drawn out of the shuttle **31**. The control arrangement serving for this purpose will now be discussed in greater detail with reference to FIGURE 8.

According to the electrical circuit arrangement shown in the drawings, the voltage variations **60** generated in the magnet arrangements **33** and **34** are fed to an amplifier **61** which simultaneously operates as a limiting device. In this way there are set up in this output rectangular pulses **62** which are fed to the input of an "AND" circuit **63** and have the character of binary signals.

Furthermore, FIGURE 8 shows diagrammatically shaft **64** which may be the picking shaft of the loom. The picking shaft **64** makes a half rotation during the time that the crank shaft of the loom makes a full rotation. The working cycle of 360°, as described with reference to FIGURES 1–4, and wherein therefore the shuttle travels from one end position to the next opposite one, corresponds to a rotation of the crank shaft through 360° and thus to a rotation of the picking shaft **64** through 180°. Thus, the angle values indicated in FIGURE 8 do not correspond to the conventional, defined magnitudes of rotation of the picking shaft but designate the rotational position of the crank shaft.

Provided on the picking shaft **64** are, on the one hand, cams **65** and **66** which actuate a switch **67**. Also on the shaft **64** is a raised portion **68** extending over half the periphery and serving for the actuation of a switch **69** with contacts **70** and **71**. Finally, there are also the cams **72** and **73** which actuate the switch **74**. For the sake of clarity, these control "shapes" or cams which are disposed side-by-side on the shaft **64** have been shown diagrammatically one above the other.

Each of the switches **67**, **69**, and **74** connects, when

it is closed, a positive voltage to specific control circuits. The switch **67** connects a positive voltage to another input of the "AND" circuit **63**. This input leads to the "1" input of a bistable multivibrator **75** wherein a signal on the "1" input determines the presence of a signal at its output. This output is connected with the input terminals of the "AND" gates of the circuits **76** and **77**. The other input terminal of the "AND" circuit **76** is connected with the contact **70** and that of the "AND" circuit **77** with the contact **71** of the switch **69**. The switch **74** connects, in the closed state, a positive voltage to the input "1" of the additional bistable multivibrator **80**. The output of the vibrator **80** is connected with the inputs of the "AND" circuits **81** and **82**. The other inputs of the circuits **81** and **82** also lead to the contacts **70** and **71**, respectively.

Furthermore, there is provided a delay and signal-converting circuit **105**. The outputs of the "AND" circuits **76**, **77**, **81** and **82** are on the one hand connected to the respective variable resistors **83**, **84**, **85** and **86** of the circuit **105** and, on the other hand, connected with the respective inputs of the "AND" circuits **87**, **88**, **89** and **90**. The other ends of the resistors **83** to **86** are connected with one plate of a condenser **91** and with the emitter of a transistor **92**. The other plate of the condenser **91** is connected to ground. Normally, the condenser **91** is at ground potential. Following the transistor **92** are two further stages with the transistors **93** and **94**. The respective resistors **95**, **96**, and **97** are connected between a positive voltage source and the transistors **92**, **93**, **94**. Resistors **98**, **99**, and **100** are, respectively, connected between ground and the transistors **92**, **93** and **94**. In the output of the last stage there is a differentiating circuit formed by the condenser **101** and the resistor **102**.

The output signal **103** of the stage of the transistor **94** is fed to the second inputs of the "AND" gates **87** to **90**. The differentiated output signal **104** is coupled, via two diodes **106** and **107**, to the "0" inputs of the multivibrators **75** and **80**. Signals conveyed via this coupling put the multivibrators **75** and **80** in the "0" state, i.e., in a state wherein no signal is present at the outputs of the multivibrators **75** and **80**. Signals at the outputs of the "AND" gates **87** and **88** produce an electrical state of the bistable multivibrators **108** or **109** which is such that they actuate the magnets **48** and **49** in the sense of jamming of the clips **46** or **47** (FIGURES 1 to 4). Opening of these clips is effected by signals from the "AND" gates **89** and **90**, which are fed to the second inputs of the multivibrators **108** and **109**.

