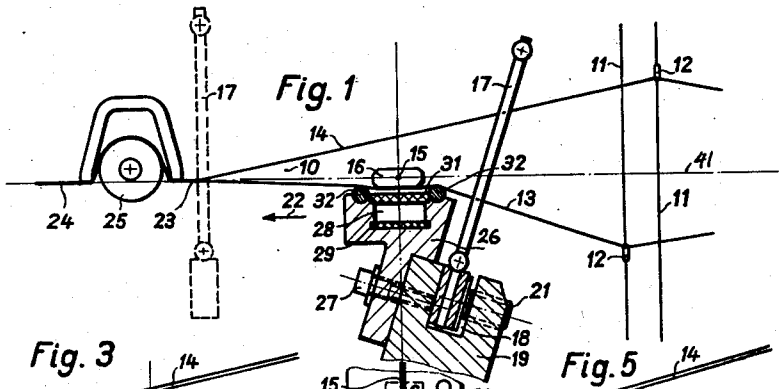
Dec. 17, 1963 E. PFARRWALLER 3,114,398

METHOD AND MEANS FOR GUIDING SHUTTLES THROUGH THE SHED IN A LOOM FOR WEAVING

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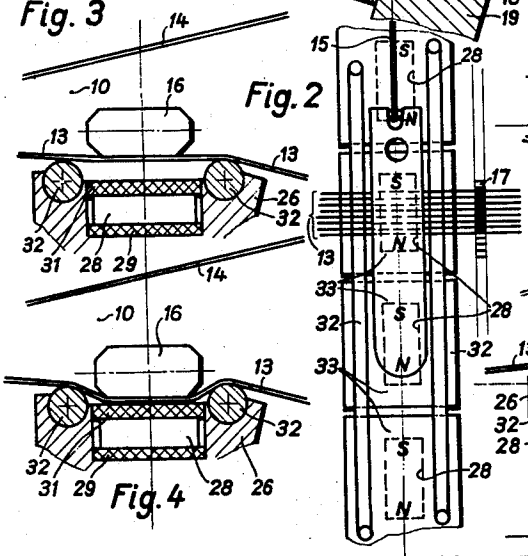
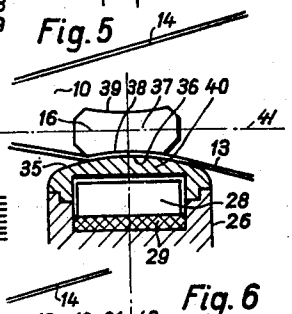
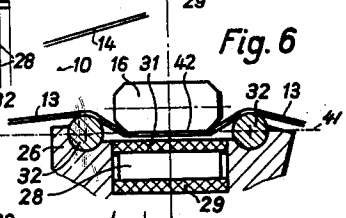
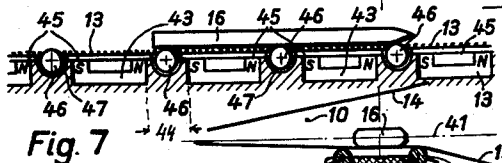
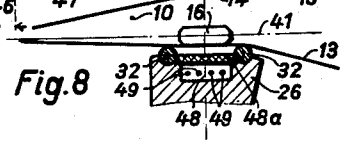


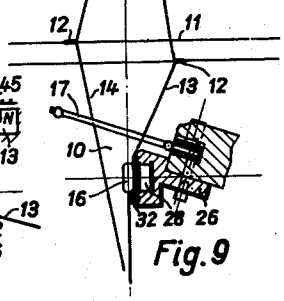
Fig. 4











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METHOD AND MEANS FOR GUIDING SHUTTLES THROUGH THE SHED IN A LOOM FOR WEAVING

