March 10, 1964 G. SLAYTER ETAL 3,124,165

DRIVE MECHANISM FOR HIGH PRODUCTION LOOM

Filed Dec. 30, 1960

2 Sheets-Sheet 1

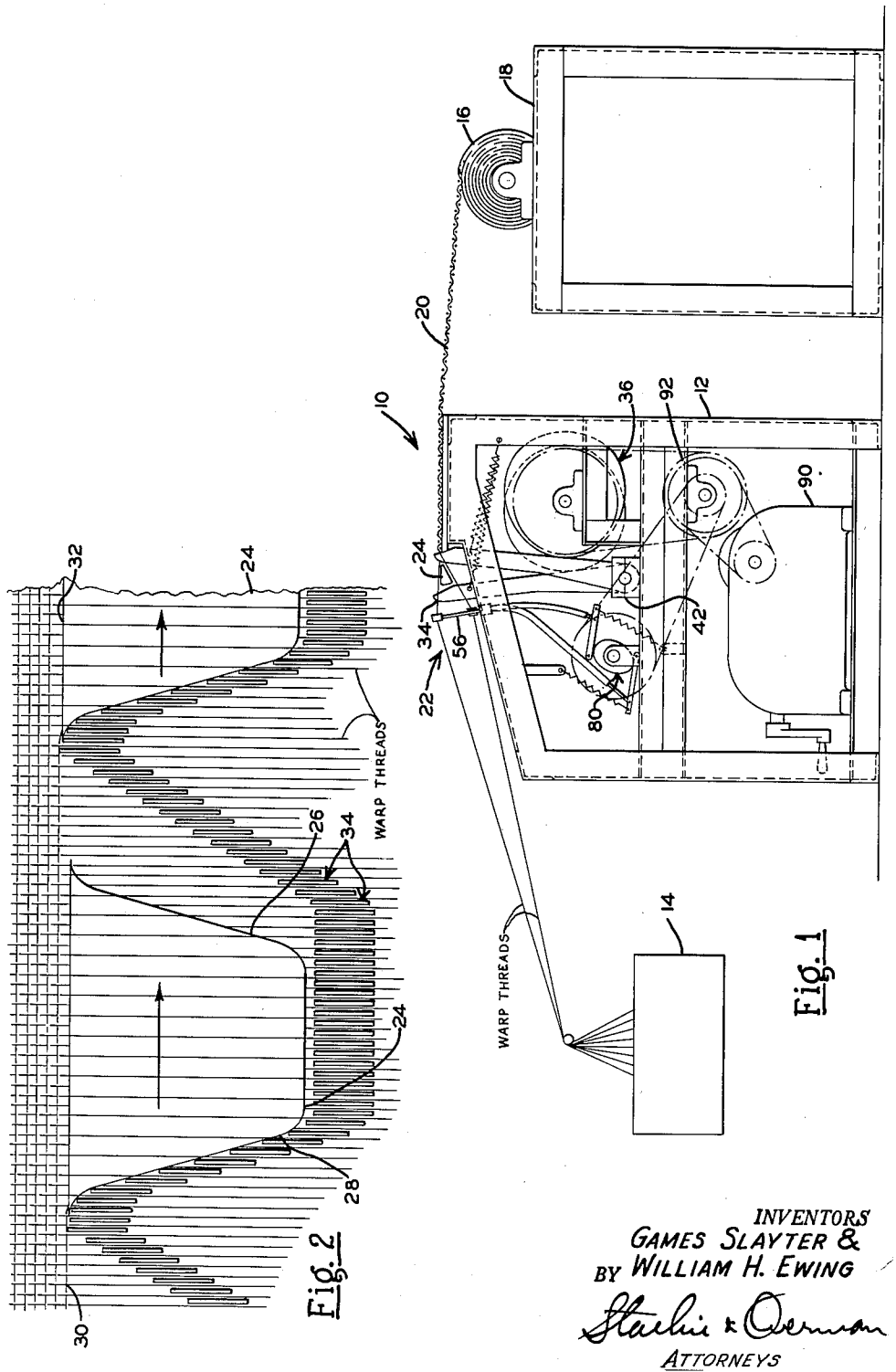


Fig. 1

Fig. 2

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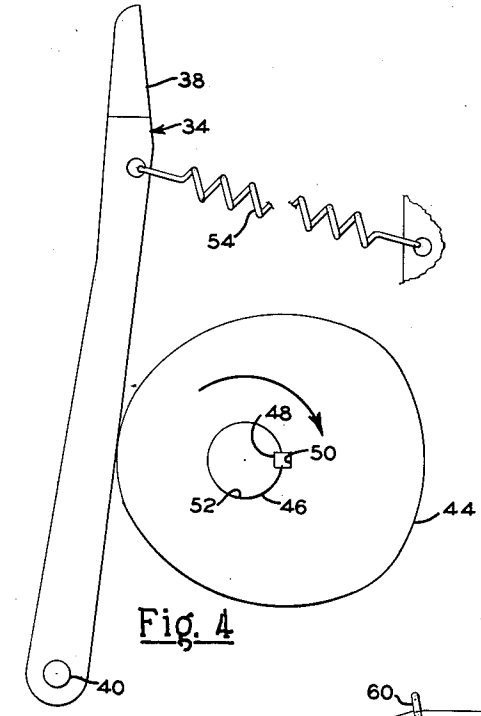


Fig. 4

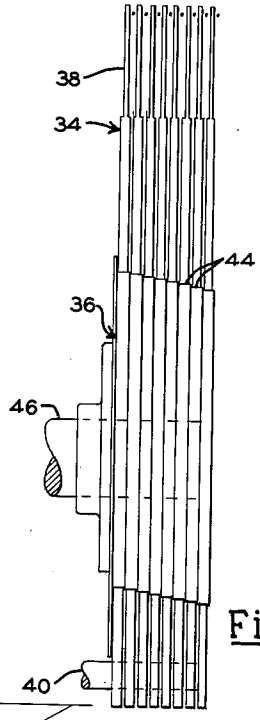


Fig. 3

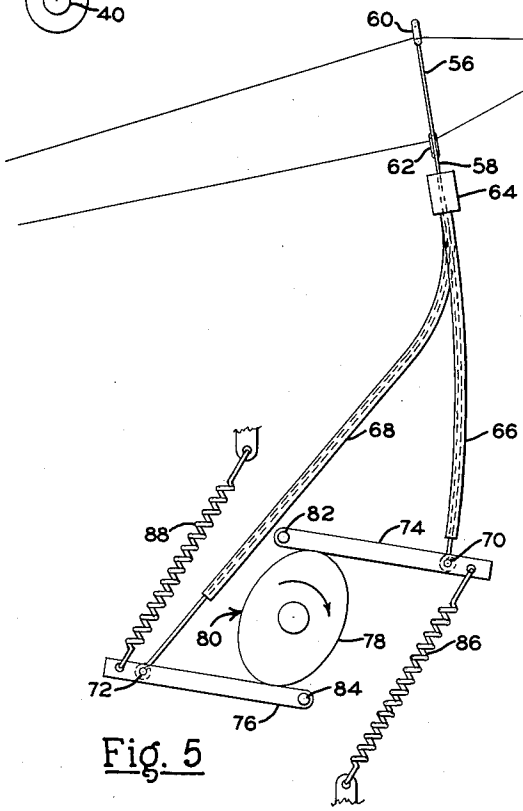


Fig. 5

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DRIVE MECHANISM FOR HIGH PRODUCTION LOOM

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7 Claims. (Cl. 139—12)

This invention relates to a high production loom and more particularly to a loom operating on a progressive shedding principle.

Looms using the progressive shedding principle employ a plurality of shuttles moving across warp threads at any given instant, with various types of finger mechanisms used to actuate the shuttles. By using a plurality of shuttles, rather than a single one moving across the warp, the same or a higher production rate can be obtained with slower shuttle movement. By maintaining a constant distance between the shuttles, regardless of the width of the fabric being woven, wider fabrics can be woven as rapidly as narrow ones because more shuttles will be moved across the wider fabric in a given period. Thus, a fabric which is twice as wide as another can employ twice as many shuttles so that weaving will proceed at the same lineal rate with the shuttles moving at the same speed. By achieving a higher production rate, less floor space is required and less labor is needed per unit of production. In addition, by using a slower shuttle speed, less vibration and noise results and there is less danger of flying, uncontrolled shuttles. Because of the fact that several shuttles are always moving across the loom at any given time, there is no lost time at the end of each trip of the shuttle across the warp while its motion is being reversed for a return trip. Another advantage of progressive shedding looms is that each fill thread thereof can be beat up sequentially rather than all at once, so that less force is needed per unit of length of the fill threads and the threads are less likely to be damaged.