In explanation of the mode of operation of the circuit shown in FIGURE 8, it should first of all be stated that the position of the picking shaft **64** shown corresponds to the state of the 0° working phase, wherein the shuttle **31** is, as shown in FIGURE 2, on the right-hand side of the sley **30**. At the commencement of the rotation of the picking shaft **64** in the direction of the arrow shown, due to the raised portion **68** initially the contact **70** is closed and the contact **71** opened. In this way, the "AND" circuits **76** and **81** receive a positive signal at one of their inputs. After a rotation of the crank shaft through approximately 60°, i.e., in the phase of the working cycle corresponding to FIGURE 3, or somewhat later, i.e., shortly after the shuttle **31** has been picked on to the right-hand side, the switch **74** is actuated temporarily by the cam **72**.

Consequently, the multivibrator **80** is put into its "1" state, i.e., a signal is set up at its output terminal. This passes to one of the input terminals of the "AND" gates **81** and **82**. Thus, a signal is available at both inputs of the "AND" gate **81** and consequently a signal also appears at the output conductor thereof. The signal passes on the one hand to one of the inputs of the "AND" circuit **89** and on the other hand, via the variable resistor **85** and accompanied by slow charging of the condenser **91**, to the emitter of the transistor **92**. After the condenser **91** has attained a predetermined voltage, the transistor **92** becomes conductive, so that the condenser **91** is again discharged. This produces at the base of the transistor **92** or across the resistor **98** a voltage pulse of a shape similar to the one designated by the reference numeral **110**.

Thus, the elements **85**, **91**, **92** form a delay circuit wherein the delay time may be varied by means of the variable resistor **85**. Similarly, the resistors **83**, **84**, and **86** together with the condenser **91**, form delay devices and a temporal delay is imparted, in the manner described, to input signals fed to the resistors **83**, **84** and **86**.

From the base of the transistor **92**, the signal **110** passes to the stage of the transistor **93**, in which it is inverted and limited. The inverted and limited signal **111** is again amplified in the stage of the transistor **94** and appears in its output as a pulse **103**; from here the pulse is fed to the "1" inputs of the "AND" gates **87** to **90**. Simultaneously, the ouput pulse **103** is differentiated by the differentiating circuit **101**, **102**. The signal **103** is fed, as a second input signal, to the "AND" gate **89**, which is already acted upon by an input signal. Thus, at the output of gate **89** a signal is produced which puts the multivibrator **108** in a condition in which it does not supply an output signal; consequently the magnet is not fed or energized. This means that the clip **46** (FIGURE 1) is opened and the shuttle **31** is able to draw yarn off from the large supply source **11**. The differentiated signal **104** is fed to the "0" inputs of the multivibrators **75** and **80**, so that the multivibrator **80** is again restored into its "0" state.

In a working phase of 220°, the iron member **35** in the shuttle **31** reaches the position of the magnet device **34**. A short time before, the cam **65** on shaft **64** reaches, due to the rotation of the shaft in the direction of the arrow, the switch **67** which it switches on, so that one of the inputs of the "AND" circuit **63** receives a signal. If, then, the iron member **35** moving over the magnet device **34** generates in the device a voltage pulse **60**, which is converted in the circuit **61** to the rectangular pulse **62** and in turn is conveyed to the other input of the "AND" gate **63**, then the pulse again appears at the output of the gate **63**.

The purpose for effecting actuation of the switch **67** by the cams **65** and **66** is to ensure that the "AND" gate **63** is open only during the time of the travel of the iron member **35** over the magnetic devices **33** or **34**. This provides a measure of safety with respect to possible disturbance signals which might occur in the event of a direct or continuous connection of the circuits **61** and **75**.

From the output of the "AND" gate **63**, the pulse passes to the "1" input of the multivibrator **75**. The output signal thereby set up at the vibrator is, as can be seen from FIGURE 8, fed to the inputs of the "AND" circuits **76** and **77**, so that the "AND" circuit **76** (at the other input of which the signal supplied via the closed switch **70** from the positive voltage source is present) produces an output signal **119**. This signal **119** passes to one of the inputs of the "AND" gate **87** and to the variable resistor **83**. Thus, a delay is imparted in the manner already described in the circuit **105** and there are set up at the output of this circuit a delayed rectangular pulse **103** and the differentiated signal **104**. The rectangular pulse **103** passes to one of the inputs of the "AND" gate **87** to **90**, at which time the gate **87** already has an input signal at its other input. In this way the gate **87** becomes active and the signal set up at its output passes to the input "1" of the multivibrator **108** and causes the output of the multivibrator **108** to produce a current. Consequently, the magnet **48** is attracted and the clip **46** (FIGURE 1) is closed. The differentiated signal **104** flowing via the rectifier **106** restores the multivibrator **75** to its "0" state.