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Fig. 10

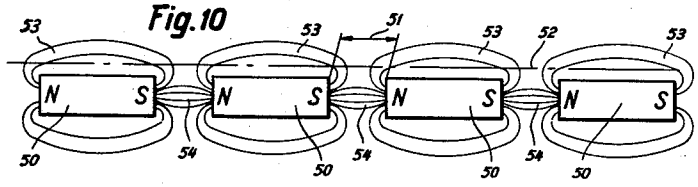


Fig. 11

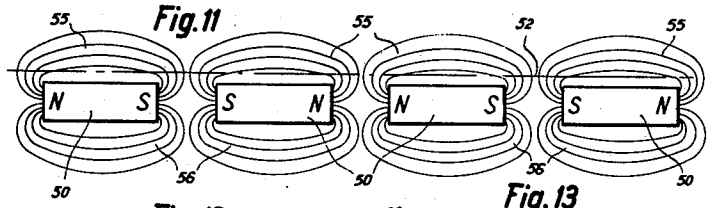


Fig. 12

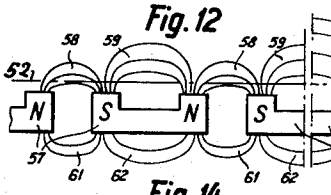


Fig. 13

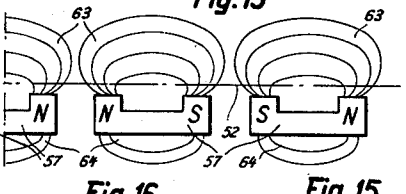


Fig. 14

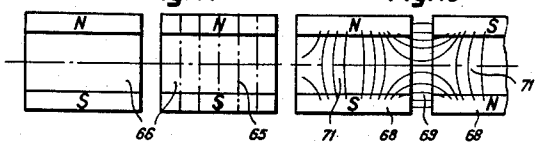


Fig. 16

Fig. 15

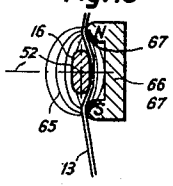
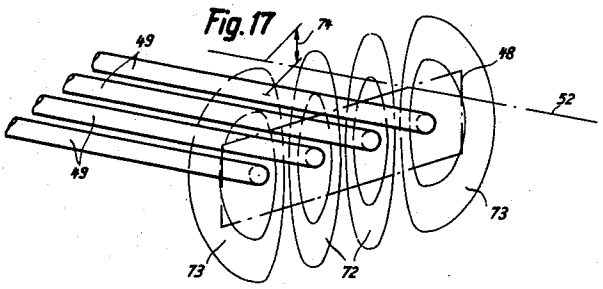


Fig. 17



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3,114,398

METHOD AND MEANS FOR GUIDING SHUTTLES THROUGH THE SHED IN A LOOM FOR WEAVING

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26 Claims. (Cl. 139—188)

The present invention relates to a method of guiding shuttles through a shed formed by warp threads in a loom for weaving and to an apparatus for performing the method.

The method according to the invention includes the step of producing a magnetic field by magnetic devices placed outside of a shed formed by warp threads in a loom for weaving and substantially parallel to the desired path of the shuttles through the shed, of pulling the shuttles, which are at least in part made of ferromagnetic material, against the portions of the warp threads which are located between said devices for producing a magnetic field and the shuttle path, and of supporting said warp thread portions to counteract the aforesaid magnetic pulling action.

In the apparatus according to the invention, magnetic force-producing devices are placed outside of the shed formed by warp threads and along the path of the shuttles traveling through the shed for producing a static magnetic field which pulls the shuttles passing through the shed and consisting at least in part of ferromagnetic material against the portions of the warp threads which are located between said magnetic force-producing devices and the shuttle path, a support bar or rail being provided outside of the shed at least on one side of the shuttle path and parallel thereto for supporting said warp thread portions against the pressure exerted by the shuttles due to the pull of the magnetic devices, the latter including permanent magnets made of material whose remanence is at least greater than that of steel.