The present invention provides a high production loom of the progressive shedding type which has the advantages outlined above as well as many others. The loom according to the invention employs a plurality of shuttles having surfaces which are angularly disposed with respect to the direction of the warp threads and reeds which operate with an undulatory or wave-like motion and strike the angular surfaces of the shuttles, causing them to move forwardly across the warp. The reeds and shuttles are designed so that several of the reeds engage the shuttle at any given instant, thus spreading the force needed to move each shuttle over several reeds. Besides pushing or advancing the shuttles, the reeds also move beyond the shuttles to beat up the newly laid woof or fill threads deposited by the shuttles, thereby combining two operations into one. The reeds are operated by a plurality of cams assembled into a cam roll which is of a generally helical configuration in order to drive the reeds with the desired motion. The heddles of the new loom are also operated by a somewhat similar cam roll which engages lever arms to which the heddles are connected to move the warp threads across the path of the shuttles to positions spaced therefrom.

The heddle and reed operating mechanisms are simple to operate and to manufacture, the parts being of simple shape and similar configuration. Thus, all of the reeds are of the same shape as are the separate reed cams which make up the reed cam roll. The heddles, heddle lever arms, and heddle cams which make up the heddle cam roll are also alike.

The operating movements of the reeds, heddles, and their driving mechanisms are also relatively simple, in-

volving only rotary motions of the cam rolls and reciprocatory movements of the reeds and the heddles. The shuttles move more slowly and more smoothly across the loom with no abrupt stops or abrupt changes in direction and the cam rolls move with circular motions, resulting in very little jarring or vibration. Although the reeds and the heddle lever arms reciprocate, they do so smoothly by gradually reducing speed before changing direction which keeps jarring and vibration at a low level. Very little noise is produced by the new loom, perhaps the loudest noise being the contact of the reeds with the lateral surfaces of the shuttles. The reed and heddle drives of the loom also enable finer count fabric to be woven.

It is, therefore, a principal object of the invention to provide a high production loom of the progressive shedding type having the advantages outlined above.

Another object of the invention is to provide a loom of the progressive shedding type capable of weaving fine count fabrics.

Numerous other objects and advantages of the invention will be apparent from the following detailed description of a preferred embodiment thereof, reference being made to the accompanying drawings, in which:

FIG. 1 is a side elevational view of a loom embodying the principles of the invention;

FIG. 2 is an enlarged, fragmentary, detailed plan view of the shuttles and reeds shown in FIG. 1;

FIG. 3 is an enlarged, fragmentary, front elevational view of a reed cam roll and a plurality of reeds shown in FIG. 1;

FIG. 4 is a side elevational view of the reed cam roll and a reed shown in FIG. 3; and

FIG. 5 is a side elevational view of a heddle drive shown in FIG. 1.

Referring to the drawings, and more particularly to FIG. 1, a loom 10 embodying the present invention includes a main frame 12, a supply of warp threads 14, and a take-up spool 16 mounted on an auxiliary frame 18, on which spool is wound a fabric 20 woven by a weaving section indicated at 22. Any suitable source of supply can be used for the warp threads, such as a beam or creel, as is well known in the art. The spool 16 can be driven directly or drive rolls can be employed between the frame 12 and the spool 16, as is known in the art. While the loom 10 employs only the one weaving section 22, it will be readily understood that a second weaving section inverted and located above the section 22 can be employed so that two fabrics or a double fabric can be woven at the same time. A loom employing a double weaving section similar to the section 22 is shown more fully in a co-pending application of Games Slayter, Serial No. 76,340 filed on December 16, 1960. See also a co-pending application of W. H. Ewing, Serial No. 79,639, filed on December 30, 1960.

