United States Patent

[11] 3,543,807

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Continuation-in-part of Ser. No. 501,651, Oct. 22, 1965, abandoned.
[45] Patented **Dec. 1, 1970**

[54] **PROCESS FOR THE INSERTION OF THE WEFT IN A LOOM**
15 Claims, 14 Drawing Figs.

[52] **U.S. Cl.** 139/125
[51] **Int. Cl.** D03d
[50] **Field of Search** 139/12, 13, 1, 16, 125, 126, 122, 134

[56] **References Cited**

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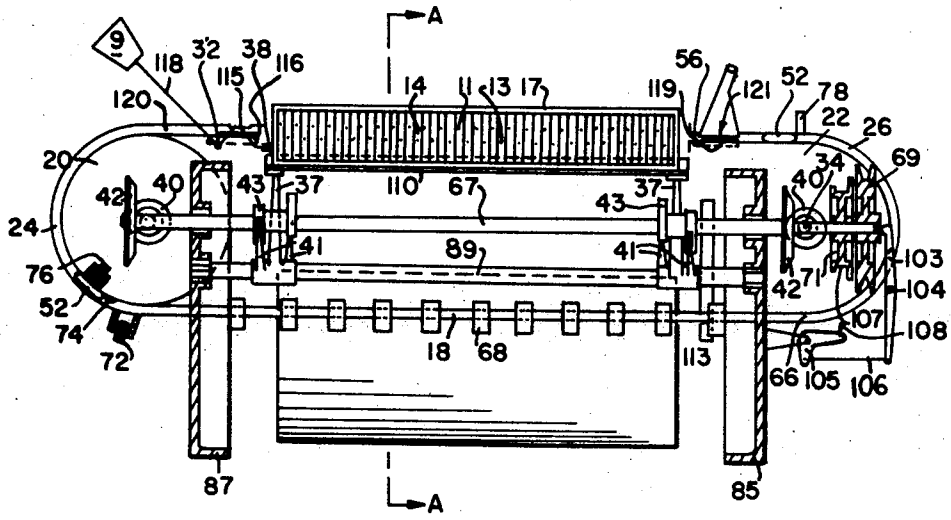
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Primary Examiner—Henry S. Jaudon
Attorney—Sherman and Shalloway

ABSTRACT: The invention provides a method of weaving and an apparatus for weaving wherein a gripper shuttle is presented at a shed entrance at the same point of time each weaving cycle.



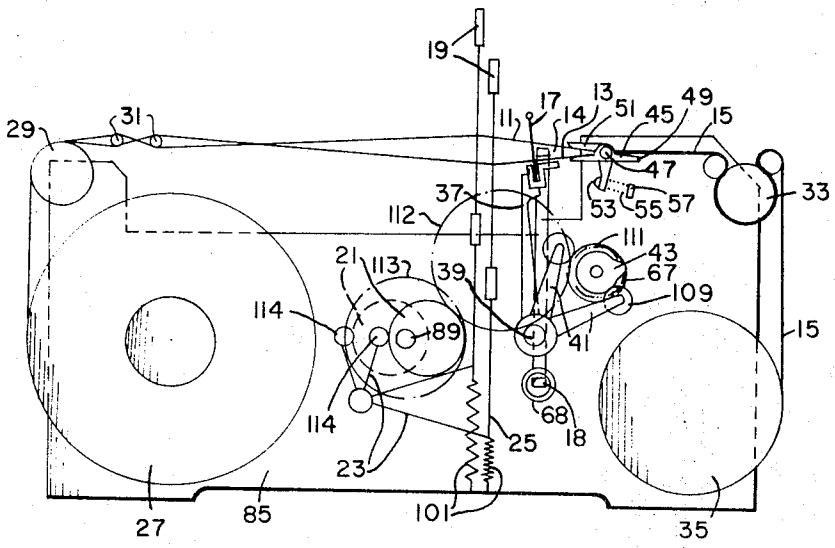


FIG. 1

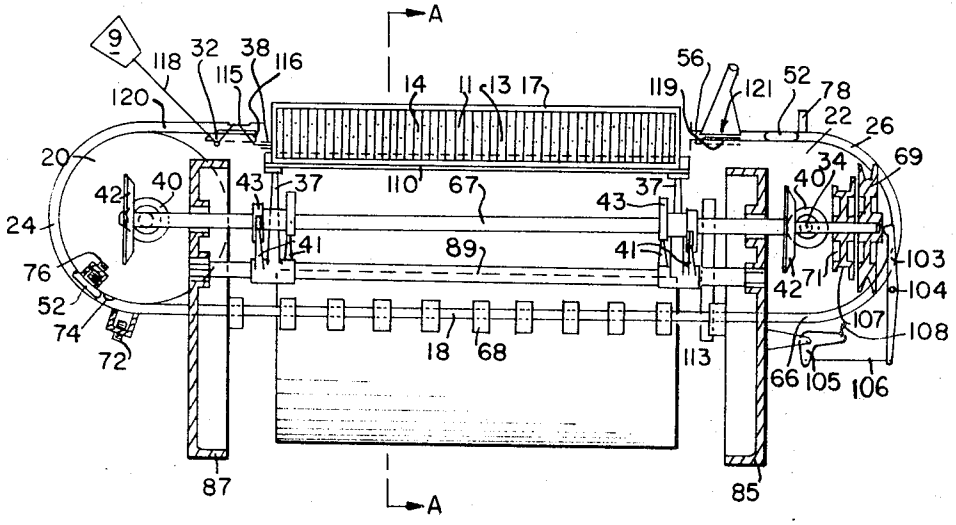


FIG. 2

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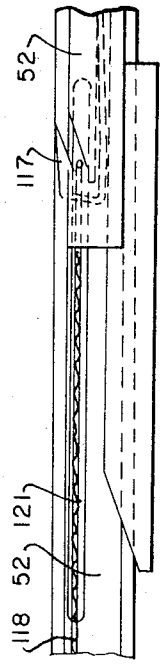


