

July 29, 1958

HANS-JOACHIM DIETZSCH ET AL

2,845,093

METHOD OF AND MEANS FOR WEAVING

Filed July 20, 1953

7 Sheets-Sheet 1

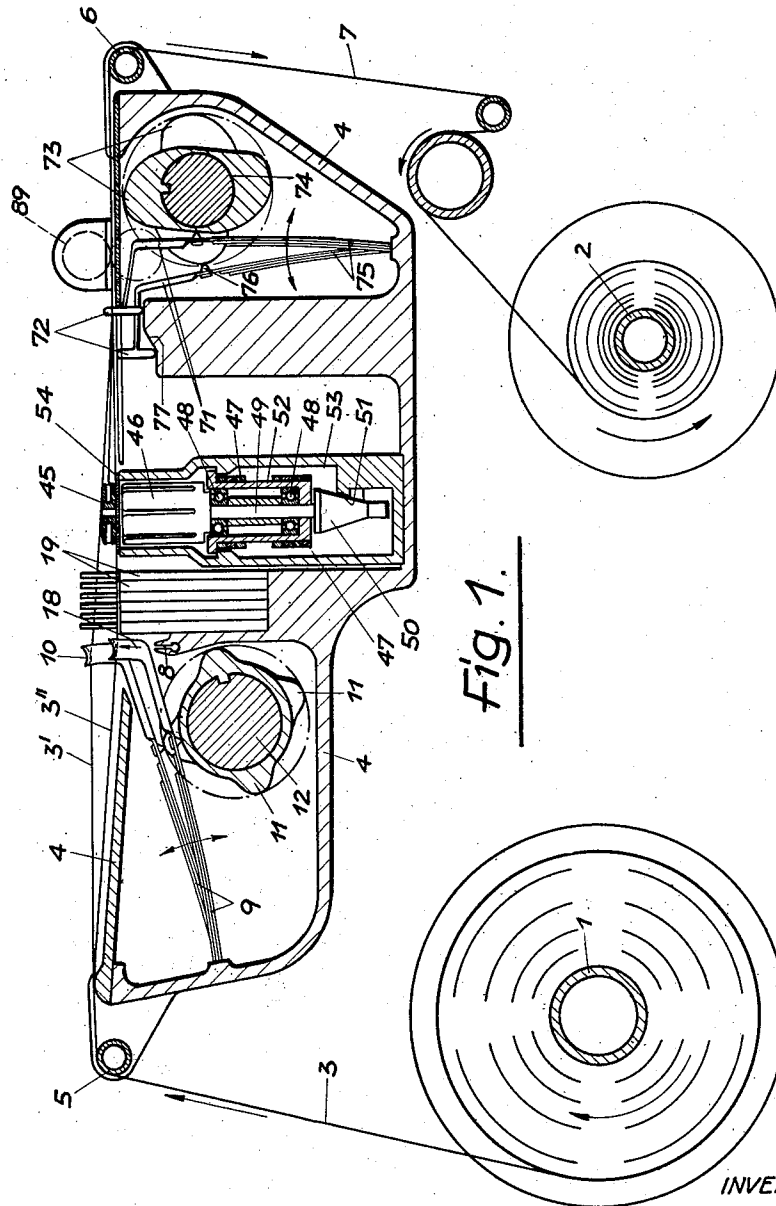


Fig. 1.

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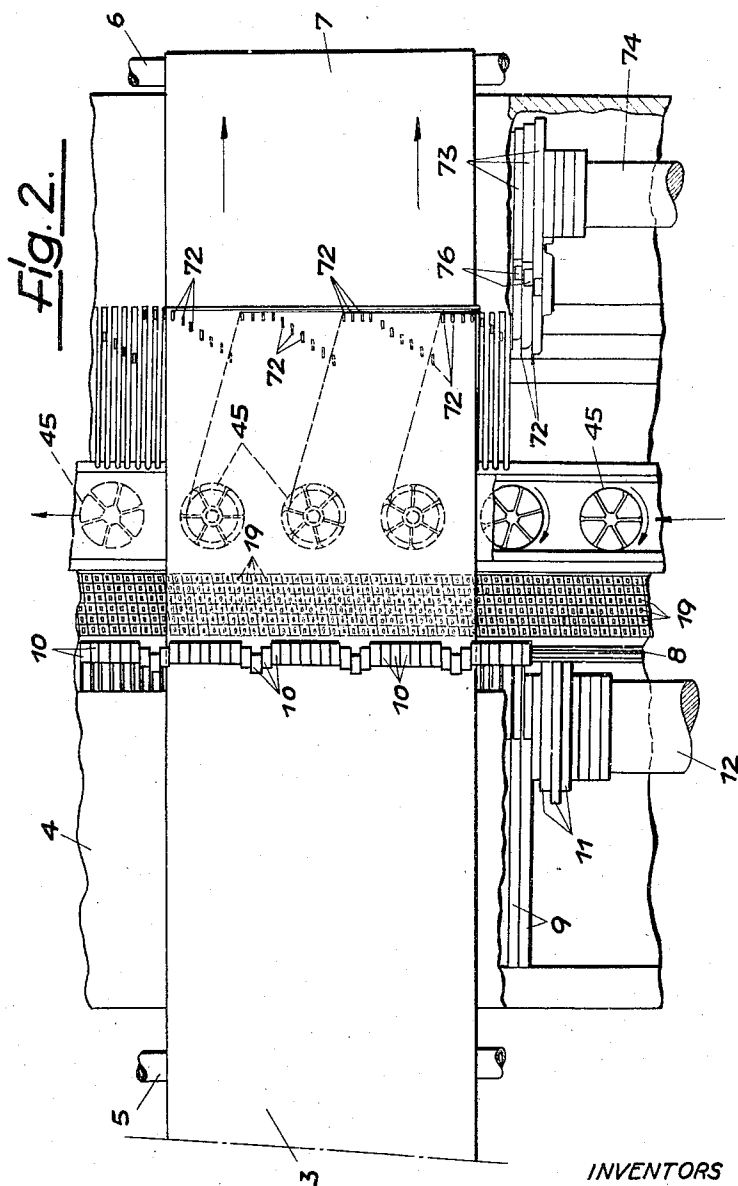
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7 Sheets-Sheet 2



