

Aug. 8, 1939.

I. BAUMGARTEN

2,168,385

CIRCULAR LOOM

Filed March 19, 1937

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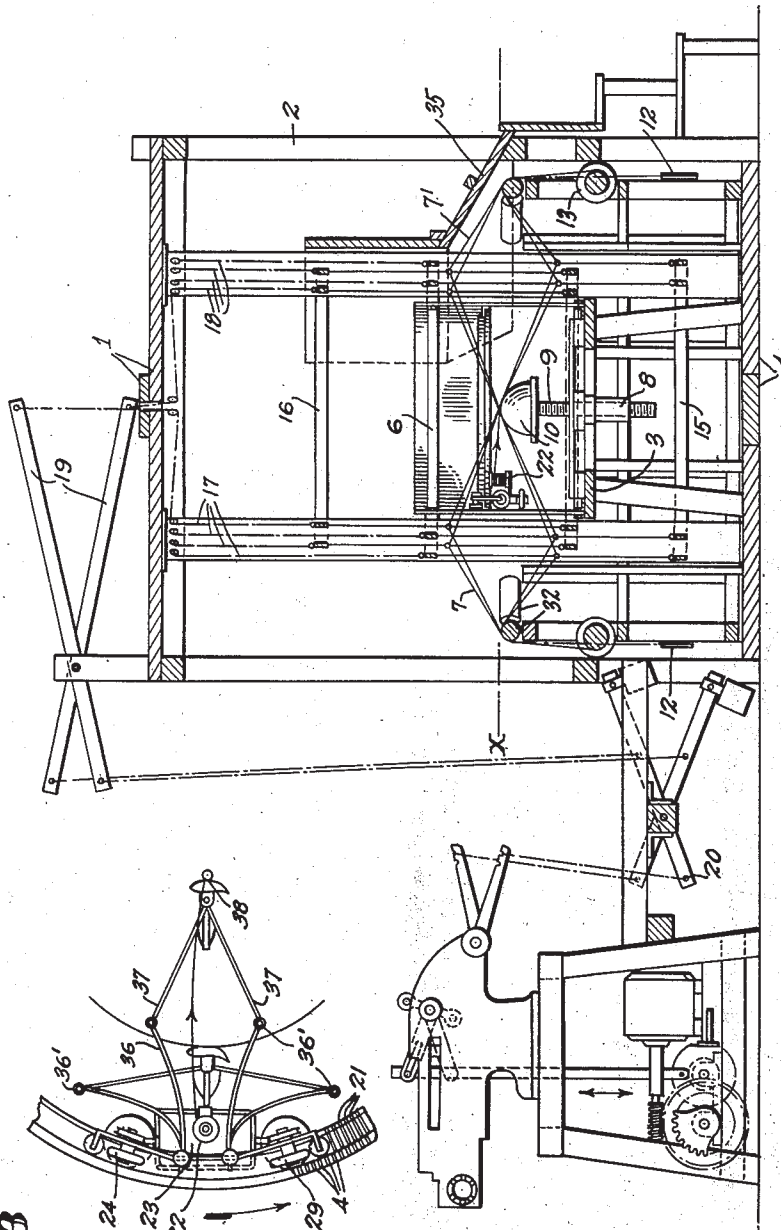