FIG. 5

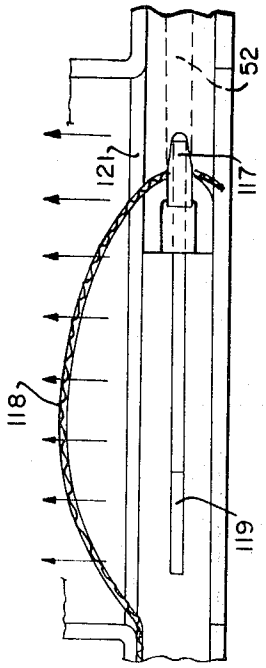


FIG. 6

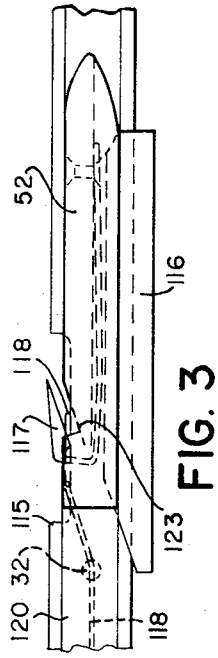


FIG. 3

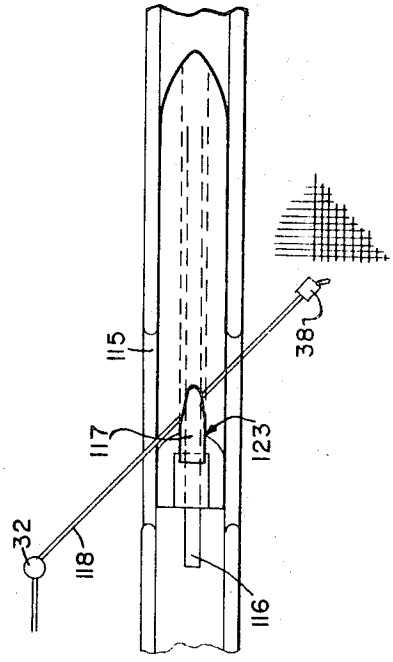


FIG. 4

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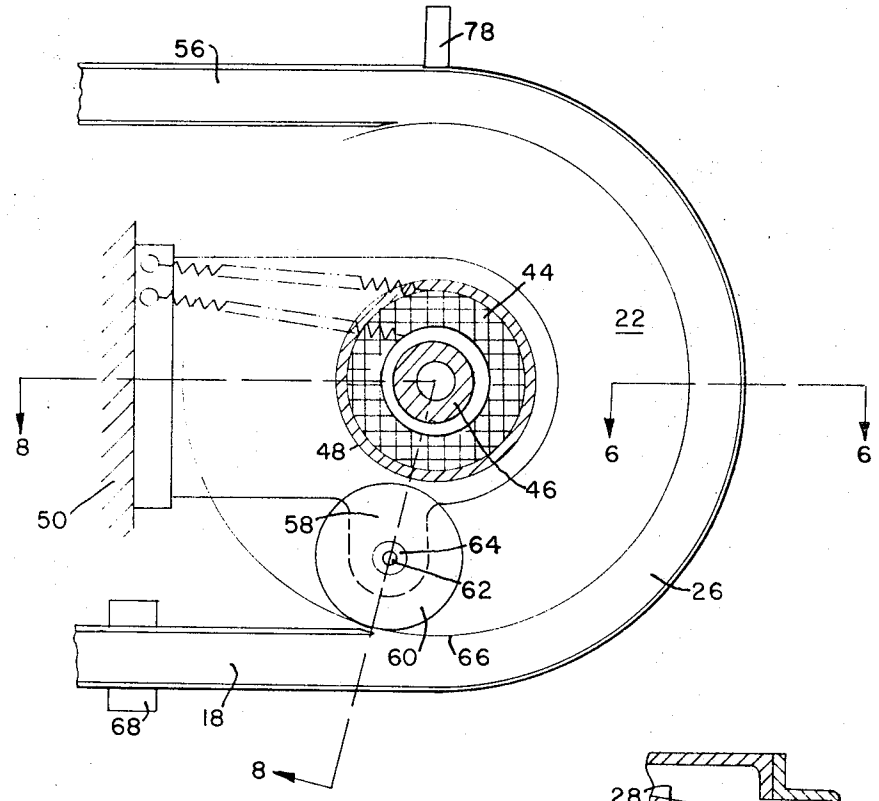