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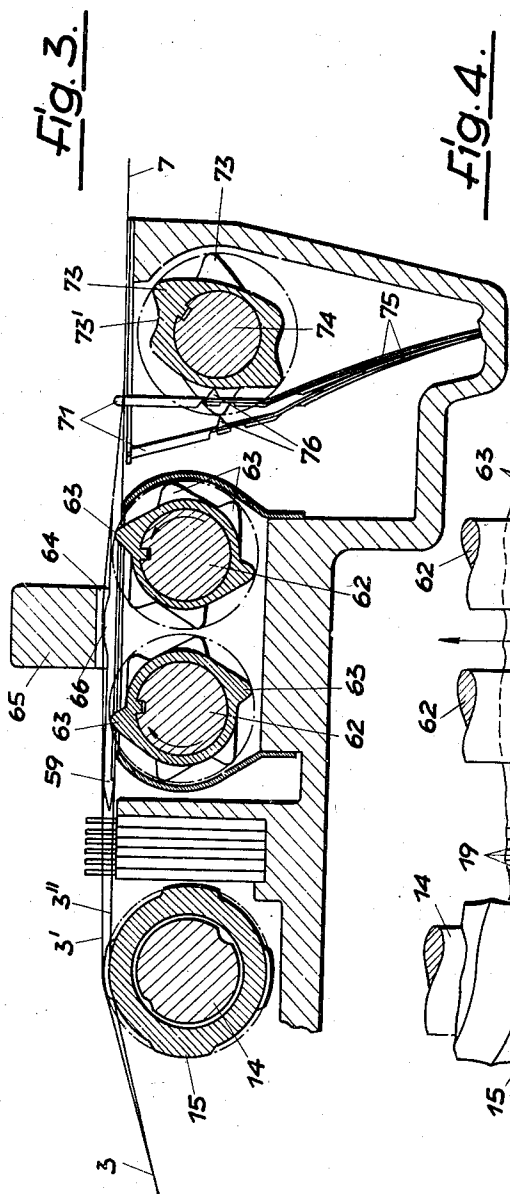
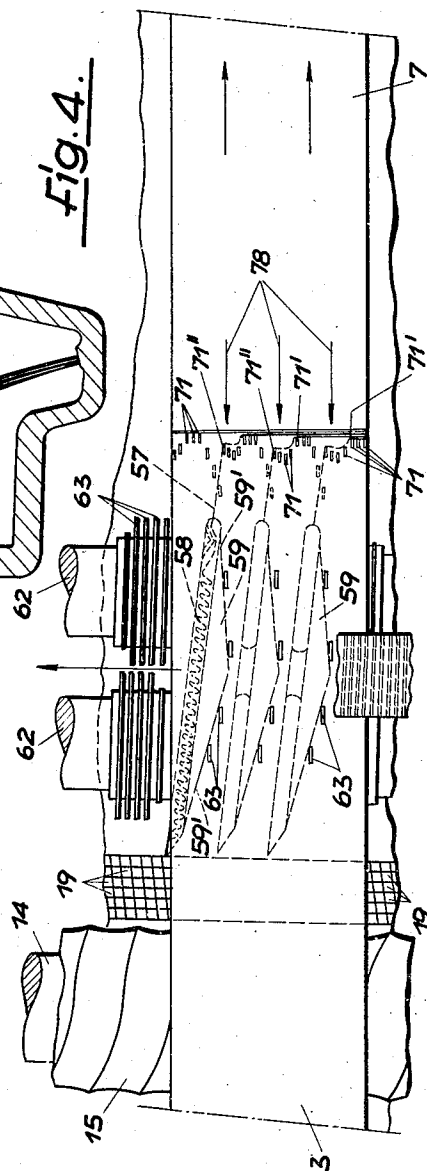
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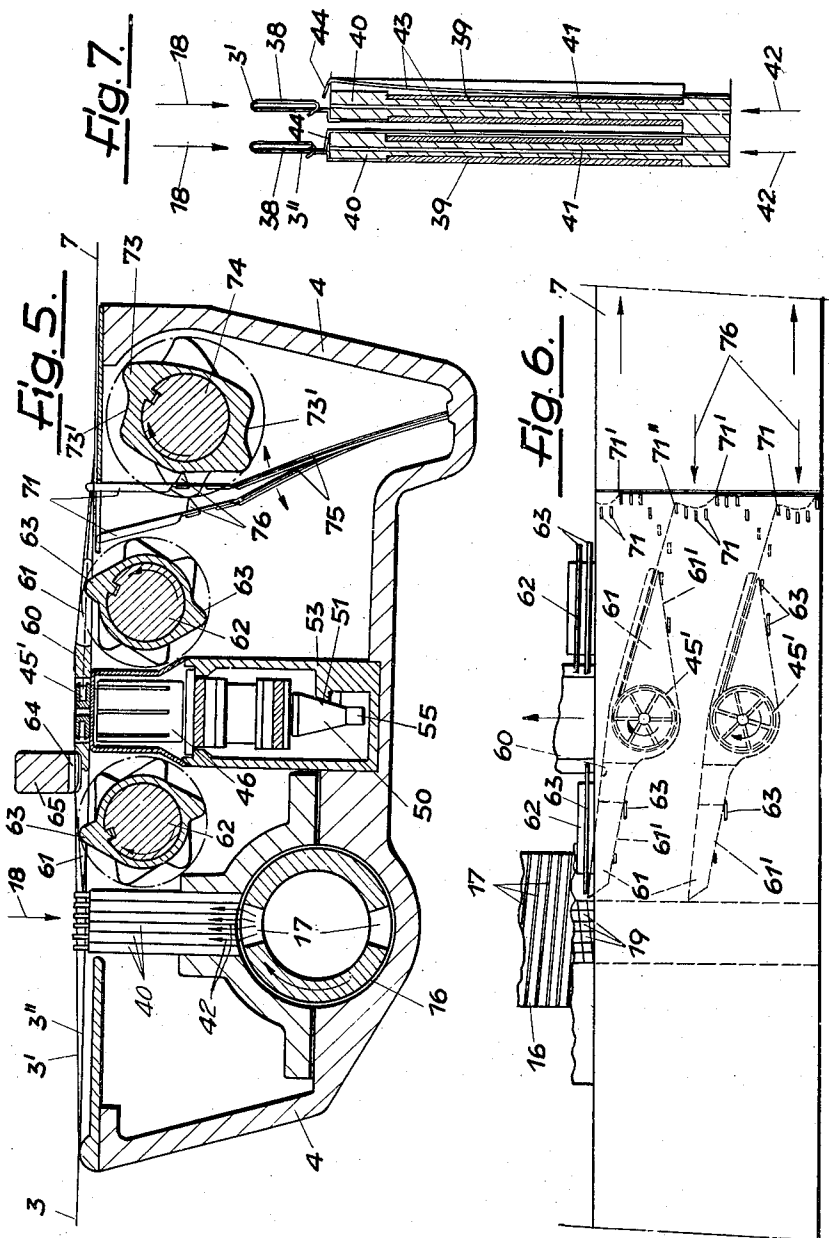
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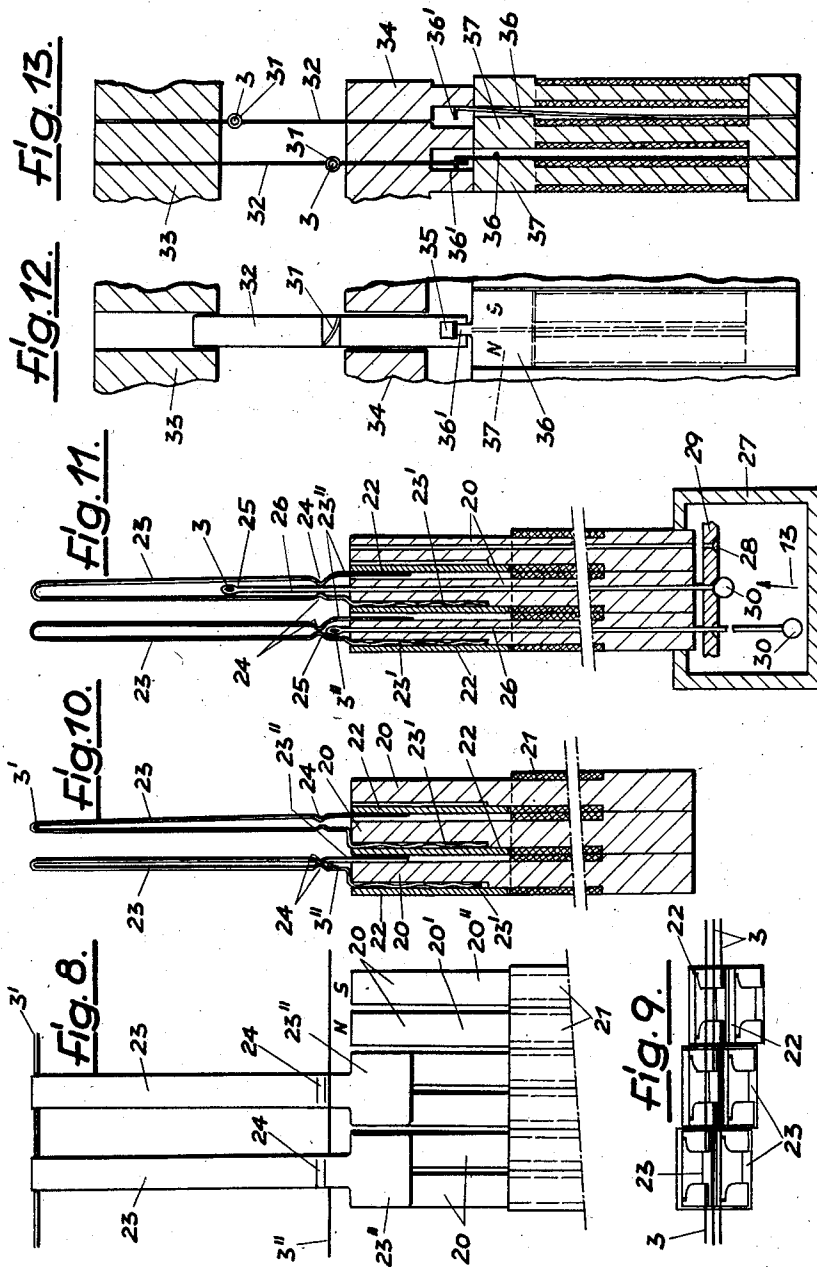
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Fig. 14.