Fig. 1

Fig. 8

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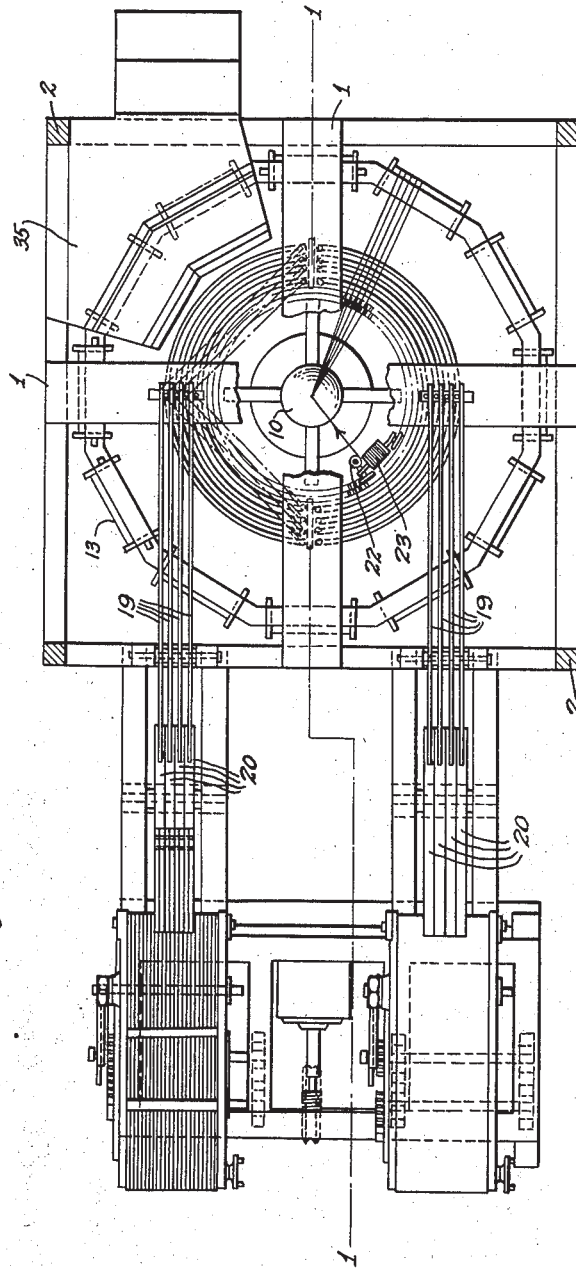
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*Fig. 2*

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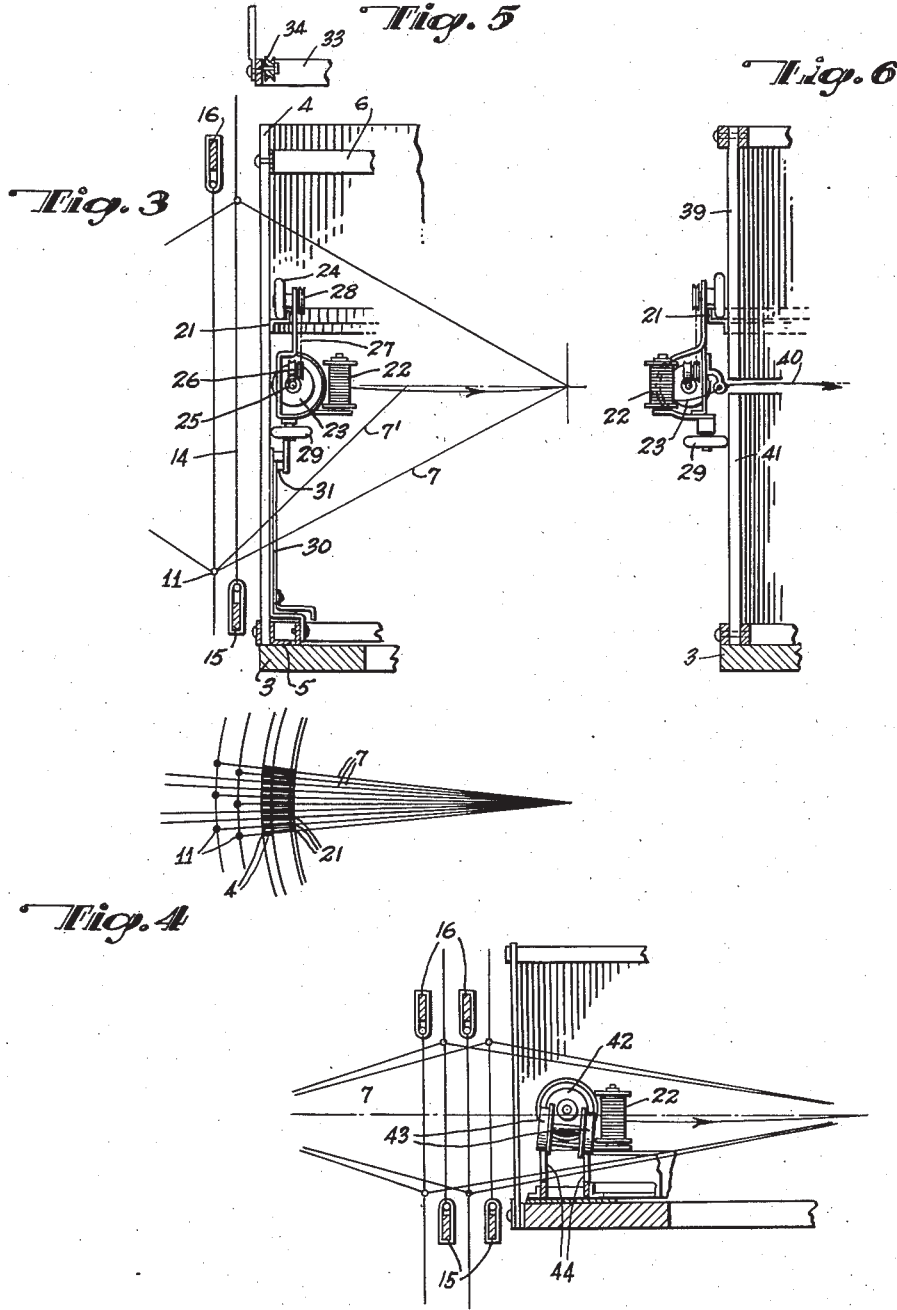