The novel features which are considered characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, and additional objects and advantages thereof will best be understood from the following description of embodiments thereof when read in connection with the accompanying drawing, in which:

FIG. 1 is a diagrammatic cross sectional illustration of a portion of a loom for weaving, showing the shed formed by warp threads, heddles, lay, reed and temples, and a shuttle guide apparatus according to the invention.

FIG. 2 is a diagrammatic top view of a portion of the shuttle guide apparatus.

FIGS. 3 and 4 are large scale diagrammatic cross sectional views of the shuttle guide shown in FIGS. 1 and 2 with the warp threads and shuttle in different operating positions.

FIG. 5 is a large scale diagrammatic cross sectional view of a modified shuttle guide.

FIG. 6 is a large scale diagrammatic cross sectional view of a shuttle guide as shown in FIGS. 1 to 4 and arranged at the elevation of the apex of the shed.

FIG. 7 is a diagrammatic longitudinal part sectional view of a modified shuttle guide arrangement according to the invention.

FIG. 8 is a diagrammatic cross sectional view of another modification of a shuttle guide according to the invention wherein the magnetic field is produced by electric conductors placed below the shed.

FIG. 9 is a diagrammatic cross sectional view of a shuttle guide arrangement according to the invention for a loom having a vertical shed formed by warp threads.

FIGS. 10 to 17 are diagrammatic illustrations of magnetic fields produced by different magnetic field producing devices used in shuttle guides according to the invention.

Referring more particularly to FIG. 1 of the drawing, numeral 10 designates a shed formed by warp threads 13 and 14 guided in eyes 12 of healds 11 supported in heald frames, not shown, and actuated in the conventional manner. Weft threads 15 are inserted in the shed by means of shuttles 16 and are beaten up by a reed 17.

The reed 17 is inserted in a recess 18 of a lay bar 19 and secured in the recess by bolts 21. For beating up the weft threads, the reed 17 is moved from the position shown in solid lines in the direction of the arrow 22 to the position shown in dotted lines. A weft thread 15 is thereby pressed into the apex 23 of the shed against the finished fabric 24 whose lateral edges are guided by temple rollers 25.

Carrier elements 26 are mounted on the lay bar 19 by means of studs 27. The elements 26 support permanent magnets 28 which rest on base elements 29 and which are covered by nonmagnetic plates 31. By changing the thickness of the elements 29, the elevation of the elements 28 can be altered. On either side of the plates 31, i.e. on either side of the shuttle path, support bars 32 are provided for supporting the lower warp threads 13 which support the shuttles 16 when picked through the shed. The location of the support of the shuttles depends on the tension of the warp threads and on the magnitude of the pull exerted on the moving shuttles by the magnetic field. In certain cases, one support bar 32, for example, the one on the right side in FIG. 1 may be sufficient since the lower warp threads 13 incline from the shuttle path to the apex 23 of the shed.

FIG. 2 shows that the magnetic elements 28 are arranged in a row and in series relation with respect to their north and south poles and that spaces 33 are provided between the magnetic elements which spaces are so great that a magnetic field extends not only between two opposed poles but is also maintained between the north and south poles of the individual magnets 28. In this way the desired force is exerted on the shuttles 16 not only between the magnets but also alongside the magnets and the shuttles are definitely guided for preventing undesired lateral movements when the shuttles are picked through the shed by a conventional picking mechanism, not shown.

The position of the magnets 28 longitudinal of the shuttle path may be varied as well as the distance of the magnets from the shuttle path by selecting inserts 29 of suitable thickness. Magnetic elements of different magnetic power may be used. The spaces 33 between the magnets 28 may be different at different parts of the shuttle path. By placing the magnets at different elevations and spacing and using magnets of different power at different portions of the shuttle path, the magnetic field can be adapted to the different requirements when the shuttle enters the shed and when the shuttle leaves the shed. The changes of the magnetic effect on the shuttles 16 along the shuttle path may be continuous or may be stepwise. If magnetic forces are produced by electric conductors instead of by permanent magnets, the forces may be changed by changing the current intensity and voltage.