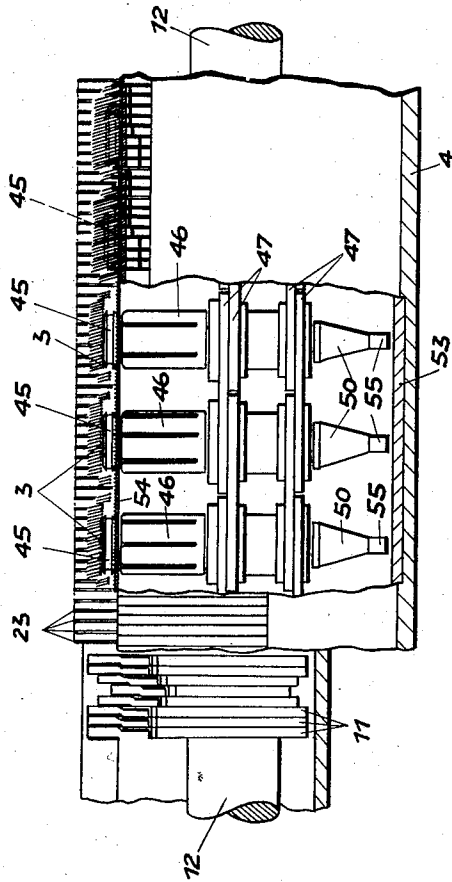


Fig. 15.

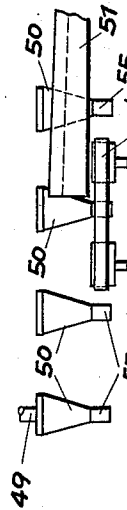
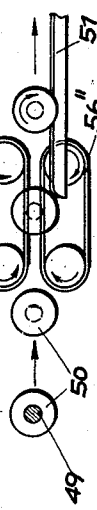


Fig. 16.



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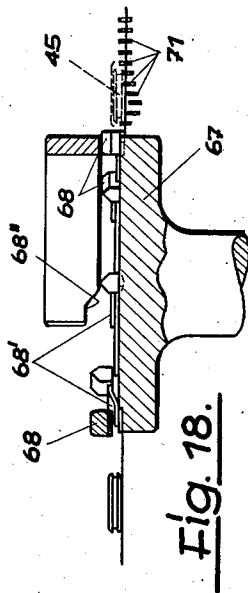


Fig. 18.