Fig. 7

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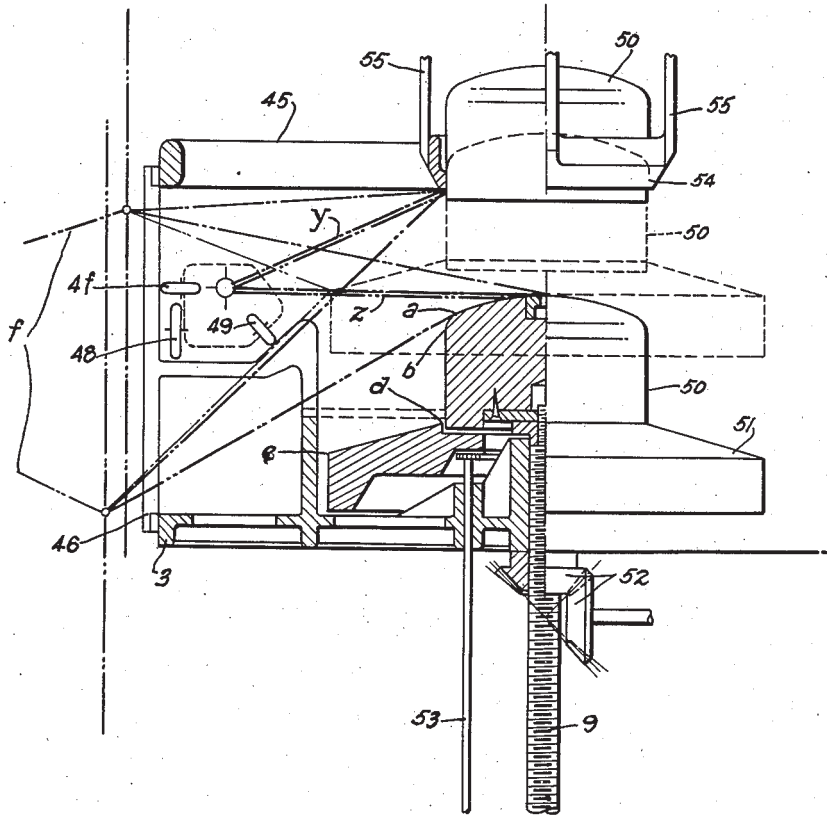
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*Fig. 9*