The thread **13** drawn from the yarn supply **11** via the clip **46** is thus jammed fast, so that its free end, which is introduced into the shuttle **31** by the drawing-in device

36, is drawn out of the said shuttle. The thread 13 is received by the yarn receiving device 26 which is displaced before the travel-through of the shuttle to the immediate vicinity of its travel, as shown in the shuttle travel from the left towards the right illustrated in FIGURES 1 through 4.

During the movement of the shuttle 31 over the sley 30, a signal 60 is of course also produced in the magnetic device 33. Since, however, this signal is produced at an instant at which the switch 67 is open, it has no effect.

If, during another part of the weaving process, the shuttle 31 is projected over the sley 30 from the left towards the right, then a process takes place in the control circuit which is exactly analogous to the process just described. Thus, this process will not be again described in detail.

Operation of the apparatus when the shuttle movement is from left to right as shown in the drawings is as follows:

First of all, the thread 14 is transferred by the yarn retaining means 22, received by the drawing-in device 37 and drawn through the aperture 43 in the shuttle 31. Due to the rotation of the picking shaft 64, the switch 69 is no longer over the raised portion 58, so that the switch 70 opens and the switch 71 closes. Thus, during the process of picking the weft yarn from the left towards the right, the "AND" gates 76 and 81 are closed and the "AND" gates 77 and 82 receive a signal at one of their inputs.

The signal produced by the cam 73 during the rotation of the picking shaft 64 puts the multivibrator 80 into its "1" state, whereby a signal is present at its output. This signal passes via the "AND" gate 82, on the one hand, directly and, on the other hand, via the resistor 86 and through the circuit 105, after a certain delay, to the two inputs of the "AND" gate 90. From this gate the signal is fed to the "0" input of the multivibrator 109 which then releases the magnet 49. Consequently, the thread 14 is no longer clamped by the clip 47.

During the picking of the yarn 14 into the shed, i.e., during the movement of the shuttle from the left towards the right, the iron member 35 produces a signal 60 in the device 33. Since this takes place during the time interval during which the cam 66 on the picking shaft 64 closes the switch 67, a signal passes into the "1" input of the multivibrator 75, so that the output signal at its output acts upon the one of the inputs of each of the "AND" gates 76 and 77. The "AND" gate 77 which thereby becomes operative supplies a signal directly to one of the inputs of the "AND" gate 88 and also to the resistor 84 and through the circuit 105, so that a delayed signal appears at the other input of this "AND" gate 88. The output signal of the gate 88 passes to the "1" input of the multivibrator 109 and in turn the output signal of vibrator 109 actuates the magnet 49 to cause clamping by the clip 47. Thus, the thread 14 can not be further drawn off from the yarn supply 12 and its free end is drawn out of the shuttle 31 and retained by the yarn receiving device 25 which has meanwhile moved, due to mechanical means, into the immediate vicinity of the shuttle 31 which is travelling past. The signal 104 produced by differentiation restores the multivibrator 75 to its "0" state.

It will be apparent that, with the present arrangement the time of the opening and closing of the clips 46 and 47 can be accurately adjusted by means of the variable resistors 83 to 86. Provided that the length of the yarn drawn into the shuttle 31 is always kept constant, it thus becomes possible, by means of these resistors, to vary, and thus to adjust, the length of the yarn picked into the shed. Thus, varying of the resistance of resistors 83 to 86 controls the duration of the delay of the signals travelling through the circuit 105, which effect the opening and closing of the clips 46 and 47. In order to substantially eliminate the deviations resulting from the variations in the duration of the shuttle travel, the magnet devices 33 and 34 are arranged as far as possible towards the ends of the shed. In this way the delay times determined by the resistors 83 and 84 in combination with the condenser 91, are kept at a low level.

With uniform shuttle travel or in a weaving loom in which it is permissible to allow a specific range of length variation in the thread ends drawn by the shuttle, it is also possible to provide a single magnet device in the center of the sley 30, in place of the two devices 33 and 34. The longer period of time elapsing between the production of the signal by the member 35 and the clamping of the clips 46 and 47 can, with such an arrangement, readily be provided by an electrical delay arrangement.