FIG. 7

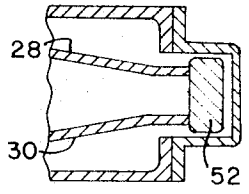


FIG. 9

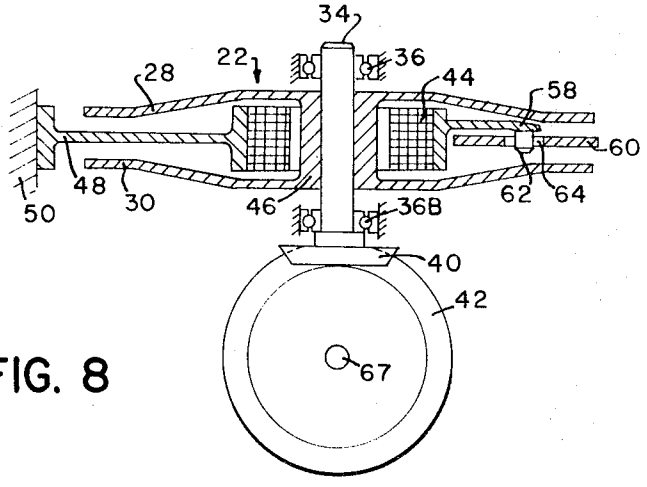


FIG. 8

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FIG. 10

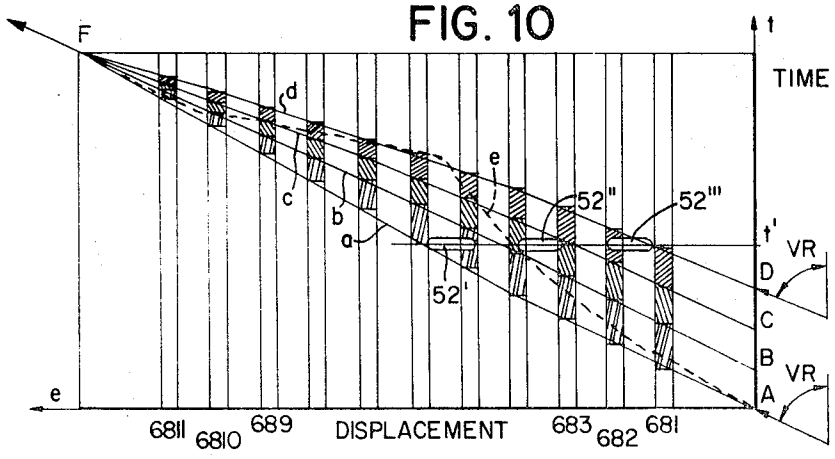
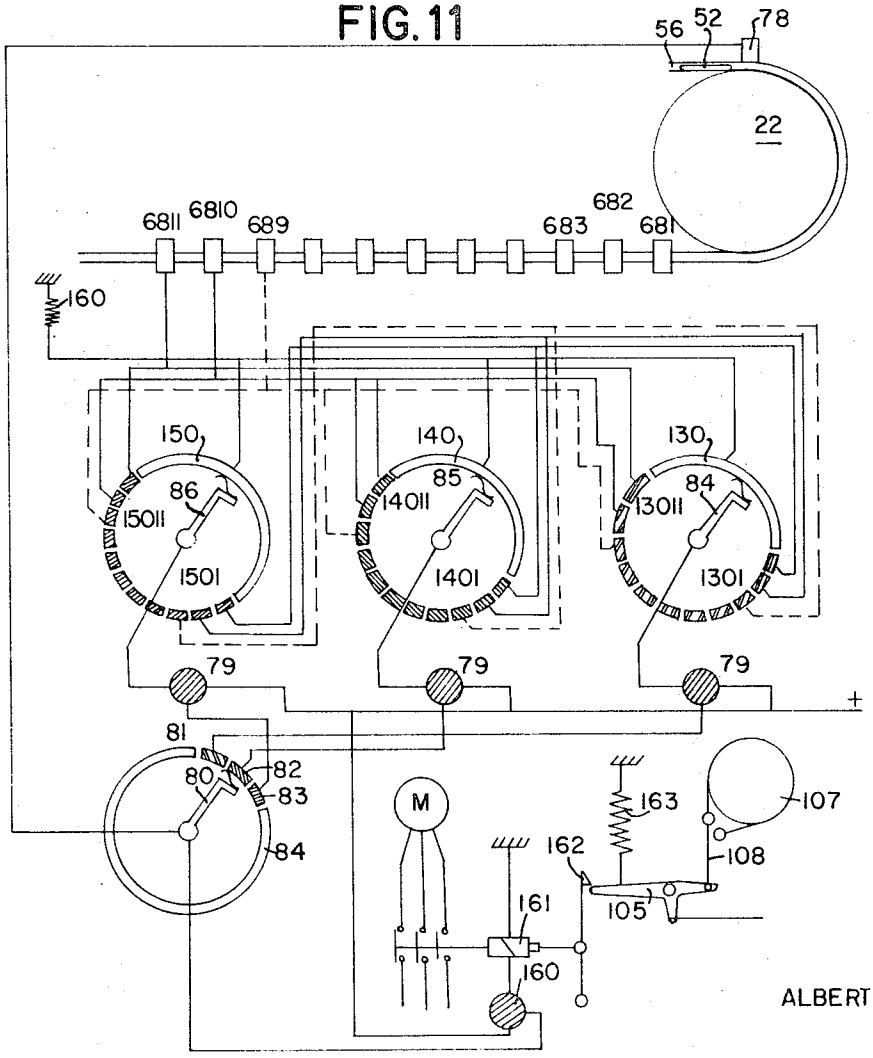


FIG. 11



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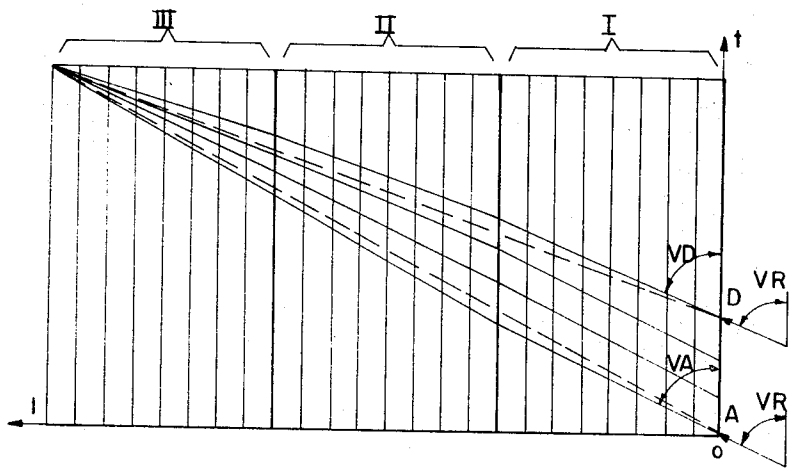


FIG. 12

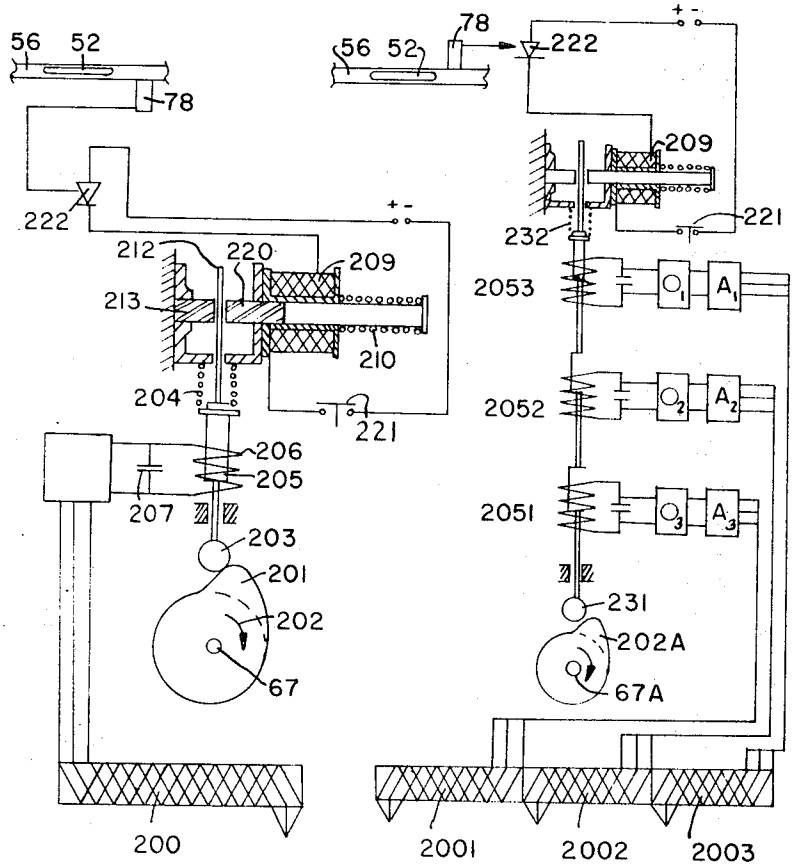


FIG. 13

FIG. 14

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PROCESS FOR THE INSERTION OF THE WEFT IN A LOOM

This application is a continuation-in-part of application Ser. No. 501,651 filed Oct. 22, 1965 now abandoned.