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# UNITED STATES PATENT OFFICE

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## CIRCULAR LOOM

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In Hungary March 24, 1936

3 Claims. (Cl. 139—13)

This invention relates to an improved circular loom operating with warp threads carried by healds arranged in a circle and with a weft thread introduced by means of a shuttle moved so as to follow a circular path, in which loom the shuttle consists of a weft bobbin mounted on a weft carriage driven by an electric motor, the weft carriage rotating along a circular weft path. In the machine according to the invention—in case it is employed for the manufacture of hats, hose or other fabrics of cylindrical shape—the weft threads arranged along radial lines start from a centre, a circular shed being produced by the movement of the healds, in a direction perpendicular to the plane of the radial weft threads of the healds. In accordance herewith the circular path of the shuttle preferably is formed by a circular comb, between the teeth of which the warp threads can be moved unhindered. The circular loom according to the invention is fitted with devices which—apart from the indispensable stoppage caused by the change of weft bobbins and by the operation of increasing the number of warp threads, or by the breaking of threads or the like—make it possible that the weft thread should be introduced continuously and in a proper manner, that the warp should be moved and stretched in a suitable manner, and that the breaking of the weft thread and of the warp threads as well as the exhaustion of the former should be indicated in a reliable manner at the moment when any such disturbance of operation takes place.

On the accompanying drawings, a few embodiments of the invention, shown by way of example, are illustrated in a diagrammatical manner.

Fig. 1 is a side-elevation partly in vertical section of a so-called circular loom operating with healds arranged along a cylindrical surface, together with a side elevation of the mechanism for actuating the healds;

Fig. 2 is a plan view;

On Fig. 3 the device introducing the weft thread in its annular path and the arrangement of the warp threads are shown drawn to a larger scale;

Fig. 4 is a plan view of a part of the annular path and of the arrangement of the warp threads;

Fig. 5 illustrates a detail of the mechanism employed for carrying warp threads to be subsequently incorporated in the web;

Fig. 6 is a front elevation of a modified arrangement of the shuttle;

Fig. 7 is a front elevation and partly a vertical section of another modified form of the arrangement of the shuttle and its path;

Fig. 8 is a plan view of a device provided on the shuttle by means of which the desired density of the weft threads introduced in a spiral or helical form can be obtained; and

Fig. 9 is a vertical section, and partly a side elevation drawn to a larger scale, of a hat form in its different positions during the production of a woven hat showing also the various formations of the shed in the various phases of the work and further showing the means for producing the cylindrical part of the hat and the actuating mechanism for the hat form.

According to the embodiment illustrated in Figs. 1 and 2 the operative parts to be described in greater detail below of the circular loom according to the invention are arranged on a frame composed of timber boards 1 arranged in cross formation at the top and bottom of timber posts 2. Within this frame the annular table board 3 is arranged on which there are fixed by means of an annular angle iron 5 the vertical bars 4 of square cross-section, arranged in a circle alongside each other. The upper ends of these bars 4 are connected by a hoop 6. By this arrangement, a cylinder surface is formed of which the bars 4 are the generatrices. The radially arranged warp threads 7 are guided through the gaps between the individual bars 4. The internal ends of the warp threads 7 used when beginning the work are fixed on the apex of the hat form 10, which latter is adjustable in the vertical direction by means of a screw-spindle 9 screwing into the rotatable bearings 8. The warp threads which are drawn through the usual heald eyes 11 of the heald cords 14 carried by the semi-circular heald frames 15 and 16 are wound on drums 13 arranged in a circle, the said drums being loaded by weights 12 so as to keep the warp threads in a suitably stretched condition.