FIG. 3 shows the position of a shuttle 16 at a relatively weak magnetic force and FIG. 4 shows the position of a shuttle 16 at a relatively great magnetic force, the tension of the warp thread 13 being the same in both cases. In the arrangement shown in FIG. 3, the magnetic field is chiefly responsible for the lateral guidance of the shuttle 16 whereas in the arrangement according to FIG. 4, the

warp threads bent on the support bars 32 prevent movement of the shuttle 16 laterally of the shuttle path.

The surface portion 16' of the shuttles running on the warp threads 13 may be made of non-magnetic material, as shown in FIG. 3.

FIG. 5 shows an arrangement in which the lateral support bars 32 are omitted and a cover 35 having a convexly shaped upper surface 36 for supporting the lower warp threads 13 is provided on the carrier 26. The shuttle 37 has concave surfaces 38 and 39 corresponding to the curvature of the surface 36. This arrangement assists lateral guidance of the shuttle 37 by the field of the magnets 28. The concave surface 39 of the shuttle 37 is only necessary if the shuttles are turned around during their passage from the shuttle receiving box to the shuttle picking box. Shuttle receiving mechanisms, shuttle picking mechanisms and shuttle return devices do not form part of the present invention and are conventional, and are therefore not illustrated.

In the arrangements shown in FIGS. 3 to 5, the center of the shuttle path is in the horizontal plane 41 extending through the apex of the shed 10. In the arrangement shown in FIG. 6, the bottom 42 of the shuttle is in the plane 41, i.e., the magnets 28 and support bars 32 are at a higher elevation as in the arrangements shown in FIGS. 3 and 4 and the lateral guidance of the shuttle by the left support bar 32 is improved.

In the arrangement shown in FIG. 7, horseshoe magnets 43 are used having the general longitudinal sectional configuration of a U whereby the space 44 between two magnets 43 is such that the field between the north and south poles of the same magnet is substantially the same as between the north and south poles of two neighboring magnets.

The magnets 43 are covered by plates 45 which are permeable to magnetic forces. These plates prevent sticking of the shuttle gliding on the warp threads 13 adjacent to the plates 45. In the arrangement shown in FIG. 7, rollers 46 are provided in corresponding grooves 47 provided in the carrier of the magnets for supporting the shuttles and reducing friction between the shuttles and the warp threads 13. The length of the rollers 46 corresponds approximately to the width of the shuttles 16 and the grooves 47 are only a little longer than the rollers to provide a small clearance to facilitate rotation of the rollers 46. The carrier closes the ends of the grooves 47 and is provided with support bars 32 as in the modifications shown in FIGS. 1 to 4 and 6 unless the shuttle guide shown in FIG. 7 is so placed that the warp threads 13 decline on both sides of the carrier when the shed 10 is open.

In the arrangement shown in FIG. 8, the carrier 26 extends all along the lay bar 19 and is provided with a longitudinal groove 48 whose top is closed by a cover 48*a*. A magnetic field is produced by electric conductors 49 arranged in parallel relation and inside the groove 48 and longitudinally thereof. The cross section of the magnetic field produced by the individual conductors 49 is circular or oval. Current intensity and voltage are so chosen that sufficient forces are exerted on the shuttle 16 for keeping the shuttle on the desired path. The magnetic forces act in the same direction as the gravity and are supplemented by the gravitation force.

If the shed 10 formed by the warp threads is vertical, an arrangement as shown in FIG. 9 may be used which includes a carrier 26 provided with magnets 28. A support bar 32 is provided only at the lower side of the shuttle path since the shuttles need to be guided only on this side.

Rodlike magnets have the advantage that they have a large field whereas horseshoe magnets, as shown in FIG. 7, have the advantage that a larger portion of the field is above the magnet, i.e., in the region where the shuttles move so that smaller magnets have the same effect on the shuttles as larger, rodlike magnets.