The present invention relates to a process and apparatus for the insertion of a weft yarn in a loom, wherein the shuttle travels without stopping in a closed circuit, picks up the weft yarn offered at the entrance of the shed, and releases it at the exit of the shed, continues its course and comes back to catch a new end of yarn at the entrance of the shed.

The difficulties of such a process lie in the impossibility of controlling the braking or slowing of the shuttle during its free motion in the shed. The braking causes said shuttle to arrive at the exit of the shed at a variable time and speed.

This slowing of the shuttle during each passage in the shed may cumulate in such a manner that its movement will soon be dephased with respect to the cycle of the loom, so that the loom must be stopped and started in renewed phase.

To overcome this disadvantage, the machines used to date stop the shuttle at the shed exit: push the shuttle into a return channel which directs it toward its launching position, and launch it into the shed at a well determined moment in synchronization with the cycle of the loom, while it pulls a weft yarn offered at the entrance. The complete stopping of the shuttle during its cycle causes a loss of time which lessens the time reserved for the passage of the shuttle in the shed. In addition, it requires complicated and precise mechanisms, which are subjected to great stress during the acceleration of the shuttle, and which are subjected to unavoidable wear and tear due to the braking of the shuttle.

To avoid the stopping of the shuttle, some manufacturers proposed to drive the shuttle in the return channel at a constant speed and to separate the mechanism of the loom ("Beater", shed, etc...) from the mechanism used for the movement of the shuttle by using magnetic coupling and brake actuated by the passage of the shuttle upon its exit from the shed. This construction requires an adjustment at each cycle of the loom, which adjustment is difficult due to the inertia of the beater, shed, etc., driving mechanism mass, and therefore requires great efforts to delicately adjust the movement of a great mass.

Other builders have proposed that the shuttle be controlled at a variable speed. There the shuttle driving means are connected to the main shaft of the loom by a speed variator actuated by the passage of the shuttle at its exit from the shed. Since the variation of the speed is effected progressively, it will be also effective on the following shuttle which may not need it.

To reduce the dephasing of the shuttle during its passage through the shed, it has also been proposed to drive it by means of a magnetic field acting in the shed and at the speed changes of the shuttle. The forces exerted by the magnetic field upon the shuttle will be a function of the differences of speed of the shuttle and magnetic field. A delayed shuttle may be accelerated up to its normal speed (i.e., the speed of movement of the magnetic field), but will not be able to catch up the delay in question. Thus, these looms have to resort to the conventional means of stopping the shuttle on the return trip to move it toward the launching point in the shed, in synchronization with the loom.

This invention consists mainly in a electromagnetic system which acts upon the shuttle during its passage into the return channel and controls the movement of said shuttle in such a manner that it reaches its launching point in the shed at a determined moment in the cycle of the loom.

The fact of placing a magnetic system on the return path of the shuttle offers numerous advantages: The solenoids which create the magnetic field acting in the shed of prior art devices must be placed outside of said shed because of the crossing of the warp yarns at each shed change. Said solenoids will therefore cover the warp yarns, making them inaccessible in such a manner that the supervision and retying of the yarns is very difficult.

Moreover, because of the shape of the shed, and its actuation by means of heddles and of the fabric which comes out of it, it will be impossible to create this magnetic field with solenoids placed axially with respect to the direction of the shuttle. The solenoids located outside of the shed will therefore exert an attraction, pressing the warp yarns between the shuttle and the poles, which pressure may be balanced by another magnetic system only with great difficulties. On the other hand, the magnetic field acting on the return path of the shuttle as in this invention may surround the shuttle on all sides and therefore annul any action other than axially acting forces.

To provide weaving apparatus and loom wherein a gripper shuttle arrives at the shed entrance at the same point of time in each weaving cycle.

Means for compensating for friction and other factors which tend to slow a gripper shuttle and cause it to arrive at the shed entrance at varying points of time.

To prevent cumulative slowing of a gripper shuttle in its passage through a series of weaving cycles to a point where the machine must be stopped and the cycle started with the shuttle rephased.

To provide electromagnetic means for varying gripper shuttle speed in accordance with the deceleration of said shuttle during its passage through a shed. To provide combined physical and electromagnetic drive means for a shuttle which serve to present the shuttle at the shed entrance at the same point of time in each weaving cycle.

The invention may best be understood by reference to the drawings wherein like numerals represent like elements and wherein:

FIG. 1 represents a sectional view taken along line AA of FIG. 2;

FIG. 2 represents a sectional view showing a loom embodying the present invention;

FIG. 3 represents a gripper shuttle picking up a thread at its entrance to the shed;

FIG. 4 is a top view of the shuttle of FIG. 3;

FIG. 5 represents the gripper shuttle releasing a thread at its exit from the shed;

FIG. 6 represents a top view of the shuttle of FIG. 5;

FIG. 7 illustrates a driving wheel of the present invention located at the exit to a shed;

FIG. 8 represents a top view of the wheel of FIG. 7;

FIG. 9 represents the structure of the drive wheel carrying a shuttle in a channel;

FIG. 10 illustrates the synchronization diagram of shuttle movement;

FIG. 11 illustrates control means for the electromagnetic means;

FIG. 12 illustrates another synchronization diagram of shuttle movement;

FIG. 13 illustrates control means for the electromagnetic means; and

FIG. 14 illustrates control means for the electromagnetic means;

FIGS. 1 and 2 show the general arrangement of the loom, illustrating the principal mechanisms necessary for the formation of the fabric, FIGS. 3, 4, 5 and 6 show the pick up of the yarn in the insertion box and the freeing of the yarn in the shuttle reception box, and FIGS. 7, 8 and 9 show the detail of a magnetic disk actuating the shuttle, FIGS. 10 and 12 are a time-path diagram showing two examples of synchronization of the shuttle, and FIGS. 11, 13 and 14 show the electrical connections creating the magnetic flow which effects these synchronizations.