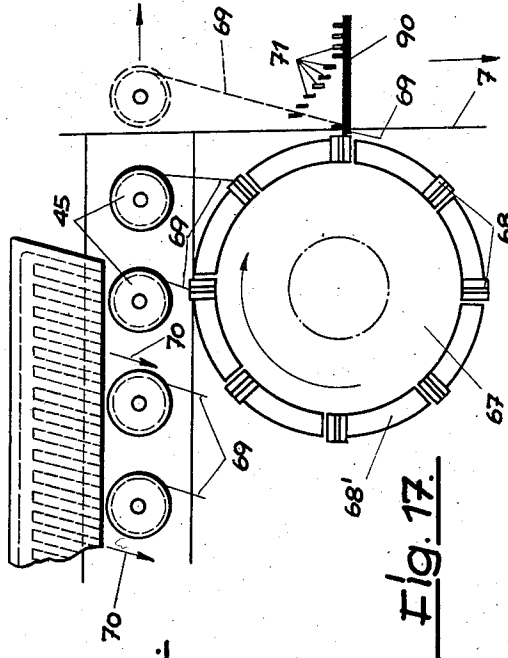


Fig. 17.

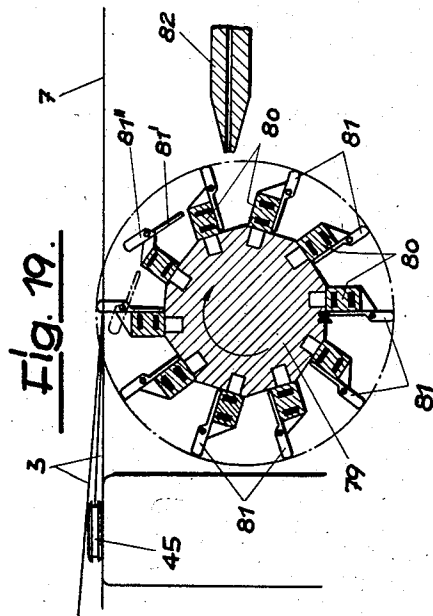


Fig. 19.

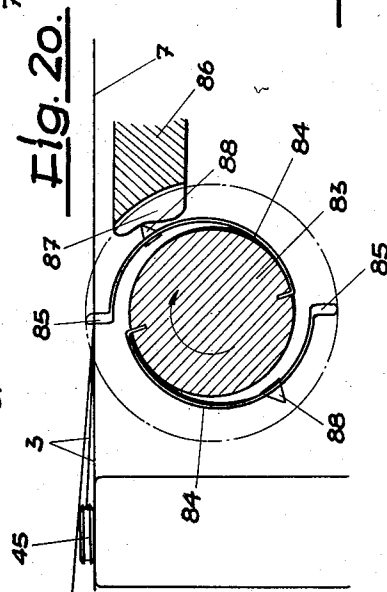


Fig. 20.

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2,845,093

METHOD OF AND MEANS FOR WEAVING

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Application July 20, 1953, Serial No. 369,098

Claims priority, application Germany July 22, 1952

19 Claims. (Cl. 139—12)

The present invention relates to a method of and a device for weaving in which consecutive waves are formed in the warp threads which waves travel transversely to the warp threads, a shuttle running in each ventral segment of the waves.

Two modifications of the aforesaid method are known: one performed in a circular loom and one performed in a plain loom. In the conventional plain weaving method, the cords guiding the warp threads are longitudinally moved and magnetically controlled at their ends to produce transverse waves in the longitudinal direction of the warp threads, the phases of the waves being so shifted with respect to the individual warp threads that waves are formed in the picking direction, the shuttles moving in the ventral segments of the waves, a plurality of shuttles being simultaneously distributed over the width of the warp.

With this method the amount of fabric produced per time unit could, no doubt, be increased relatively to the conventional plain loom in which only one shuttle travels through the shed, at a time. It is not known, however, how the individual warp threads can be actuated by a magnetic control of the cords for forming the shed, particularly according to patterns.

The fundamental idea of the present invention is to move the warp threads perpendicularly to the plane of the warp between two end positions by means of two forces one of which is stronger than the other and acts intermittently in one direction, and the other force, which is weaker, acts continuously in the other direction. The warp threads are either temporarily arrested against the action of the continuous force in one position by means of an arresting device for forming a shed, if desired outside of the rhythm of movement caused by the aforesaid two forces, or are arrested in the other position by means of the continuous force by additional inactivation of the intermittently acting force.

In order to increase output, the effect of the intermittently acting force and the effect of the arresting or locking devices or the additional inactivation of the intermittent force with respect to juxtapositioned warp threads or groups of adjacent warp threads are shifted as to their phases, so that a dense sequence of shuttles is made possible. Due to this phase-shifting of the forces controlling the warp threads, waves are produced which travel in the direction of the pick, forming consecutive sheds through which the shuttles travel one after the other, the shed changing continuously between the shuttles. Beating up of the individual weft threads inserted by the shuttles is also effected in the form of travelling waves immediately following the passage of each shuttle, by means of controlled devices.

The apparatus for performing the method includes a housing whose top is partly open and over which the warp threads coming from the warp beam are guided. Means for moving the warp threads into their positions, for arresting the warp threads in one of the end positions, for guiding the shuttles between the warp threads, and

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means for beating up the warp threads are provided within the housing. The fabric beam is arranged behind the housing.

Details of the method and of the device for performing it will be understood from the following description of embodiments of the invention when read in connection with the accompanying drawing in which:

Fig. 1 is a longitudinal sectional view of a first modification of a weaving device according to the invention;

Fig. 2 is a plan view of the device shown in Fig. 1;

Fig. 3 is a longitudinal sectional view of a second modification of a weaving device;

Fig. 4 is a plan view of the device shown in Fig. 3;

Fig. 5 is a longitudinal sectional view of a third modification of a weaving device;

Fig. 6 is a plan view of Fig. 5;

Fig. 7 is a part sectional view of an arresting device;

Figs. 8, 9 and 10 are views of a modified arresting device seen in the direction of the pick, in plan view, and in the direction of the warp, respectively;

Fig. 11 is a part sectional view of another modification of an arresting device;

Fig. 12 is a view in the direction of the pick and

Fig. 13 is a view in the direction of the movement of the warp of a further modification of an arresting device;

Fig. 14 shows a transverse section through a part of a weaving device;

Fig. 15 is a side elevation and Fig. 16 is a plan of a device for revolving the shuttles before they enter the shed;

Fig. 17 is a plan and Fig. 18 is a side elevation of a device for holding the ends of the weft threads;

Figs. 19 and 20 are sectional views of different modifications of beat-up devices.