The warp threads for the fabric 20 are carried to an intermediate point of the weaving section 22 where they are woven with fill or woof threads which are carried by shuttles 24 (FIGS. 1 and 2). Each of the shuttles has symmetrical forward and trailing edge portions or surfaces 26 and 28 which are angularly disposed with respect to the path of the individual reeds and the warp threads. A fill thread 30 is carried on a bobbin in the shuttle 24 and is fed through a slot in a rear tapered edge portion 32 as is shown in more detail in the aforementioned co-pending patent application. The symmetrical configuration of the shuttle 24 enables it to travel in either direction across the warp threads so that it need not be predisposed in a particular position before being fed across the warp.

As shown in FIG. 2 a number of the shuttles 24 are

moved across the warp threads at any given instant by a plurality of separate and separately operated reeds 34 which are moved progressively with an undulatory or generally wave-like motion by a reed cam roll 36 to cause tip portions 38 (FIGS. 3 and 4) of the reeds 34 to engage the angular surfaces 28 of the shuttle with successive contacts. This motion propels the shuttles across the loom by a camming action, the frequency of the wave-like motion of the reeds being such that a number of shuttles are propelled across the fabric at the same time, one behind the other. As shown in FIGS. 3 and 4, the reeds 34 are pivotally mounted on a common shaft 40 which is supported on the frame 12 by blocks 42 (FIG. 1). The shaft 40 is positioned so that the reed cam roll 36 contacts intermediate portions of the reeds 34 between the shaft 40 and the tips 38. The cam roll 36 includes a plurality of individual cams 44, all of which are identical and are arranged in predetermined fixed positions, each slightly angularly rotated with respect to each adjacent one so that an undulatory motion is established for the row of reeds when the cam roll is rotated. The particular shape of each of the cams 44, as seen in FIG. 4, is shown only for purposes of illustration and is not intended to represent the exact shape of the individual cams. This also applies to the portion of the cam roll 36 shown in FIG. 3.

While the cams 44 can be mounted in a number of ways, as shown, they are mounted on a shaft 46 by a key 48 located in the notches 50 of the individual cams 44. The notches 50 are machined in slightly different circumferential positions around holes 52 of the individual cams 44 so that each cam will be circumferentially displaced a predetermined constant angle from its adjacent cam when they are mounted on the shaft 46. By way of example, when the shuttles 24 are to be moved across the warp at six inch intervals, the notches 50 of the cams 44 will be displaced 7½ degrees from the notches of the adjacent cams.

It will be understood that, particularly for finer count or more finely woven fabrics, the reeds 34 must be quite thin in order for them to extend between the warp threads of the fabric. On the other hand, the reeds 34 must be sufficiently thick to withstand the lateral reactive force acting on them when they contact the angular surfaces 28 of the shuttles 24. To overcome this conflict, the tip portions 38 of the reeds 34 are made considerably thinner, preferably not more than ½ as thick as the main portions of the reeds 34, so that they can project upwardly between the warp threads and at the same time enable the main portions of the reeds 34 to lie in sliding contact one with another. While the main portions of the reeds 34 as shown in FIG. 3 appear to be spaced apart, this is only for clarity of illustration and, in actuality, the reeds lie in contiguous, sliding contact. This arrangement has the advantage that each of the reeds 34 can rely in part upon the adjacent reeds 34 to provide lateral stiffness, because a substantial part of each of the reeds 34 will be in contact with the adjacent reeds during all portions of their reciprocatory movements. The lateral reacting force on the reeds 34 is also maintained at a minimum by designing the contour of the shuttles 24 and the movement of the reeds 34 so that a minimum of three reeds, and preferably more, always engage the angular edges 28 of the shuttles 24. Of course, the larger the number of the reeds 34 engaging the angular edge 28, the less will be the lateral force acting on any one of the reeds 34 which tends to bend them to one side. While the tips 38 of the reeds 34 are quite thin and thus tend to be more flexible, at the same time, they are quite short and if necessary can be made of stiffer or more dense material than the main portions of the reeds 34. The main portions of the reeds 34 are preferably relatively light in weight to minimize their momentum and enable them to more easily follow the cam roll 36. For this purpose also, the reeds are provided with springs 54 or other suitable resilient means to urge them against the cams 44.