In FIG. 1, the warp beam 27 turns around its axle in the bearings affixed on frame 85. Said warp beam unwinds the warp yarns 11 and 13 as the fabric advances by means of known mechanisms which are not shown. The warp yarns 11 and 13 pass on cylinder 29, are separated by divisions 31, and pass in the heddles of frames 19 which spread them apart to form the shed 14. Said shed 14 closes again upon the forma-

tion of the fabric 15. The fabric thus formed passes over the fabric guiding roller 33 which is provided with a rough coating and moves the fabric while tightening the warp yarns by means of known mechanisms (not shown). The fabric is then wound on the fabric beam 35 rotating in bearings affixed on frame 85. Frame 85 also has bearings in which rotates the main shaft 67 on which are keyed the double cams 43 which impart motion to the lay. Conical gears 42 and a braking pulley 71 are keyed on this same shaft. Next to braking pulley 71, driving pulley 69 is mounted on shaft 67 on which it can turn freely. Lever 103, rotating around its fixed axle 104, exerts a pressure between the driving pulley 69 and the braking pulley 71, in such a manner that the machine is driven by a motor and belt (not shown). To start the machine, lever 105 is turned in a counterclockwise direction, which tightens the coupling by means of rod 106 and releases the (brake) strap 107 of the brake pulley 71 through rod 108. To stop the machine, lever 105 is turned in a clockwise direction, which releases coupling 69 and brakes pulley 71. The coupling pulley is provided with a great mass, in such a manner that it acts as a flywheel or steadying force when the loom is in operation.

Double cams 43 act through the intermediary of rollers 109 on the double levers 41 which actuate levers 37 carrying the lay 110 in which is affixed comb 17.

Main shaft 67 also carries affixed thereto a gear 111 which imparts to shaft 89 a rotating motion with a number of turns equal to a simple fraction of the number of turns of the main shaft, through the intermediary of gears 112 and 113. In the example illustrated, shaft turns half as fast as shaft 67. On this shaft 89 are affixed cams 21 which act through the intermediary of rollers 114 on bent levers or bellcranks 23, raising and lowering at the desired rhythm rods 25 and frames 19 which are brought back by springs 101.

The conical gears 42 engage with conical gears 40 affixed on shafts 34 which are perpendicular to the main shaft 67. The two shafts 34 and shaft 67 are located in the same plane. The shuttle revolving drums 20 and 22 are affixed at the extremities of said shafts 34.

The circuit in which shuttles 52 travel is formed by the receiving channel 56 which receives the shuttle 52 when it comes out of the shed, the semicircular channel 26 in which the shuttle is taken by the revolving drum 22, the rectilinear return channel 18 in which the shuttle is accelerated or braked, as explained later, by a magnetic flow created for this purpose, depending upon whether it is late or early, the semicircular channel 24 in which the shuttle, synchronized in channel 18, is pulled by means of a spigot or catch 74 affixed on the revolving drum 20, and finally the rectilinear channel 120 which guides the shuttle in the direction of shed 14 which forms the last portion of said circuit. The three portions 120, 14 and 56 are directed in the same direction and are tangent to the semicircular channels 24 and 26; similarly, channel 18 is tangent to the other extremity of these semicircular channels.

As we can see in the example of FIG. 2, while a shuttle 52 is launched into the shed by the drum 20, a second shuttle has been launched by drum 22 into return channel 18. Upon passing in front of opening 115, a fixed cam 116 opens the clip 117 of the first-mentioned shuttle 52, which hooks the warp yarn 118 (FIGS. 3 and 4). When the shuttle clip arrives at the height of the fabric, yarn 118 has slid to the bottom of the clip, on stop 123, cam 116 closes clip 117 which holds the yarn while fixed clip 38 opens to free the extremity of the yarn 118. Upon reaching the other extremity of the shed, the shuttle is picked up in channel 56 which has, like channel 120, a fixed cam 119 opening clip 117 of the shuttle, thus freeing the extremity of the warp yarn 118 inserted into the shed (FIGS. 5 and 6). To prevent said extremity from jumping back into the shed under the influence of its elasticity, clip 117 of the shuttle is open in such a manner that the yarn extremity coming out of the shed is big enough and is offered to a slit 121 which sucks in said yarn by means of air suction. To limit to the minimum the losses of yarn, the warp yarn is then pulled out in a direction opposite that of its insertion by a specific amount.

This insertion process is the object of copending U.S. Pat. application Ser. No. 501,652 now U.S. Pat. No. 3,378,040.

FIGS. 7 and 8 show an example of drum 22 in a front and sectional view. Drum 22 is formed of two discs 28 and 30 made of ferromagnetic material connected at their center by a hub 46 also made of ferromagnetic material and affixed on a shaft 34 rotating in a fixed portion in which are affixed ball bearings 36A and 36B. Said shaft is rotated by means of a set of conical gears, gear 40 being affixed on shaft 34 and gear 42 being affixed on main shaft 67. Around said hub 46 is mounted a solenoid 44 in which passes an electric current creating a magnetic flux which will be guided in said hub 46 and will spread into discs 28 and 30. If a shuttle 52 comes near the periphery of these discs, as indicated in FIG. 9, it will close the circuit of the magnetic flux and the shuttle will be strongly attracted against these two discs. The intensity of the magnetic flux will be calculated in such a manner that the attraction of the shuttle against the discs will be greater than the centrifugal force to which it will be subjected in the semicircular channel.

To eliminate the necessity of a collector to feed solenoid 44 if said solenoid turned with hub 46, solenoid 44 is affixed on a fixed portion 48 concentrically to hub 46 and with a slight clearance inbetween. The fixed portion 48 will extend between the two discs 28 and 30 to the fixed portion 50 of the machine. The fixed portion 48 will preferably be made of nonmagnetic and electrically insulating material to prevent any loss of energy.