The healds composed of heald cords 14 and semi-circular heald frames 15 and 16, are vertically suspended on cords 18 which run over pulleys 17. The cords 18 are connected to double-arm levers 19 pivotally supported on the frame, the said levers being connected by means of cords or the like with further levers 20 of the heald operating mechanism shown diagrammatically on the drawings.

It is however possible to bring the circular loom according to the invention into connection with a Jacquard machine whereby it becomes possible for the shedding of the number of warp threads to be effected automatically. In this case all the warp threads which are to be used in the weaving process are inserted into the fabric, grouped in

the desired order of sequence; notably in such a manner that the warp threads are grouped so as to correspond, for instance, to two semi-circles or to four quarters of a circle, and a Jacquard machine is provided for each group, the said Jacquard machines operating independently of each other but possessing a joint driving gear. As in these individual Jacquard machines each warp thread may have its own hook and the number of cards which can be employed is unlimited, the card chain being easily exchangeable, this co-operation of the circular loom with the Jacquard machine creates the possibility of weaving any kind of patterns no matter how complicated.

On each bar 4 a Z-shaped piece 21 is fixed at a suitable height. These Z-shaped pieces together form the annular track of travel of the shuttle carrying the weft bobbin 22 and driven by the electric motor 23, the said shuttle being according to the embodiment shown on the Figs. 1, 2, 5, 6 suspended on two wheels 24, which roll along the annular track formed by the Z-shaped pieces 21. Driving of the shuttle is effected by the motor by means of the worm 25, the worm-wheel 26, the driving cord 27 and the cord pulley 28. The freely rotatable wheel 29 arranged below the motor casing is supported on the bars 4 and keeps the shuttle in the proper position during the circular movement of the latter. The feeding of the electric motor 23 is effected by means of a sliding contact 31 and by means of the conductor wires 30 insulated from the bars 4.

The shuttle including the electric motor 23, the weft bobbin 22, the running wheels 24, the supporting wheels 28 and the trolley contacts 31 should be dimensioned and arranged in such a manner as to ensure that the entire profile of the shuttle assemblage can freely pass through the shed even at the time when the weaving of a hat reaches its termination. This phase of work is illustrated in Fig. 3 by the warp thread position 7'.

The weaving of a hat on the circular loom according to the invention is effected in the following manner:

The warp threads 7 wound on the drums 13 arranged in a circle are carried over the guide rollers 32 also arranged in a circle, and following this each warp thread is drawn through individually in a radial direction towards the middle, between two bars 4. The ends of about 16 to 32 warp threads are fixed on the apex of the hat form 10 arranged on the screw spindle 9. Following this, the apex is brought by rotation of the screw-spindle 9 into the plane of the fabric or web indicated by the line x. For weaving a hat of normal dimensions, about 400 to 600 warp threads are required. The warp threads to be used when beginning the operation of weaving are selected among this large number of warp threads in such a manner that they should form an angle of

$$\frac{360}{n}$$

degrees with each other, in which formula  $n$  is the number of initial warp threads, and will preferably vary between 16 and 32. The rest of the warp threads which are not brought into use at the beginning are suspended, assembled in groups, on pulleys 34 which are mounted so as to be rotatable on a frame 33 arranged above the loom frame. With the progress of weaving a suitable number of warp threads are inserted between the initial warp threads by being fas-

tened into the already completed fabric or web in order to obtain the desired density of warp threads when increasing the diameter of the fabric or web. The weft thread is introduced into the shed in a spiral line by means of the shuttle 5 moving in a circular path, and being driven by the electric motor 23.