FIG. 10 shows a magnetic field as produced by magnetic devices 50 arranged at a relatively small space between two neighboring magnets and with the north and south poles of each unit 50 arranged in the same manner along the shuttle path 52. The shuttle path 52 intersects the upper magnetic fields 53 which retain the shuttles on the shuttle path 52.

There is a magnetic field 54 between the opposed ends of two neighboring magnets 50 which field is rather powerful because of the relatively small space 51 between the magnets and which field uses up energy not available for the fields 53. The magnetic fields 54 do not contribute to holding the shuttles on the path 52.

If every other magnet 50 is turned around 180°, always two like poles are in opposed position as shown in FIG. 11. In this case, no magnetic field is formed between the ends of the magnets. The fields repulse each other at the ends of the magnets so that only two fields 55 and 56 are formed which have the same configuration if the magnets are in the shape of rods. The shuttle path 52 intersects the upper fields 55 which are considerably stronger than the fields 53 in the arrangement shown in FIG. 10, assuming that the magnets 50 in both figures have the same coercive force at the same remanence.

FIGS. 12 and 13 show the magnetic fields which are developed if horeshoe magnets 57 are arranged beneath the shuttle path 52, the north and south poles of the magnets pointing upward towards the shuttle path. The sequence of the poles in FIG. 12 is the same as that shown in FIG. 10 and the sequence shown in FIG. 13 is equal to that shown in FIG. 11. In the arrangement shown in FIG. 12, a rather strong magnetic field 58 is formed between neighboring north and south poles of different magnets 57. The field 59 between the poles of the same magnets is therefore somewhat weakened. There is also a field 61 formed between the north and south poles of neighboring magnets 57 below the magnets and a magnetic field 62 between the ends of the same magnets and therebelow. The field 61 extending between two neighboring magnets is stronger than the field 62 which forms at the lower side of each magnet 57. The fields 61 and 62 are weaker than the fields 58 and 59 formed above the magnets.

In the arrangement shown in FIG. 13, no magnetic field develops between opposed poles of neighboring magnets 57 and the fields 63 developing at the upper side of the magnets as well as the fields 64 formed at the lower side of the magnets are considerably stronger than their corresponding magnetic fields in the arrangement according to FIG. 12. The stronger magnetic fields 55 and 63 provide more assurance against running away of the shuttle from the straight shuttle path than the weaker fields produced by the other arrangements. A further advantage of fields of the type designated by numerals 55 and 63 is that they extend farther above the shuttle path 52 than the relatively weak fields 53, 58 and 59 so that the shuttle path 52 may be arranged farther above the magnets 50 and 57 in FIGS. 11 and 13 than in FIGS. 10 and 12.

Instead of arranging the poles of the magnets longitudinally of the shuttle path 52, they may be arranged at either side of the shuttle path so that the magnetic fields 65 are normal to the shuttle path as shown in FIGS. 14 to 16 and particularly in FIG. 15. Horseshoe magnets 66 are used in the arrangement illustrated in FIGS. 14 and 15. The upper ends, forming the poles, are rounded and smooth so that they may serve also as rails for supporting the warp threads 13. To prevent sticking, the parts of the poles of the magnets 66 which may be contacted by the shuttles 16 are preferably provided with magnetically permeable layers 67.

In the arrangement shown in FIG. 14, like poles are on the same side of the shuttle path 52 so that no magnetic field is formed between neighboring magnets. As shown on the right side of FIG. 14, each magnet may be

subdivided into a plurality of units of equal size and configuration which abut each other and form a continuous support for the warp threads 13. The length of the magnets may be changed by changing the number of units.

In the arrangement shown in FIG. 16, the individual magnets 68 are so placed relative to the shuttle path 52 that the poles alternate on each side of the shuttle path. In this way, magnetic fields are produced which are different from those produced in the arrangement according to FIG. 14. A field 69 develops between the ends of the magnets and a field 71 is at the top of the magnets. The cross section of the field 71 corresponds to the field 65 shown in FIG. 15.