The warp threads are given a sequential vertical motion as the shuttles 24 are moved thereacross by means of a plurality of heddles 56 and 58 (FIG. 5) having eyes 60 and 62 at their tip portions through which the warp threads pass. Because there is an individual heddle 56 or 58 for each of the warp threads, difficulty is sometimes experienced in being able to pack in enough heddles laterally across a loom of the progressive shedding type, particularly when finer count fabrics are being woven. To alleviate this problem, the heddles 56 and 58 in this instance are made of long, flexible wires which extend through a single guide bar 64 and through guide tubes 66 and 68 to a point remote from the warp threads. The ends of the wires constituting the heddles 56 and 58 opposite the eyes 60 and 62 are pivotally attached by suitable pivot pins 70 and 72 to end portions of heddle lever arms 74 and 76 which are located in a common vertical plane and are reciprocated by a common cam 78 constituting part of a heddle cam roll 80. With this arrangement, two adjacent heddles can be driven by means of a single cam and with spaced but aligned heddle lever arms, the tip portion of one of which may be slightly offset to provide the necessary lateral displacement of the adjacent heddles. One row of heddle lever arms can be pivotally mounted on a common shaft 82 on one side of the cam roll 80 and the other row of heddle lever arms 76 can be mounted on a common shaft 24 located on the other side of the heddle cam roll 80. The shafts 82 and 84 and the cam roll 80 are positioned in a manner such that the individual cams 78 contact intermediate portions of the lever arms 74 and 76 between the pivot pins 70 and 72 and the shafts 82 and 84. The lever arms 74 and 76 are maintained against the cam 78 by suitable resilient means or springs 86 and 88 which are connected to the tips of the lever arms 74 and 76 and to portions of the frame 12. While as shown in FIG. 5 the upper portions of the heddles 56 and 58 are aligned, it is to be understood that this is not essential and that the heddles 56 and 58 can be staggered or displaced slightly longitudinally of the warp threads with separate guide bars 64 employed to conserve even more lateral space, if necessary. Also, an additional cam roll 80 can be employed if the number of heddle lever arms operated by one heddle cam roll is insufficient. The additional heddle cam rolls can also be driven at different speeds to provide a greater variety of fabric patterns.

As shown in FIG. 1, the reed cam roll 36 and the heddle cam roll 80 are driven by the same motor and variable speed drive 90 through suitable chain and sprocket connections indicated at 92. Any suitable drive can be employed as long as the reed cam roll 36 and the heddle cam roll 80 are synchronized to properly coordinate the movement of the reeds 34 and the heddles 56 and 58.

While the operation of the loom 10 will be evident from the above discussion, a brief description of the operation will be set forth. The shuttles 24 are moved at a constant speed and with constant spacing across the set of warp threads by the reeds 34 through engagement of the tips 38 with the trailing angular edges 28 of the shuttles 24, several of which tips are in contact with each of the shuttle edges at any given instant. The row of tips 38 and the reeds 34 is operated with an undulatory motion by rotation of the reed cam roll 36 through the motor 90 and the connections 92. The particular shape of the undulatory motion is determined by the configuration of the individual reed cams 44 and their positions relative one to another. When the shuttles reach the end of the fabric, they then may be transferred back to the opposite side by any suitable conveying means, or, where two fabrics are used, they will be moved across the other fabric by similar reeds. While the shuttles 24 move across the warp, the heddles 56 and 58 control the posi-

tions of the warp threads by means of the lever arms 74 and 76 and the heddle cam 78 which operates both arms and which, in turn, is rotated by the motor 90 through the driving connections 92.

It will be seen from the accompanying drawings and the above discussion that the loom according to the invention can be made relatively compact and can be used for fine count fabrics because of the nature of the reed and heddle design. Thus, the reeds 34 can be quite thin and closely packed for finer count fabrics with the warp threads thereof passing between the thin tips 38 and with sliding contact between the adjacent reeds to provide lateral stiffness therefor. The particular design of the heddles enables a maximum number to be placed in a given space laterally of the loom and yet provide simple operation. In addition, the individual parts are of relatively simple shape and parts of each unit are of similar shape so that their manufacture is relatively inexpensive. As previously discussed, vibration and jarring are also minimized because of the rotary motion of many of the parts and the relatively smoother reciprocatory motions of other parts.