It is also possible, if a certain variation in the length of the weft threads picked is permissible, not only to control the opening of the clips 46 and 47 by means of cams, as shown with regard to the embodiment described (by means of the cams 72, 73), but also to close the clips 46 and 47 by means of cams suitably positioned on the picking shaft 64. The pulses generated by the cams would be directly conveyed to the bistable multivibrator 75. In the case of an embodiment of this kind, the devices 33 and 34 and the iron member 35 are no longer required. If the electrical delay arrangement were to be dispensed with, then a circuit which is considerably simpler than that shown in FIGURE 7 may also suffice for the control of the picking arrangement of the present invention.

In the simplest case, this consideration leads to a purely mechanical control arrangement (as shown diagrammatically and by way of example in FIGURE 9) which is suitable for controlling the clip 46 shown in FIGURE 1. The picking shaft is again designated by the reference numeral 64, the clip by reference numeral 46 and the weft thread by 13. On the picking shaft 64 is a raised portion 120 which, on rotation in the direction of the arrow, presses the roller 121 downwardly. The rod 122 then rotates about its pivoting axis 123 against the force of the tension spring 124, so that the yarn clip 46 is opened.

The initial portion 125 of the raised portion 120 is so arranged on the periphery of the shaft 64 that immediately, at the commencement of the picking movement by the shuttle 31, the clip 46 is opened, and the weft thread 13 is drawn off from a large supply source and is picked into the shed. Similarly, the end 126 of the raised portion 120 is so positioned that, shortly before the emergence of the shuttle 31 out of the shed, the yarn clip 46 closes, so that the yarn end retained by the shuttle 31 is drawn out of it.

The raised portion 127 shown in broken lines is arranged, relatively to the rotational axial of the picking shaft 64, opposite the raised portion 120 and is somewhat offset in the axial direction. It co-operates with an arrangement (not shown) which is identical with the movement transmitting arrangement provided by elements 121 to 124 and which serves to actuate the clip 47 (shown in FIGURE 1) with the thread 14.

It will be apparent to the person skilled in the art that the mode of picking the weft thread described herein is not limited to a mode of picking involving the use of a picking means consisting of a shuttle, but is equally suitable for other known modes of picking involving the use of rods, tapes, liquid or air jets and the like.

While the novel features of the invention have been shown and described and are pointed out in the appended claims, it is to be understood that various omissions, substitutions and changes in construction and arrangement of the features shown and described may be made by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. In a weaving loom having a yarn supply arranged externally of the shed and a yarn picking means for drawing weft yarn from said yarn supply into the shed, the improvement which comprises yarn picking means for holding a portion of the yarn in the vicinity of a free end with a first force that is smaller than the tearing strength

of the yarn, and for allowing said yarn to be drawn out therefrom when a second force greater than the first force is applied to the yarn during movement of said picking means, braking means for retaining the yarn during selected periods of the working cycle of the loom, said braking means being disposed between the yarn supply and the picking means and control means for actuating the braking means whereby the braking means allows the yarn held by said picking means to travel through the shed until the picking means reaches a pre-determined position in its path through said shed and then applies said second force to the yarn to draw the yarn out of the picking means, said pre-determined position being selected so that the free end of the yarn, upon being drawn from the picking means, projects out of the shed.

2. The loom of claim 1 in which the weft yarn to be picked is mechanically grasped by the picking means and said braking means includes a closable clip that clamps said yarn to retain it whereby drawing-out of the yarn grasped by the moving picking means is effected.

3. The loom of claim 1 in which said control means causes said braking means to clamp said yarn for the purpose of determining the length of the weft yarn to be picked, when the position of the portion of the yarn held by the moving picking means relative to the shed is such that the free end of the yarn drawn out of the picking means projects a pre-determined length out of the shed.

4. The loom of claim 2 in which said control means causes the clip to open when the yarn picking means is in a selected position on the sley, and the yarn grasped by the picking means is drawn through an aperture in said picking means by a pre-determined amount at the commencement of the travel of said picking means.

5. The loom of claim 2 in which said control means includes members arranged along the path of the picking means for determining passage of the picking means adjacent to said members.

6. The loom of claim 2 which further comprises yarn receiving means for grasping the yarn after it has been picked by the picking means into the shed, said receiving means being arranged laterally of the shed and being positioned during the travel-through of the picking means directly adjacent to the front side of the picking means.