The electric conductors 49 shown in FIG. 8 individually produce cylindrical magnetic fields whose cross sections are circular. If a plurality of conductors 49 are arranged in parallel relation and if the radius of the periphery of the magnetic fields is greater than one half the distance between two conductors 49, the cross section of the individual fields 72 produced by the inner conductors 49 becomes oval, as shown in FIG. 17. The fields 72 are higher than the fields 73 of the marginal conductors. This has the advantage that the shuttle moving on the path 52 which is located at an elevation 74 above the center between the central conductors 49 is well affected by the higher fields 72.

The carrier for the magnets may be made in one piece extending over the width of the loom or be composed of a plurality of individual pieces, each being provided with a magnet 28, as shown in FIG. 2. The warp supporting rails 32 are preferably made of a nonmagnetic, sintered material such as hard metal, or sinter ceramic. If they are not made of one piece, the individual pieces are preferably provided with slanted ends which abut against correspondingly slanted ends of the neighboring pieces.

In order to reduce formation of eddy currents, the shuttles are preferably made of ferromagnetic material having a relatively high specific resistance which exceeds, for example, that of steel by 0.002 ohm per one square mm. cross section and one mm. length. The running surface of the shuttles may be made of nonmagnetic material. In order to avoid losses caused by hysteresis of the material of the shuttles 16 because of the change of polarity during the run of the shuttles on the path 52, the shuttles are preferably made of soft steel. The permanent magnets may be made of a material which has a higher remanence than steel and which, in addition, may have a higher coercive force than steel.

The spaces between the magnetic devices placed along the shuttle path may vary, for example, may be relatively small at the end of the shuttle path in order to effect braking of the shuttles.

I claim:

1. In a loom for weaving, a shed formed by warp threads, shuttles traveling through the shed for inserting weft threads into the shed, said shuttles being at least in part made of ferromagnetic material, means placed outside of the shed alongside the desired shuttle path for producing a magnetic field extending into the shed and into the shuttle path for magnetically retaining the shuttles on the desired path and pressing the shuttles against the warp threads extending between the shuttle path and said magnetic field producing means, and support means placed along the desired shuttle path and outside of the shed for supporting the warp threads, said support means being so constructed and arranged as to allow the shuttle to effect bending of the warp threads by the shuttles pressed thereagainst by said magnetic field, the bent warp threads forming an additional guide for the shuttles along the desired shuttle path for preventing sideways movement of the shuttles out of the desired shuttle path.

2. In a loom for weaving as defined in claim 1 and wherein said magnetic field is permanent and stationary relative to the shuttle path.

3. In a loom for weaving as defined in claim 1 and wherein said magnetic field producing means are formed by permanent magnets whose remanence is greater than that of steel.

4. In a loom for weaving as defined in claim 1 and wherein said magnetic field producing means are formed by permanent magnets whose coercive force is greater than that of steel.

5. In a loom for weaving as defined in claim 1 and wherein said shed is in substantially horizontal position, and said magnetic field producing means are placed below the shed.

6. In a loom for weaving as defined in claim 1 and wherein said magnetic field producing means are formed by oblong permanent magnets placed in spaced relation lengthwise in a row substantially coextensive with the shuttle path, the north pole of one magnet facing the south pole of the successive magnet, said magnets individually producing magnetic fields alongside the magnets and extending into the shuttle path.

7. In a loom for weaving as defined in claim 1 and wherein said magnetic field producing means are formed by oblong permanent magnets placed in spaced relation lengthwise in a row, the longitudinal extension of the spaces between successive magnets being at least as great as the lengths of the successive magnets.

8. In a loom for weaving as defined in claim 1 and wherein said magnetic field producing means are formed by rodlike permanent magnets.

9. In a loom for weaving as defined in claim 1 and wherein said magnetic field producing means are formed by permanent magnets having a U-shaped configuration, the ends of the legs of the U forming the poles of said magnets being placed in series relation alongside the shuttle path.