Upon passage of the shuttle from the semicircular channel to the rectilinear channel 18, the removal of the shuttle from said discs 28 and 30 is facilitated by disc 60 located between said discs 28 and 30 and which projects slightly over their periphery. The arrangement must be such that the tangential line passing through the periphery of discs 28, 30 and 60 have the same direction as channel 18. Disc 60 is affixed on fixed axle 62 through the intermediary of ball bearing 64, said axle being integral with an extension 58 of the fixed portion 48.

Disc 60 is preferably made of an electrically conductive material which is nonmagnetic, for example, aluminum; it may turn freely between the opposite sign magnetic poles of the discs 28 and 30. Under the action of the magnetic field in motion with discs 28 and 30, a parasitic electric current is created in the aluminum disc 60 which rotates it at a speed substantially equal to the peripheral speed of discs 28 and 30. When the shuttle will pass the tangential point 66 of the rectilinear channel 18 and of the semicircular channel 26, it will be lifted by disc 60, which immediately decreases the magnetic attraction force.

Shuttle 52 will be launched at the peripheral speed of drum 22 into channel 18, along which is placed a whole series of solenoids 68 creating a magnetic field in said channel. The solenoids will be fed according to a well determined plan, as will be explained later, in such a manner that the shuttles always arrive at the same moment of the loom cycle at the outlet of said channel 18, regardless of the moment of entrance. The variable delay incurred by the shuttle during its free passage through the shed thus will be compensated for, and the shuttle will remain synchronized with the cycle of the loom. Since the shuttle is synchronized when it comes out of channel 18, it will enter into the semicircular channel slightly prior to the driver 74 of drum 20, which is driven by the loom and is therefore synchronized.

To absorb any speed difference between shuttle 52 and drum 20 and prevent the shuttle from hitting driver 74, an electromagnet 76 is mounted on said drum, creating a pressure between disc and shuttle. This pressure may be selected as greater than the centrifugal force exerted upon the shuttle to eliminate any rubbing in the semicircular channel. The excitation of the electromagnet may be interrupted by conventional means to allow the shuttle to leave along the tangent in channel 120, for example, by a switch (not shown) attached to the channel 24 and adapted to be brushed by means 76. Thus, the shuttle will be launched into the shed 14 at a time and speed determined by the spigot 74 of drum 20, therefore absolutely in synchronization with the loom cycle.

To synchronize a shuttle which has been delayed or dephased during its free movement through the shed, solenoids **68** will be fed temporarily according to a predetermined law, which is indicated as an example in FIG. **10**, which illustrates a time-path diagram. The X-axes (abscissae) show the lengths; the distance comprised between 0 and 1 represents the length of channel **18** along which the position of the solenoids **68** has been indicated. The Y-axis (ordinate) indicates the times; the value *t* represents the time at which a synchronized shuttle arrives at the extremity of channel **18**, i.e., arrives on drum **20**. The point F is therefore defined by the time *t* and the length 1 of channel **18**.

The shuttle arrives in channel **18** (on the Y-axis 0) between the times A and D, which represent the extreme limits of dephasing of the shuttle. If the shuttle arrives in channel **18** with a greater dephasing, this cannot be corrected and the machine will have to be stopped. For the smoothest possible operation of the loom, it is necessary to be able to correct shuttle dephasings as large as possible, i.e., the distance between A and D must be as long as possible.

The height of the shaded surface upon the emplacement of each solenoid **681, 682**, etc., represents the time during which each solenoid **68** is excited. The curve *a* and *d* represents the extreme movements between which the shuttle may move. At time *t'*, shuttle **52**, located at **52'**, i.e., in one of the most dephasing positions, will be subjected to an attraction inside the magnetic field attracting it between the two curves *a* and *d*, therefore slowing it down. Similarly, a shuttle located at **52'''**, will be subjected to an attraction attracting it between the two curves *a* and *d*, therefore accelerating it. On the other hand, a shuttle located at **52''** in a substantially homogeneous magnetic field will not be subjected to any change in speed, since the magnetic action is being exerted in both directions.

When the distance between the two curves *a* and *d* is too big, it may happen that a shuttle arrives in the movement correction zone (curve *a* or *d*) with a speed that is too different from that that it should take after correction, in such a manner that the magnetic forces acting then are not sufficient: A shuttle which follows curve *a* at the beginning may be braked by some outside cause (friction) in the return channel; its trajectory will curve in progressively (dotted line *e*) and will reach curve *d* where it will then feel the effect of the magnetic forces; at that time, it is possible that the speed of the shuttle may have been reduced so much that the magnetic forces exerted along curve *d* would not be sufficient to accelerate it and force it to stay inside curves *a* and *d*.

To avoid this disadvantage, a succession of connecting diagrams of solenoids **681 6811** is provided, for the purpose of subdividing the field comprised between the curves *a* and *d* of FIG. **10** into a succession of fields comprised between the curves *a* and *b*, *b* and *c*, *c* and *d*. Only one of these fields will operate at any one time; it will be selected in correspondence with the time of entrance of the shuttle into channel **18**. An example of electric diagram which permits the installation described above is given in FIG. **11**.