Like parts are designated by like numerals in different figures of the drawing.

The warp threads which are arranged side by side, as usual, move in their longitudinal direction according to the speed of production of the fabric in the conventional manner. The shed may be formed in different ways.

Fundamentally, the shed is formed by two forces which move the individual warp threads perpendicularly to the plane of the warp between two end positions, one force being greater and acting intermittently in one direction and another force being weaker and acting continuously in the other direction. The stronger, intermittently acting force may be produced by mechanical means, as shown in Figs. 1 to 4.

Fig. 1 shows the warp beam 1 and the cloth beam 2. The warp threads 3 are guided over the weaving device which includes a housing or the like 4 and a feed roller 5 for the warp threads 3 and a delivery roller 6 for the cloth 7. In Fig. 2, which is a plan view of Fig. 1, only a small portion of the warp threads 3 and of the cloth 7 is shown so that the parts arranged below the warp threads and the cloth can be seen.

In this embodiment of the invention, the warp threads 3 are moved into an upper end position 3' by means of compressed air emerging from a slot 8 extending over the whole width of the housing 4. The stream of compressed air constitutes the aforementioned force which acts continuously in one direction and which is weaker than the intermittent force. The latter is produced by means of swinging levers or tensioned springs or by a combination of such elements as shown in Figs. 1 and 2. Springs 9 have one end fixed in the wall of housing 4 and have a head piece 10 at their free end. There is a head piece 10 for each warp thread or group of warp threads, the head piece being so shaped that when it moves downwards, it takes along the respective warp thread from the position 3' to the position 3''.

The head pieces 10 which have a tendency to move

downwards because of the springs 9, are moved by means of cams 11 on a rotating shaft 12 which extends over the whole width of the warp, the number of cams 11 corresponding to the number of springs 9 and head pieces 10 and the cams being staggered corresponding to the shifting of the wave phases to form the shed. The shaft 12 and the head pieces 10 are arranged in the direction of the pick, i. e. not at a right angle to the warp threads 3 but in a direction deviating somewhat in the direction of the longitudinal movement of the warp threads.

In the modification shown in Figs. 3 and 4, the mechanical means, which produce the force, which acts intermittently on the warp threads 3, are formed by a shaft 14 which is parallel to the direction of the pick and whose surface has a projection or crest following a screw line. The crests are preferably formed in the manner of a multithread screw. In this modification the warp threads are moved into the upper end position 3' by means of the mechanical intermittent force in contradistinction to the modification shown in Figs. 1 and 2 in which the warp threads are moved into the upper position by the continuously acting compressed air. Whereas in the modification according to Figs. 1 and 2 the warp threads are moved to their lower end or base position 3'' by mechanical means, namely the end pieces 10, they are moved into the lower position 3'' by their own tension in the modification according to Figs. 3 and 4, the threads being so guided that the tensioned threads rest on the screw 15 and tend to enter the grooves of the screw whenever this is possible, due to the position of the screw.

In the modification shown in Figs. 5 and 6, a rotating cylinder 16 is supported in the housing 4, the surface of the cylinder being provided with a plurality of slots 17 which follow a screw line. Through these slots, compressed air is blown upwardly in a manner which will be described later, moving the threads into their upper position 3'. The air admitted through the rotating cylinder 16 forms the greater, intermittently acting force, which is counteracted by a continuously acting weaker stream of compressed air, indicated in Fig. 5 by an arrow 18, which stream tends to move all warp threads into the lower end or base position 3''.

The two forces, namely the stronger force acting intermittently in one direction and the weaker force acting continuously in the other direction, move the warp threads 3 in a definite rhythm to produce waves travelling in the direction of the pick and producing a shed. Special provisions are made to produce bindings in any desired manner. These provisions include arresting or locking devices 19 of which there is one for each warp thread and which are staggered in groups in the direction of movement of the warp so that they can be placed over the width of the warp. Each arresting device has an eye through which a warp thread 3 extends, and an electromagnetically controlled locking element, whose actuation prevents return of the warp thread to its initial position by the continuously acting force.

Figs. 8, 9 and 10 illustrate an arresting device 19 which comprises an electromagnet 20 having windings 21 and two parallel legs 20' and 20'' forming a north pole and a south pole. The individual magnets which are arranged in staggered relation are separated from each other by insulating layers 22. Loops 23 made of wire or foil have one leg 23' clamped between the magnets 20 and the layers 22, the other leg 23'' serving as armature of the respective magnet, a clearance being provided between the magnet 20 and the neighboring layer 22. The loops 23 are resilient and either so formed that the legs 23'' tend to move away from the respective magnets 20 or are so formed that the legs 23' are adjacent to the magnets 20 but can be moved from the magnets by the warp threads 3 if the magnets are not excited so that there is no arresting. Each leg of one loop has a deflection 24 close to the magnet, the deflections being so formed that they abut against each other

or that they are at least so close to each other that no warp thread can pass through, if the legs 23'' are attracted by the magnets. In Figs. 8 and 10 one warp thread 3'' is in its lower position wherefrom upward movement is prevented by the deflections 24, the warp thread 3' being in the upper position.

A second modification of an arresting device 19 is shown in Fig. 11. This is different from that shown in Figs. 8 to 10 in that the warp threads 3 are not directly guided in the loops 23 but indirectly, namely in eyes 25 of needles 26 which are longitudinally movable in the respective loops 23. The needles 26 have a lower end extending into a channel 27. The latter contains a carrier 29 having bores 28, which carry along groups of needles 26 provided with heads 30 in one direction, namely toward the lower end or base position of the warp threads 3. The intermittently acting force is produced in this modification by the carriers 29 which may be actuated, for example, in the same manner as the end pieces 10 in Fig. 1. The continuously acting force is produced by a compressed air stream flowing in the direction of arrow 13 in Fig. 11 and acting on the heads 30 against the action of the carriers 29 and emerging from bores provided in the magnets for the needles 26.