The formation of the shed takes place in the embodiment illustrated by the usual raising and lowering of the semi-circular heald frames 15, 16 10 and cords 14 forming the healds. If it is desired to form a new shed by means of the warp threads 7<sub>1</sub> and 7<sub>2</sub> shown on the right-hand side of Fig. 1, the heald frame 15 belonging to the warp thread 7', which heald frame is in its lower position, is 15 raised, whereas the heald frame 16, belonging to the warp thread 7<sub>2</sub> and situated in its upper position is lowered. By these means, all the warp threads situated in a semi-circle are raised or lowered, as the heald cords 14 belonging to them 20 are connected to the semi-circular heald frames. The actuation of each pair of semi-circular heald frames is preferably always effected at the moment when the shuttle has left the shed formed by the heald frames in question and has entered 25 the new shed formed by the other pair of semi-circular heald frames. If it is desired to produce a pattern fabric, it is necessary to make provision for operating the healds separately or in smaller groups of warp threads in a known 30 manner, and which are operated by suitable heald-raising mechanism preferably by machines constructed according to the Jacquard system.

After about 10 to 15 layers or turns of weft have been introduced into the fabric in a spiral 35 line from the weft bobbin by means of the shuttle running in its circular path, the number of warp threads is increased. This is brought about by the person operating the circular looms who stands and walks about on the platform 35 40 removing such a number of warp threads from the pulleys 34 supported on the frame 33 and suspending them by passing the same into the eyes 11 of the heddles and fixing them to the hat form so as to double the number of warp threads. 45 Thus a new warp thread is placed between each two adjacent original warp threads. Such increase of the number of warp threads is repeated as often as is requisite until all of the warp threads required have been inserted. 50

The weft thread introduced in a spiral line is pushed on to the fabric being formed by the warp threads as they are tensioned after mutually crossing for the formation of a new shed. 55 If it is desired to produce a kind of fabric in which the rows of the weft thread are situated closely adjacent to each other, a device is employed by which the weft thread is applied resiliently or with a definite pressure to the fabric. 60

An embodiment of such a device shown by way of example is illustrated in Fig. 8. Each of the free ends of the two plate springs 36 fixed on the motor casing is connected in an articulate 65 manner at 36' with an arm 37, virtually forming a sort of toggle. In the common joint of these arms 37 a guide or weft laying device or shuttle 38 is pivotally supported. The weft thread is led to this shuttle and leaves the latter through a suitable orifice while being properly applied to 70 the fabric by the action of the plate springs 36. As the process of weaving is progressing in the radial direction and the weft thread is describing a spiral line, the guide 38 likewise has to move along a spiral line, i. e. along a curve of increas- 75

ing radius of curvature. This is rendered possible by the points of articulation 36' of the plate springs 36 being capable of movement apart from each other. In Fig. 8 two positions of the shuttle or weft laying device 38 are illustrated.

The embodiment according to Fig. 6 differs from the one described above only in that the shuttle carrying the weft bobbin and driven by the electric motor 23 travels in a circle on the annular path formed by the Z-shaped parts 21 fixed on the external side of the bars 39 arranged in a circle. This arrangement makes it necessary that no obstacle should exist in the plane of the fabric or web by which the introduction of the weft thread 40 would be hindered. The bars 39 are accordingly terminated above this plane and the bars 41 forming the continuation of the bars 39 are fixed on the table board 3 in such a manner that a suitable horizontal annular gap will be formed between the ends of the bars 39 and those of the bars 41.

According to the embodiment illustrated in Fig. 7, the shuttle carrying the weft bobbin 22 and driven by the electric motor 42 runs by means of the wheels 43 on two annular rails 44 which are shaped, by means of radially disposed recesses, in the form of combs, so that the radially arranged warp threads 7 can, for the purpose of the formation of a shed, enter below the shuttle into the cut-in recesses of the annular rails. The number of recesses corresponds to that of the warp threads to be employed.

In Fig. 9 there is provided an annular path formed by shaped pieces 46 arranged, in a circle so as to maintain suitable gaps for the warp threads 7 to be drawn through and fixed on the table board 3 as well as on the upper ring 45, from which circular path the shuttle driven by an electric motor (not shown) should be able to roll on the wheels 47, while being supported by the wheels 48 and 49 arranged so as to suit the shape of the annular path.