Various modifications of the above-described embodiment of the invention will be apparent to those skilled in the art and it is to be understood that such modifications can be made without departing from the scope of the invention, if within the spirit and tenor of the accompanying claims.

What we claim is:

1. In a loom of the progressive shedding type, a frame, a shaft mounted horizontally on said frame, a plurality of reeds mounted on said shaft in contiguous relationship, the adjacent reeds being in slidable contact one with another, said reeds having thin tip portions adapted to extend between warp threads, a reed cam roll rotatably supported on said frame in a position spaced from said shaft to contact portions of said reeds spaced from said shaft and from said tip portions, means for rotating said reed cam roll about an axis parallel to said shaft, a supply of warp threads, means spaced from said supply for moving said warp threads in parallel, spaced relationship across said frame a plurality of flexible wire heddles, ends of which engage said warp threads, a plurality of guide means supported by said frame for guiding said heddles through movements laterally of said warp threads, a plurality of lever arms pivotally connected to ends of said heddles opposite the warp-engaging ends, a lever arm shaft on which said lever arms are pivotally mounted, a heddle cam roll mounted on said frame and spaced from said lever arm shaft, means for rotating said heddle cam roll for rotation about an axis parallel to said lever arm shaft to contact portions of said lever arms spaced from said lever arm shaft, a plurality of shuttles riding on a portion of said warp threads, each of said shuttles having a surface angularly disposed with relation to and intersecting the paths in which at least three of said reeds move, said shuttles being moved across said warp threads when the surfaces of said shuttles are engaged by said tip portions of said reeds, a plurality of the tip portions engaging said surfaces at any given instant, and means for coordinating rotational movement of said cam rolls.

2. In a loom of the progressive shedding type, a frame, a shaft mounted horizontally on said frame, a plurality of reeds mounted on said shaft in contiguous relationship, the adjacent reeds being in slidable contact one with another, said reeds having thin tip portions adapted to extend between warp threads, a reed cam roll rotatably supported on said frame in a position spaced from said shaft to contact portions of said reeds spaced from said shaft and from said tip portions, means for rotating said reed cam roll about an axis parallel to said shaft, a supply of warp threads, means spaced from said supply for moving said warp threads in parallel, spaced relationship across said frame, a plurality of heddles, ends of which engage said warp threads, a plurality of guide means supported by said frame for guiding said heddles through movements laterally of said warp threads, a heddle cam roll comprising a plurality of individual heddle cams, two heddle lever arm shafts supported by said frame on opposite sides of said heddle cam roll, a heddle lever arm pivotally mounted on each of said lever arm shafts for each of said heddle cams and contacting the heddle cam on opposite edges thereof, at least a tip portion of one of the lever arms being laterally offset with respect to the other, means for rotating said heddle cam roll for rotation about an axis parallel to said lever arm shafts to contact intermediate portions of said lever arms spaced from said shafts, a plurality of shuttles riding on a portion of said warp threads, and having trailing edges lying angularly to the paths in which the reeds are moved, said shuttles being moved across said warp threads when said trailing edges are engaged by said tip portions of said reeds, and means for coordinating rotational movement of said cam rolls.

3. In a loom of the progressive shedding type, a frame, a shaft mounted horizontally on said frame, a plurality of reeds mounted on said shaft in contiguous relationship, a reed cam roll rotatably supported on said frame in a position spaced from said shaft to contact portions of said reeds spaced from said shaft and from said tip portions, means for rotating said reed cam roll about an axis parallel to said shaft, a supply of warp threads, means spaced from said supply for moving said warp threads in parallel, spaced relationship across said frame, a plurality of heddles, ends of which engage said warp threads, a plurality of guide means supported by said frame for guiding said heddles through movements laterally of said warp threads, a heddle cam roll comprising a plurality of individual heddle cams, two heddle lever arm shafts supported by said frame on opposite sides of said heddle cam roll, a heddle lever arm pivotally mounted on each of said lever arm shafts for each of said heddle cams and contacting the corresponding heddle cams on opposite edges thereof, means for rotating said heddle cam roll for rotation about an axis parallel to said lever arm shafts to contact intermediate portions of said lever arms spaced from said shafts, a plurality of shuttles riding on a portion of said warp threads, and having trailing edges lying angularly to the paths in which the reeds are moved, said shuttles being moved across said warp threads when said trailing edges are engaged by said tip portions of said reeds, and means for coordinating rotational movement of said cam rolls.