Figs. 12 and 13 show a further modification of an arresting device 19 in which the warp threads 3 are guided in eyes 31 of laminae 32 which are moved up and down, in one direction by the greater intermittently acting force and in the other direction by the continuously acting force, so that the warp threads are moved into their upper and lower positions. The laminae are guided in members 33 and 34 positioned above, respectively, below the plane of the warp. The lower ends of the laminae are provided with apertures 35 receiving the hooked ends 36' of plate springs 36 which form the armature of magnets 37, if the laminae are in their lower positions and if the magnets are energized. The plate springs are so formed that the hooked ends 36' are away from the apertures 35 when the magnets are not energized, see right side of Fig. 13.

The modification of the arresting devices 19 shown in Figs. 8 to 13 are suitable for the modification of the weaving device according to Figs. 1 to 4.

Fig. 7 shows two arresting devices which are suitable for a weaving apparatus according to Figs. 5 and 6. The devices comprise longitudinal eyes or loops 38 which are individually connected with an electromagnet 40 provided with windings 39. The legs of the magnet 40 are provided with a bore 41 through which air is blown in the direction of the arrows 42. This air constitutes the intermittently acting force which moves the warp threads 3 extending through the loops 38 against the action of a continuous air stream 18 into the upper or elevated position 3', unless the air stream flowing through bores 41 is interrupted, in which case the warp threads are held in their lower or base position 3'' by the continuous air stream. Interruption of the air stream 42 is effected by plate springs 43 forming the armatures of the magnets 40 and having at their upper ends a hook 44 or the like adapted to cover the upper mouth of the bore 41. The compressed air flowing through the bores 41 and intermittently acting on the warp threads 3 is controlled by the slots 17 of the rotating cylinder 16 (Figs. 5 and 6).

The magnets of the arresting devices may be controlled, for example, by one or more commutators. The weft threads 3 are introduced by shuttles moving at constant speed in the picking direction, each shuttle carrying a weft thread whose length exceeds the width of the warp. There are always as many shuttles distributed over the width of the warp as sheds are formed so that the number of weft threads picked per time unit corresponds to the number of formed sheds. For this reason the distance between the end positions of the warp threads is made as small as possible. This distance may be, for example, only little greater than the height of the shuttle. The

speed of the latter and that of the waves of the warp threads is so chosen, that the shuttle is always closely enveloped by the warp threads. The distance between the end positions of the warp threads may also be made smaller than the height of the shuttle. In this case the warp threads are spread apart by a wedge shaped portion forming the front part of the shuttle or running ahead of the shuttle as an independent part.

Figures 1, 2 and 14 to 16 show a first modification of shuttles and their actuation. The shuttles 45, which consist merely of a spool, pass between the warp threads 3 which are in their extreme positions 3' and 3''. The shuttles are driven by magnets 46 which move below the plane of the warp threads in the direction of the pick, the shuttles receiving a driving pulse not only in the direction of the pick, but also a rotating pulse by means of a drive which is independent of the weft thread for unwinding the latter at a uniform speed.

An endless chain 47 is provided for this purpose which is guided in a horizontal plane and one run of which is positioned parallel to the picking path. The chain 47 is provided with axles 49 which are perpendicular to the plane of the chain and which are arranged as far apart as the shuttles. The axles are borne in ball bearings 48, each axle carrying a magnet 46. The axles 49 and the magnets 46 are rotated. The latter have an even number of poles, the respective shuttles 45 are also constructed as magnets with the same number of poles or they are provided with portions which can be magnetized, so that the shuttle 45 moving inside the shed is rotated by the magnets 46 which are outside of the shed.

The axles 49 are provided with a friction cone 50 at their ends opposite to the magnets 46 and distal of the warp, the cone running along a rail 51 which is parallel to the direction of the pick and whose elevation is such that the circumferential speed of the part of the cone 50 which contacts the rail 51 corresponds to the speed of unwinding of the weft thread from the shuttle which should be proportional to the speed of translation of the shuttle. This unwinding speed is preferably somewhat greater than the speed of the movement of the shuttles in the direction of the pick so that a greater length of weft thread is worked than is theoretically required, because the actually needed weft thread length is different for different bindings and also depends on the material of which the weft thread is made. Undesired tensions would occur in some cases, if the weft thread is too short.

The axles 49 are so supported in the bores of the bolts 52 of the chain 47, that they are resiliently pressed against the rail 51.

The chain 47, which supports the magnets 46 causing rotation of the shuttles 45, runs in a channel 53 in which also the rail 51 is positioned. The channel 53 may be covered by a foil 54 which can be penetrated by the magnetic lines of force and which forms a flat support for the warp threads 3 which are in the lower end position, the shuttles 45 running on these threads. The foil 54 may be provided with protuberances or ridges arranged between the warp threads 3, the shuttles sliding on the protuberances. In order to reduce friction between the shuttles 45 and the warp threads 3, the shuttles may be vibrated in the direction of their rotation axis, the vibrations being preferably produced by sound waves.

The axles 49 are preferably provided with a cylindrical portion 55 below the cone 50 by means of which portion the rotation of the axles 49 at the entry side of the shuttles can be brought to the speed needed for the beginning of the pick. As seen in Figs. 15 and 16, endless belts 56 engage the cylindrical portions 55 at the entry side of the shuttles 45 which belts rotate the cylindrical portions 55 by means of friction. The runs of different belts 56, which face each other and which are adjacent to the cylindrical portions 55, move from the moment in which they grip a cylindrical portion 55,

both runs running at first in the same direction and at the same speed so that the cylindrical part is, at first, moved forward without being rotated. Thereupon the belt 56' which is distal of the rail 51 moves faster whereas the belt 56'' which is proximal of the rail 51 moves more slowly. This causes rotation of the cylindrical part 55 so that, when the friction cone 50 runs on the rail 51, the angular velocity of the part 55 is the velocity which is imparted to the cone 50 by the movement of the chain 47 when the cone runs onto the rail.

Figs. 3 to 6 show shuttles which consist of a part carrying the thread and a support for this part. In the modification according to Figs. 3 and 4, the thread supporting part or thread carrier is formed by a tubule 58 through which the weft thread 57 extends, the thread carrier of the modification according to Figs. 5 and 6 being formed by a spool 45'.

In the modification according to Figs. 3 and 4, the support 59 for the tube 58 consists of a flat body of approximately triangular configuration. The support 60 for the spool 45' in the modification according to Figs. 5 and 6 is provided with fins 61 extending transversely to the direction of movement of the shuttle.

The supports 59 and 60 have inclined surfaces 59' and 61', respectively, at their rear side.