The adjustment in the vertical direction, required in the various phases of operation, of the hat form, i. e. of the cylindrical central part 50 and of the lower part 51, having the shape of a truncated cone, which latter supports that part of the fabric which will yield the border of the hat, is effected by means of the screw-spindle 9 operated by the pair of bevel gears 52, and by means of vertically displaceable rods 53, by means of which it is possible to raise and lower the bottom part 51.

When beginning the operation of weaving the cylindrical middle part 50 of the hat form is situated in the lowest position drawn in full lines, and while the portion of fabric the radius of which is represented by the distance  $O-a$  is being produced, the central part 50 is preferably raised to an extent corresponding to the difference in height between the two points  $O$  and  $a$ . Following this, that part of the fabric is produced which covers the rounded position of the hat form along the distance  $a-b$ . For this purpose the central part 50 is made to approach the fixed ring 54 in such a manner as to produce a shed in which the direction of the introduction of the weft thread corresponds to the line  $v$ . During the production of the hose-shaped portion of the fabric, corresponding to the cylindrical part of the hat form, the central part 50 is preferably gradually raised to an extent corresponding to the extent of the progress of the weaving operation. This relates to the distance  $b-d$ , on which

the weft thread introduced forms a continuous helical line. During this process of weaving the hose-shaped portion of the fabric is properly held on the cylindrical part of the hat form, this being due exactly to the arrangement of the fixed ring 54 held by arms 55. During the production of the portion of fabric corresponding to the rim part of the hat, i. e. of the distance  $d-e$ , the central part 50 is lowered whereas the bottom part 51 is raised so that the part  $d$  should preferably come to be placed into the direction of weft thread  $z$ . In the production of the portion of fabric corresponding to the length  $d-e$  the hat form is preferably gradually raised to an extent corresponding to the difference in height between the points  $d$  and  $e$ .

The shed formation formed in the various phases of work of the manufacture of hats are illustrated in Fig. 9 for the sake of greater clearness by lines traced in a different manner.

In the embodiments described above, the annular path of travel for the shuttle is of comb formation, to enable the radially arranged warp threads to be moved, for the purpose of forming sheds from the plane of the fabric to above and below the shuttle.

I claim:

1. In a circular loom for weaving hats and similar structures, wherein an electrically driven shuttle carriage is adapted to travel in an annular path within a warp shed, a pair of leaf springs connected to said shuttle carriage and projecting inwardly into the area bounded by said annular path, a pair of arms articulated at their outer ends to the inner ends of said springs, and a weft shuttle articulated to the inner ends of said arms, said springs tending to close toward each other and bring together the outer ends of the arms articulated thereto and thereby resiliently extend the weft shuttle radially inward so as to press the same continuously inwardly against the fabric as it is being woven.

2. In a circular loom according to claim 1, having a form piece located axially of the loom and adapted for the initial attachment of the warp threads and capable of vertical adjustment during the weaving operation, the feature comprising a fixed ring located in the vertical path of said form piece in a position which disposes the lower edge of said ring immediately above and closely adjacent the opening of the shed upon said form piece and the line along which the weft shuttle exerts its pressure upon the fabric during the weaving.

3. In a circular loom for weaving hats and similar structures, wherein an electrically driven shuttle carriage is adapted to travel in an annular path within a warp shed, means determining the path of said shuttle carriage comprising a plurality of spaced bars arranged about said area, and a fixed member upon each of said bars having a profile serving as a rail so that all of the fixed members upon all of said bars together form guiding rail means upon which rollers of the shuttle carriage may travel in a predetermined accurate path, there being a radially movable weft shuttle and means mounted upon the shuttle carriage for supporting and resiliently pressing said weft shuttle radially inward against the fabric as it is woven including a plurality of opposed members articulated together at their inner ends and attached to said shuttle at their outer ends.

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