As described in FIG. **1**, the shuttle **52** coming out of shed **14** is picked up by the receiving channel **56** and the moment of its passage is determined by a conventional proximity detector **78**. Shuttle **52**, when passing in front of said detector **78**, induces an impulse transmitted to the rotative selector **80** which rotates at the rhythm of the loom, i.e., one turn per filling yarn. A determined amount of time will occur between the moment of detection of the shuttle and the moment when it will be subjected to the influence of the magnetic flux of channel **18**, the speed VR of the shuttle between these two points being determined by the speed of the drum **22** which is driven by the loom. We will return later to this phase difference. The impulse given by the proximity detector **78** will pass through the rotative selector **80** and will be transmitted to one of the thyratrons (amplifiers) **79** according to the moment of passage of the shuttle, i.e., according to contact **81, 82** or **83** in front of which is the rotative selector **80** at that time. This impulse triggers said thyratron which then releases the current through one of the rotative selectors **84, 85, 86** which is coupled thereto. At the moment of the triggering of the thyratron, the rotative selectors are in contact with a wide key or contact **130, 140** and **150** through which passes the current of the corresponding thyratron through a resistance **160**, which serves to limit the current to the minimum necessary to keep the thyratron in charge. At that moment, nothing yet will happen in the solenoids **68** of channel **18**; with the loom and the shuttle continuing their movement, the rotative selectors will continue to rotate until they come in contact with keys or contacts **1301, 1401** or **1501**, which transmit the current of the thyratron into the first solenoid **681**. The time between the detection of the passage of the shuttle and the actuating of solenoid **681** will be exactly the time necessary for shuttle **52** to pass from detector **78** to the first solenoid **681** of channel **18**, it will be given by the angle comprised between the keys **81** and **1301**, which is the same as between the keys **82** and **1401** and as between **83** and **1501**, as can be seen in FIG. **11**. Upon rotating, one of the rotative selectors **84** or **85** or **86** will feed successively the solenoid **1301 + 13011** or **1401 + 14011** or **1501 + 15011**. The keys or contacts **13011, 14011** and **15011** will feed the last solenoid approximately at the same time, since the shuttle is to arrive at the extremity of the channel at the same moment. Thus the solenoids will be fed successively as the rotative selector advances. To obtain an excitation of the solenoid **68** in the time according to the diagram of FIG. **10**, in which several solenoids are excited at the same time, each one having different ignition and extinction times, the keys or contacts shall be placed in a cylinder, these keys being staggered or shifted axially so as to be able to give an independent contact at the same time as another key. This can be illustrated easily with three diagrams according to FIG. **10** wherein cylindrical surfaces are spread out flat, the lengths being in the direction of the axis of said cylinder, the times being curved. Each of the cylinders of rotative selectors **84, 85** and **86** will receive one of these diagrams, after metallization of the following shaded surfaces: For selector **84** the shaded surfaces comprised between curves *a* and *b*, i.e., field ABF; for selector **85**, the shaded surfaces comprised between curves *b* and *c*, i.e., field BCF; for selector **86**, the shaded surfaces comprised between the curves *c* and *d*, i.e., field CDF. The contact brush of these rotative selectors will act upon a generator of these cylinders and will transmit to each solenoid **68**, during the time corresponding to the diagram of FIG. **10**, the current necessary for the creation of the desired magnetic flux.

It is clear that to increase the regularity of the travel of the shuttle in the return channel, it is possible to increase the number of solenoids. It is also possible to place current amplifiers between the rotary selectors **84, 85** and **86** and the solenoids **86**; it would also be possible to subdivide the time of action into more than three zones, as shown in the example given.

If the shuttle arrives at **78** after selector **89** has passed over contact **83**, the shuttle will arrive too late to be taken in a magnetic field controlled by selectors **84, 85** or **86**; an additional contact **84A** is therefore provided, which will send an impulse in the thyratron **160** which passes the current of the + source through a solenoid **161**, which will trigger the click or catch **162**, thus freeing lever **105** which, under the action of spring **163**, will block the band brake **107** through the intermediary of rod **108**. Solenoid **161** will, through the same movement triggering click **162**, trigger the supply current of the motor M which drives the loom.

Another example of electromagnetic control synchronization of the shuttle during its return trip is shown in FIGS. **12** and **13**. Solenoids **200** are placed much closer together than in the preceding example, and they may even touch each other. Their division will have a very determined value which, with the frequency of an alternating current, will produce a magnetic field moving in the direction of the axis of channel **18** at a determined speed. This system will act as an electric motor which would have been opened and developed following a straight line. For a determined distribution of the solenoids,

the speed of displacement of the flux may be changed by changing the frequency of the supply current.

To be able to synchronize a shuttle which has been dephased during its passage in the shed, it will have to be, according to FIG. 12, taken in channel 18 toward point F, whatever the moment at which the shuttle enters said channel. It may, for example, have a constant speed between A and F or D and F, which will imply a different feeding frequency in the case where the shuttle arrives at A or at D. (The speed is illustrated in a time-path diagram by the slope of the curve which represents the movement).

The diagram of FIG. 13 indicates, as an example, a means to adapt the frequency of the supply current of solenoids 200 in function of the time of passage of the shuttle. A cam 201 is actuated by the main shaft 67 and rotates in a clockwise direction (arrow 202). The little wheel or follower 203 is applied on said cam 201 by means of spring 204. When cam 201 is in the position illustrated in the drawing, little wheel 203 comes down the curve and the ferrous mass 205 penetrates in choke coil 206, changing its impedance and consequently the frequency of the oscillating circuit formed by choke coil 206 and condenser 207. The form of cam 201 will be determined in such a manner that each position of the cam corresponds, in the oscillating circuit, to the frequency giving to the magnetic flux of solenoids 200 the speed determined in the diagram of FIG. 12. When the shuttle passes over detector 78, it produces in the latter a pulse which results in the triggering of the thyratron 222 permitting the feeding of solenoid 209. The hub 210 of said solenoid 209 will then be attracted by the magnetic flux and will hold part 212 between a brake 220 and a fixed portion 213. The ferrous mass 205 will then be fixed in the position that it has at the moment of the triggering produced by detector 78, and the little wheel will stay in its position without following the cam. The frequency of the oscillating system 206—207 will therefore remain constant and will keep the desired value until solenoid 209 is triggered by the loom by means of contact 221 through the intermediary of a cam (not shown). Contact 221 can be closed immediately, the current being then disconnected by the thyraton 222. Little wheel 204 will fall back upon cam 201 and the cycle will be repeated upon passage of the next shuttle. Through this means, the shuttle may arrive at any moment between the limit values A and D, the speed of the magnetic flux will be comprised between VA and VD and will be directed toward point F of the diagram of FIG. 12.

Since the shuttle arrives in channel 18 always with the same speed VR which is the speed of drum 22, it is possible that the difference between the shuttle entering speed and the speed of the corresponding magnetic flux, VD for example, be too great to be driven without too much sliding. It is then possible to divide the unit formed by solenoids 200 of channel 18 and the linear motor, into three sectors I, II and III which will each be fed by a determined frequency corresponding to the frequencies necessary to obtain the speeds indicated in full lines on the diagram of FIG. 12. The control of these frequencies will be effected as in the preceding example and is shown in FIG. 14.

On rod 230 actuated by follower 231 contacting cam 202A on shaft 67A and spring 232, three ferrous masses 2051, 2052 and 2053 each influence its own oscillating system 01, 02 and 03 controlling the three groups of solenoids 2001, 2002 and 2003. The form of these ferrous masses will be selected in such a manner that for the same displacement, the variations of the choke coil correspond to the frequency variations prescribed by the diagram of FIG. 12. As in the preceding example, amplifiers A1, A2 and A3 are provided between the oscillating circuit and the solenoids 2001, 2002 and 2003. Each amplifier will supply three currents having the same frequency, but dephased with respect to each other by one-third of a phase.