10. In a loom for weaving as defined in claim 1 and wherein said support means is in the shape of a rail placed longitudinally of the shuttle path.

11. In a loom for weaving as defined in claim 1 and wherein said support means is made of nonmagnetic sintered material.

12. In a loom for weaving as defined in claim 1 and wherein said magnetic field producing means are formed by permanent magnets having a surface facing the shuttle path, a layer of a magnetically permeable substance being made fast on and covering said surface.

13. In a loom for weaving as defined in claim 1 and wherein said shuttles have a running surface portion contacting the warp threads and made of a nonmagnetic substance.

14. In a loom for weaving as defined in claim 1 and wherein said magnetic field producing means are formed by individual permanent magnets, a lay being provided, and a plurality of carriers made of nonmagnetic material being mounted on said lay and individually supporting said permanent magnets.

15. In a loom for weaving according to claim 14 and wherein said magnets are arranged in a row and spaced from each other, the length of said carriers being equal to the length of the magnet mounted thereon plus substantially one half of the length of the spaces between the respective magnet and the neighboring magnets, the magnets being mounted substantially in the middle of said carriers.

16. In a loom for weaving as defined in claim 1 and wherein said magnetic field producing means are formed by permanent magnets placed in spaced relation in a row, support rollers being individually placed in the spaces between the magnets for supporting the shuttles.

17. In a loom for weaving as defined in claim 1 and wherein said magnetic field producing means are formed by permanent magnets placed in spaced relation in a row, the spaces between the magnets being different at different parts of the row.

18. In a loom for weaving as defined in claim 1 and

wherein said magnetic field producing means are formed by permanent magnets placed in spaced relation in a row and spaced from the shuttle path, the distance between the magnets and the shuttle path being different at different parts of the row.

19. In a loom for weaving as defined in claim 1 and wherein said shuttles are made of ferromagnetic material having a relatively high specific resistance.

20. In a loom for weaving as defined in claim 1 and wherein said magentic field producing means are formed by individual oblong permanent magnets placed in spaced relation lengthwise in a row substantially coextensive with the shuttle path, like poles of successive magnets facing each other.

21. In a loom for weaving as defined in claim 1 and wherein said magnetic field producing means are formed by permanent magnets placed in a row parallel to the shuttle path and individually transversely to the shuttle path, one pole of each magnet being at one side of the shuttle path and the opposite pole of each magnet being at the other side of the shuttle path.

22. In a loom for weaving according to claim 21 and wherein like poles of said magnets are on the same side of the shuttle path.

23. In a loom for weaving according to claim 21 and wherein said magnets have a U-shaped cross sectional configuration normal to the shuttle path, the ends of the legs of the U forming the poles of the magnets and being rounded and forming said support for the warp threads extending between the shuttle path and said magnets.

24. In a loom for weaving according to claim 23 and wherein a layer of nonmagnetic material is provided at least at the inside of said rounded ends for preventing sticking of the shuttles thereon.

25. A method of guiding shuttles made at least in part of ferromagnetic material and passing through a shed formed by warp threads while slidably engaging the warp threads, comprising the combination of bending the portions of the warp threads on which the shuttles slide for mechanically guiding the shuttles longitudinally of the shuttle path, and subjecting the shuttles to magnetic forces penetrating through the warp threads on which the shuttles slide for pressing the shuttles against the warp threads and exerting pressure by the shuttles on the warp threads for supplementing the mechanical guidance of the shuttles by the bent warp threads.

26. A method of guiding shuttles made at least in part of ferromagnetic material and passing through a shed formed by warp threads while slidably engaging the warp threads, the latter being supported by shaped continuous support means along and opposite the desired shuttle path, the method comprising subjecting the shuttles to magnetic forces effective along the desired shuttle path for retaining the shuttles on the desired path, and causing bending of the portions of the warp threads on which the shuttles slide for additionally guiding the shuttles longitudinally of the desired shuttle path, by pressing the shuttles by said magnetic forces against the warp threads and thereby the latter against said support means.

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