For moving the supports 59 and 60 two parallel shafts 62 rotating preferably in opposite directions and extending in the direction of the pick are provided. Cam like laminae 63 extending between the warp threads which are in their lower position 3'' are arranged along a screw line on the surfaces of the shafts, the laminae engaging the inclined surfaces 59' or 61' thereby advancing the shuttle 58, 59 or 45', 60, respectively, in the direction of the pick.

The carrier parts or fins 61 which extend in a direction opposite to the longitudinal movement of the warp threads 3 are wedge shaped so that they spread the shed which is defined by the distance between the end positions of the warp threads which distance is smaller than the height of the shuttle.

Plates 64 may be provided on a support 65 for guiding the shuttle, as shown in Figs. 3 and 5, the plates being arranged in the direction of the pick between the warp threads 3 at a distance corresponding to the distance between two or more warp threads. The plates engage guide portions 66 provided on the shuttles in the picking direction. As shown in Fig. 3, the shuttles 58, 59 may have protuberances which run in corresponding recesses of the laminae 64, or, as shown in Figs. 5 and 6, the shuttle carrier 60 may have a recess receiving the plates.

Since, as previously mentioned, each shuttle 45 carries only so much thread as corresponds amply to the width of the warp, each weft thread must be held at one end when the shuttle enters the shuttle run until the weft thread is so much bound that it cannot be pulled along by the shuttle. For this purpose a preferably rotating device 67 (Figs. 17 and 18) is provided at the point of entry of the shuttle 45, which device grips the weft thread ends 69 by means of grippers 68, placing the thread ends onto the previously inserted weft thread 90 and releasing the ends after a portion of the gripped thread has been beaten up. The weft thread ends 69 are preferably blown into the grippers 68 by compressed air acting in the direction of the arrows 70. The grippers 68 may be arranged on springs 68' which lift the grippers above the plane of the device 67. When the weft thread end 69 has arrived between the surface of the device 67 and a gripper 68, it is pressed against the surface of the device 67 by a curved guide 68'' and firmly held.

After the pick, the shuttles are provided with a new weft thread. This makes it possible to produce patterns by using different weft threads.

The weft threads are beaten up by tongues 71 or laminae shaped parts 72 provided at the ends of such

tongues which are arranged between the path of the shuttles and the fabric and whose ends are reciprocated between the warp threads 3. They are so positioned so that, in one extreme position, they are outside of the plane of the warp thread. The tongues rest resiliently on cams 73 provided on a rotating shaft 74. The number of cams 73 corresponds to the number of tongues 71 and the cams 73 are staggered relatively to each other according to the shift of the phase of the travelling wave. The tongues 71 are connected with springs 75 fast on the housing 4. The springs 75 are provided with follower pins 76 or the like which rest on the cams 73.

If laminae shaped end portions 72 are provided on the tongues 71 as shown in Fig. 1, these parts may rest on a curved surface 77 which extends over the width of the warp parallel to the direction of the pick and which rises in the direction of the movement of the warp towards the fabric 7. The cams 73 may be so formed that the tongues 71 actuated thereby perform one or a plurality of strokes at each revolution of the cams.

Since, as mentioned supra, the length of the weft thread carried by a spool 45 is somewhat greater than the width of the warp and in order to properly accommodate this excess length, the cams 73 include recesses 73' (Figs. 3 and 5) so that, as seen in Figs. 4 and 6, the tongues 71 are so guided relatively to each other when they approach the fabric 7 that between a tongue 71' which is in the beat-up position and a tongue 71'' pulling a weft thread from a shuttle, a curve is formed which is concave toward the fabric and against which the weft thread is pressed by compressed air flowing in the direction of the arrows 78.

Beating up of the weft threads may also be effected by means of a rotating cylinder 79 (Fig. 19) which is arranged in the zone between the shuttle path and the fabric and whose axis is parallel to the direction of the pick, electromagnets 80 being mounted on the cylinder in rows following generatrices of the cylinder. Pivoted to the magnets 80 are flaps 81 formed as two-arm levers which flaps enter between the warp threads 3 and are arranged along screw lines on the cylinder 79, the arm 81' of the flaps forming the armature of the magnets and the other arm 81'' forming a beat-up element corresponding to a tongue 71 of the modification according to Figs. 1 to 4. The armatures 81' are pulled from the electromagnets by the beat-up operation so that the arm 81'', which is the beat-up element, can slip beneath the fabric 7 after completion of the beat-up operation. The armatures 81' are returned to the magnets 80 by means of compressed air which may be admitted, for example, through a nozzle 82. In the aforescribed arrangement the force of the beat-up action can be regulated by controlling the magnet current.

Fig. 20 illustrates a further modification of a beat-up device. A rotating cylinder 83, whose axis is in the direction of the pick, is arranged between the shuttle path and the fabric 7, tongues 85 being mounted on the cylinder by means of springs 84 spirally extending around the cylinder 83.

The tongues 85 are so staggered that, seen from above, they are located as the members 72 in Fig. 2 or the members 71 in Figs. 4 and 6. As shown in Fig. 20, the arrangement may be so that two tongues 85 enter consecutively between two warp threads. To afford slipping of the tongues 85 beneath the fabric 7 after completion of the beat-up, laminae 87 are provided on a carrier element 86 along which laminae slide follower pins 88 which press the tongues 85 beneath the fabric after completion of the beat. The tongues 85 pass between the laminae 87.

The housing 4 is preferably so constructed that a stream of compressed air can be introduced therein which acts from the interior of the housing towards the outside thereof, sweeping over all parts, which are arranged below the plane of the warp, from the elements forming

the shed to the beat-up device, for removing dust and other finely divided foreign matter.

Since no selvage is formed with the weaving method according to the invention, one or more warp threads made of thermoplastic material are preferably provided at the borders of the warp which are welded within the fabric with the weft threads, for example by means of heated rollers 89 shown in Fig. 1.

While specific embodiments of the invention have been shown, it will be apparent to those skilled in the art that various changes, modifications, substitutions, additions and omissions may be made therein without departing from the spirit of the invention as set forth in the appended claims.

What is claimed is:

1. A method for weaving, comprising the steps of moving the warp threads perpendicularly to the plane of the warp between a first end position and a second end position by means of two forces, one of said forces being relatively strong and intermittently acting on all warp threads, tending to move same into the second end position, the other force being relatively weak and acting permanently in the direction toward the first end position, of locking selected warp threads in the second end position by a third force for forming a shed, of shifting the phase of the movements of juxtapositioned warp threads for forming waves travelling in the direction of the pick, of moving shuttles in the ventral segments of the waves, and of beating up the weft threads according to the progress of the travelling waves.