7. The loom of claim 2 which further comprises a drawing-in device located adjacent to the inoperative position of the picking means and a yarn guide for transferring the weft yarn to the drawing-in device, said drawing-in device being adapted to be moved to the yarn guide through an aperture formed in the picking means for the purpose of grasping the weft yarn and in order to draw the grasped yarn through the said aperture whereby said yarn is inserted into said aperture.

8. The loom of claim 7 in which said drawing-in device is secured on the sley of the loom; said device having a means which, due to the movement of the sley, travels along a guide track, said track being shaped to effect movement of the drawing-in device to and from the yarn guide.

9. The loom of claim 7 which further comprises cutting means arranged on the sides of the shed for cutting the picked weft yarn, yarn retaining means for retaining the ends of the cut yarn joined to the yarn supply; the retaining force of the yarn retaining means being smaller than the tearing strength of the yarn whereby said yarn can be drawn out of said yarn retaining means.

10. The loom of claim 9 in which the drawing-in device comprises movable hook means adapted to be moved towards the yarn guide for transferring the yarn available at the yarn guide to the picking means by drawing the yarn from the yarn guide and by drawing the yarn out of the yarn retaining means.

11. The loom of claim 6 in which yarn receiving means arranged for movement on the sley comprises suction means which can be displaced relatively to the sley by said control means into the following positions during the working cycle of the loom:

(a) during the travel of the picking means in the sley, said suction means is displaced by said control means into the immediate vicinity of that side of the picking means which is moved adjacent to the selvedge of the fabric to be woven;

(b) during the beating-up of the yarn by a reed the suction means is displaced by said control means into the immediate vicinity of the reed;

(c) during the cutting-off of the end of the yarn re-received by the picking means, the suction means is displaced by said control means to a position directly before an imaginary extension of the selvedge of the fabric to be woven; and

(d) during the cutting-off of the weft yarn which has been picked from the yarn supply, the suction means is displaced by said control means in front of a yarn retaining means.

12. The loom of claim 11 in which the yarn receiving means is movable in a direction perpendicular with respect to the longitudinal direction of the sley and is guided by a movable linkage which is controlled by a guide cam in response to the working cycle of the loom.

13. The loom of claim 9 in which the yarn retaining means is secured to a fixed machine part at a position which is approximately in line with an imaginary extension of the selvedge of the fabric to be woven and said yarn receiving means is disposed between the fabric and the yarn retaining means.

14. The loom of claim 1 in which the control means includes a control cam that is disposed on a shaft driven by the loom drive and that is so arranged on the periphery of the shaft that, on rotation of the shaft, the control cam produces, together with a member co-operating with it, signals for actuating the braking means.

15. The loom of claim 1 in which said control means includes an electro-magnet which actuates the braking means and signal-generating means combined with the sley for supplying a control signal to effect actuation of the electro-magnet in response to a selected working phase of the loom.

16. The loom of claim 15 in which said control means further comprises electrical circuits which convert the electrical signal fed to them into a binary signal and which in turn convert the binary signal into a current for actuating said electro-magnet.

17. The loom of claim 15 in which said control means also comprises electrical circuits having a variable electrical delay circuit means over which the control signals for effecting actuation of the braking means are conducted.

18. The loom of claim 17 in which said control means also includes ferro-magnetic material fitted in the picking means and magnetic means electrically responsive to the ferro-magnetic material at one point on the path of the moving picking means, the control signal being produced by the electrical response of the said magnetic means.

19. The loom of claim 18 in which said control signal generated in the electrically responsive magnetic means controls the electromagnet to effect closure of the clip of said braking means whereby said yarn is retained.

20. The loom of claim 18 in which the magnetic means electrically varied by the ferro-magnetic material is arranged on one side of the loom along the path of the moving picking means in a position such that the generation of the control signal takes place directly before stopping of the yarn; the electrical delay of said delay circuit being kept small in order that the predetermined length of the drawn-out yarn is substantially independent of variations in the travel time of the picking means.

21. The loom of claim 15 in which the control means comprises cams which are disposed on a shaft driven by the loom drive and which co-operate with an electrical contact whereby the electrical signals produced by actua-

tion of the contact control the electro-magnet to effect opening of the clip of said braking means.

22. The loom of claim 1 in which said control means also actuates the braking means to retain the yarn during the initial picking movement of the yarn into the shed.

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