The various parts described may be combined. For example, it is possible to replace drum 20 which drives the shuttle with a spigot, by a drum similar to drum 22 in which only the magnetic attraction actuates the shuttle.

Of course, the invention is not to be interpreted as limited to herein described specific embodiments but may include equivalent means and obvious modifications.

I claim:

1. A method of weaving comprising the steps of moving a gripper shuttle without a stop in a closed circuit, said circuit including passage through a shed having an entrance and an exit, causing said shuttle to pick up a weft yarn at the shed entrance with a constant speed, causing said shuttle to release the yarn adjacent the shed exit, and continuously repeating the steps of picking up and releasing the yarn while controlling the shuttle motion by a successive and programed energization of a plurality of electromagnetic means in spaced relation within the return channel so that the shuttle always reaches the shed entrance at the same point of time in each weaving cycle.

2. In a weaving loom comprising a shed having an entrance and an exit, a rectilinear receiving channel ending adjacent the shed exit, a first semicircular channel, a rectilinear return channel, a second semicircular channel, a rectilinear guide channel adjacent the shed entrance, gripper shuttle means, constituted by two gripper shuttles, one being projected into the shed while the other returns to the position for projecting and means to project these gripper shuttles at a constant speed in one direction into the shed wherein they traverse same under the influence of inertia, the improvement comprising: a detection means indicating the variable delay of each shuttle at the exit of the shed, first electromagnetic means adjacent to the rectilinear return channel and exercising directly a magnetic force and limited to the shuttle that has been detected previously, without any action of the projecting means and control means for said first electromagnetic means.

3. The apparatus of claim 2 wherein the means to project said gripper shuttles comprises a drive wheel adjacent one semicircular channel, said drive wheel having magnetic means to hold a shuttle against the wheel while said shuttle is in said semicircular channel.

4. The apparatus of claim 2 wherein the means to project said gripper shuttles comprises a drive wheel adjacent one semicircular channel having a second electromagnetic means to hold a shuttle against the wheel during a portion of the shuttle's travel through said channel, means to activate the second electromagnetic means, and a pusher element attached to said wheel adjacent said second electromagnetic means.

5. The apparatus of claim 3 wherein the drive wheel comprises two discs having said magnetic member therebetween.

6. The apparatus of claim 5 wherein the wheel further comprises a fixed arm extending between the two discs and supporting a hub having an annular coil therearound, said coil being spaced between the hub and the discs and said coil serving to create the magnetic flux through said discs.

7. The apparatus of claim 5 wherein the wheel further comprises an arm extending between the discs and supporting a second smaller, freely rotatable wheel, said second wheel being made of nonmagnetic material and extending beyond the periphery of said discs.

8. The apparatus of claim 2 wherein the first electromagnetic means comprises first coils and last coils and wherein the control means comprises means to excite the first coils for a longer time than the last coils.

9. The apparatus of claim 2 wherein the control means comprises switch means adjacent the return channel to select one of a plurality of distributors for exciting the first electromagnetic means.

10. The combination of a curved shuttle channel, a drive wheel disposed adjacent said channel on the inner side thereof, said wheel having a central hub and two spaced discs forming a hollow chamber therein, an annular magnetic member disposed in spaced relationship around said hub and between said discs, a substantially flat arm extending outwardly of said discs, a fixed support secured to said arm, a lug extending outwardly from said arm with a pin thereon, said lug and pin located within said chamber, a small wheel of electrically conductive material mounted for free rotation on said

pin, said wheel having a portion extending between said discs and beyond the peripheral edges of said discs, said channel having an entrance and an exit, said wheel being positioned adjacent said exit.

11. The combination of a curved shuttle channel in which a drive wheel member is disposed adjacent to said channel and wherein said drive wheel comprises two spaced discs having an annular magnetic member therebetween, said curved shuttle channel having an entrance and an exit, said exit being adjacent to a straight channel portion, said straight channel portion being composed of a guide wound with electrical wire which is connected with a power source for creating magnetic field to influence the shuttle therein, said straight channel portion being connected with a second curved shuttle channel in which a second drive wheel member is disposed, said second drive wheel member comprising a single disc having on its periphery a pusher member and a magnetic member disposed adjacent the pusher member, said second curved shuttle channel having an entrance adjacent the straight portion channel and an exit adjacent to a shed.

12. In a method of weaving in which a gripper shuttle is picked in the shed at a determined constant speed, said shuttle circulating without any stop in a closed circuit, said circuit including passage through a shed having an entrance and an exit, the improvement which comprises causing said shuttle to pick up a weft yarn at the shed entrance with a constant speed, causing said shuttle to release the yarn adjacent the shed exit, and continuously repeating the steps of picking up and releasing the yarn while controlling the shuttle motion by a successive and programed energization of a plurality of electromagnetic means in spaced relation within the return channel so that the shuttle always reaches the shed entrance at the same point of time in each weaving cycle.

13. In a weaving loom comprising a beating means for the beating of the inserted weft in the fabric and frames to form a shed having an entrance and an exit, a return channel connecting this exit and this entrance forming with the shed a closed circuit, gripper shuttle means and means to move said gripper shuttle means without any stop in the closed circuit, the beating means and the frames forming the shed being actuated in rhythm with the main shaft of the loom, the improvement comprising first electromagnetic means adjacent said return channel acting on the shuttle in conjunction with a successive and programed energization of a plurality of electromagnetic means in spaced relation within the return channel to vary the speed of this shuttle within the return channel so that the shuttle arrives at the shed entrance at the same time in relation with the motion of the main shaft.

14. A shuttle carrier means of a weaving loom with a gripper shuttle with the weft thread from a fixed package located outside the shed and in which the shuttle circulates in a closed continuous path of travel, one part of same being formed by the shed and electromagnetic means disposed alongside another portion of said path of travel which are energized in a successive and programed manner for controlling the movement of the shuttle passing therealong.

15. A shuttle carrier means of claim 14 comprising a closed continuous path of travel including at least two straight portion channels and two curved portion channels adjacent to the opposite ends of said straight portions, one of said straight portions forming the shed and electromagnetic means disposed alongside the other straight portion channel which are energized in a successive and programed manner for controlling the movement of the shuttle during its way.