2. A method as defined in claim 1 in which the permanently acting force is produced by tensioning the warp threads.

3. A method as defined in claim 1 in which the permanently acting force is produced by a current of compressed air.

4. A weaving apparatus comprising, in combination, two beams supporting a warp to form a plane, first means for producing a force permanently acting on the individual warp threads and tending to hold the warp threads in a first end position, second means for producing a force intermittently acting on the individual warp threads for swinging the warp threads from the first end position perpendicularly to the plane of the warp into a second end position, means for shifting said forces with respect to the warp threads for producing an undulating movement of the warp and forming waves in the warp travelling in the direction of the pick, locking means for temporarily locking selected warp threads in the second end position, a plurality of shuttles, each shuttle having a weft thread wound thereon, means for moving said shuttles in the ventral segments of the waves formed by the warp threads, and means for progressively beating-up the weft threads as they are unwound from the shuttles.

5. A weaving apparatus according to claim 4 in which said locking means individually include a longitudinal loop for receiving a warp thread, and an electromagnetically controlled lock means in said loop for holding the warp thread extending through the loop in a predetermined position in the loop.

6. A weaving apparatus according to claim 4 in which said locking means are arranged in groups, the locking means of each group being staggered in the direction of movement of the warp.

7. A weaving apparatus according to claim 4 in which said locking means individually include a controllable electromagnet, a hair pin shaped loop member for receiving a warp thread, said loop member having one leg connected with said electromagnet, the other leg of said loop member forming the armature of the electromagnet, the legs of said loop member individually having an inwardly bent portion, said bent portions abutting against each other when said electromagnet is energized for preventing movement of the warp thread extending through the ear past said bent portions.

8. A weaving apparatus according to claim 4 in which said locking means individually include a lamina movable perpendicularly to the plane of the warp, said lamina having an eye for receiving a warp thread, a controllable electromagnet, an armature in the form of a plate spring cooperative with said electromagnet and having a hook, and said lamina having an aperture adapted to receive the hook of said armature when said electromagnet is operated, for locking said lamina in a predetermined position.

9. A weaving apparatus according to claim 4 in which said locking means are electromagnetically controlled.

10. A weaving apparatus according to claim 4, comprising a rotatable screw extending below the plane of the warp in the direction of the pick and supporting the warp threads for producing the intermittently acting force.

11. A weaving apparatus according to claim 4, comprising swingable levers individually engaging individual warp threads for producing the intermittently acting force moving the warp threads into the second end position.

12. A weaving apparatus according to claim 11, comprising a rotatable shaft disposed below the plane of the warp and extending in the direction of the pick, a plurality of cams on said shaft, each cam engaging one of said levers, said cams being placed on said shaft in staggered relation for shifting actuation of said levers for producing the undulating movement of the warp.

13. A weaving apparatus comprising two beams supporting a warp in a plane, means for producing a force permanently acting on the individual warp threads, means for producing a force intermittently acting on the warp threads for swinging the warp threads perpendicularly to the plane of the warp, means for shifting the intermittently acting force for producing an undulating movement of the warp for forming waves in the warp travelling in the direction of the pick, locking means for temporarily locking the warp threads in one of their end positions, a plurality of shuttles, means for moving said shuttles in the ventral segments of the waves formed by the warp threads, and means for progressively beating-up the weft threads; said shuttles consisting of a thread carrier and a support for the latter, fins connected with said support and extending transversely to the direction of movement of the shuttles, the fins projecting against the direction of movement of the warp being wedge shaped for spreading the shed formed by the warp threads, said fins having inclined surfaces at the trailing side, the weaving apparatus comprising two rotatable shafts disposed substantially parallel to the picking path, cam shaped laminae projecting from the surface of said shafts and being consecutively arranged along a screw line, said laminae extending between the lower warp threads and slidably engaging said inclined surfaces for moving said shuttles in the picking direction.

14. A weaving apparatus according to claim 13, said thread carrier consisting of a tubule.

15. A weaving apparatus according to claim 13, comprising stationary guide means extending between the upper warp threads of the shed and being positioned along the picking path, said shuttles having portions mating said stationary guide means for guidance by said guide means.

16. A weaving apparatus comprising two beams supporting a warp in a plane, means for producing a force permanently acting on the individual warp threads, means

for producing a force intermittently acting on the threads for swinging the warp threads perpendicularly to the plane of the warp, means for shifting the intermittently acting force for producing an undulating movement of the warp for forming waves in the warp travelling in the direction of the pick, locking means for temporarily locking the warp threads in one of their end positions, a plurality of shuttles, each shuttle carrying a weft thread, means for moving said shuttles in the ventral segments of the waves formed by the warp threads, means for progressively beating up the weft threads as they are released from the shuttles, said last mentioned means including a plurality of tongue members individually having end portions reciprocally extending between the warp threads in a zone between the shuttle path and the fabric, said end portions being below the plane of the weft threads in one end position of said tongue members, a rotatable shaft, a plurality of cams fast on said shaft, and resilient means connected with said tongue members for resiliently pressing the latter against said cams.

17. A weaving apparatus according to claim 16 comprising a longitudinal guide means extending parallel to the picking path and below the warp and having a surface curved transversely to the longitudinal extension of said guide means, said surface rising in the direction of the movement of the warp, and said end portions of said tongue members slidably resting on said surface.

18. A weaving apparatus according to claim 16, in which the length of the weft threads carried by the shuttles exceeds the width of the warp, said cams being so formed and so placed on said shafts that said end portions of groups of said tongue members are positioned along curves which are concave towards the fabric and which extend between an end portion which is next to the shuttle path and an end portion which has arrived at the fabric, the weaving apparatus comprising compressed air supply means for directing a stream of air towards the weft thread to be beaten up for pressing the weft thread against said end portions which are positioned along a curve.

19. A method of weaving in which the warp threads are moved perpendicularly to the plane of the warp between a first and a second end position, the warp threads being actuated for movement into the second end position by an intermittently acting relatively strong force, the warp threads being yieldably urged into the first end position by a permanently acting relatively weak force, and in which method selected warp threads are temporarily retained in the second end position by a third force for forming a shed, the phase of the movements of juxtapositioned warp threads being shifted for forming waves travelling in the direction of the pick, shuttles being moved in the ventral segments of the waves, and the weft threads being beaten up according to the progress of the travelling waves.

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