4. In a loom of the progressive shedding type, a frame, a supply of warp threads, means spaced from said supply for moving said warp threads in parallel, spaced relationship across said frame, a plurality of flexible wire heddles, ends of which engage said warp threads, a plurality of guiding and supporting tubes held by said frame for guiding and supporting said heddles through movements laterally of said warp threads, a heddle cam roll comprising a plurality of individual heddle cams, two heddle lever arm shafts supported by said frame on opposite sides of said heddle cam roll, a heddle lever arm pivotally mounted on each of said lever arm shafts for each of said heddle cams and contacting the corresponding heddle cams on opposite edges thereof, at least a tip portion of one of each set of lever arms being laterally offset with respect to the other, and means for rotating said heddle cam roll for rotation about an axis parallel to said lever arm shafts to contact intermediate portions of said lever arms spaced from said shafts.

5. In a loom of the progressive shedding type, a frame, a shaft mounted horizontally on said frame, a plurality of reeds mounted on said shaft in contiguous relationship, said reeds having main portions and tip portions, the main portions of the adjacent reeds being in slidable contact one with another, said tip portions being substantially thinner than said main portions of said reeds

to enable said tip portions to extend between warp threads while said main portions remain in slidable contact, a reed cam roll rotatably supported on said frame in a position spaced from said shaft to contact portions of said reeds spaced from said shaft and from said tip portions, means for rotating said reed cam roll about an axis parallel to said shaft, a supply of warp threads, means spaced from said supply for moving said warp threads in parallel, spaced relationship across said frame, a plurality of heddles, ends of which engage said warp threads, a heddle cam roll mounted on said frames for driving said heddles, means for rotating said heddle cam roll, a plurality of shuttles riding on a portion of said warp threads, each of said shuttles having a surface angularly disposed to and intersecting the paths in which at least three of said reeds move, said shuttles being moved across said warp threads when the surfaces of said shuttles are engaged by said tip portions of said reeds, a plurality of the tip portions engaging said surfaces at any given instant, and means for coordinating rotational movement of said cam rolls.

6. In a loom of the progressive shedding type, a frame, a shaft mounted horizontally on said frame, a plurality of reeds mounted on said shaft in contiguous relationship, said reeds having main portions and tip portions, the main portions of the adjacent reeds being in slidable contact one with another, said tip portions being not more than about one-half as thick as said main portions to enable said tip portions to extend between warp threads while said main portions remain in slidable contact, a reed cam roll rotatably supported on said frame in a position spaced from said shaft to contact portions of said reeds spaced from said shaft and from said tip portions, means for rotating said reed cam roll about an axis parallel to said shaft, a supply of warp threads, and a plurality of shuttles riding on a portion of said warp threads, each of said shuttles having a surface angularly disposed to and intersecting the paths in which at least three of said reeds move, said shuttles being moved across said warp threads when the surfaces of said shuttles are engaged by said tip portions of said reeds, a plurality of the tip portions engaging said surfaces at any given instant.

7. In a loom of the progressive shedding type, a frame, a shaft mounted horizontally on said frame, a plurality of reeds mounted on said shaft in contiguous relationship, the adjacent reeds being in slidable contact one with another, said reeds having thin tip portions adapted to extend between warp threads, a reed cam roll rotatably supported on said frame in a position spaced from said shaft to contact portions of said reeds spaced from said shaft and from said tip portions, means for rotating said reed cam roll about an axis parallel to said shaft, a supply of warp threads, means spaced from said supply for moving said warp threads in parallel spaced relationship across said frame, a plurality of flexible wire heddles, ends of which engage said warp threads, a plurality of guiding and supporting tubes held by said frame for guiding and supporting said heddles through movements laterally of said warp threads, a heddle cam roll comprising a plurality of individual heddle cams, two heddle lever arm shafts supported by said frame on opposite sides of said heddle cam roll, a heddle lever arm pivotally mounted on each of said lever arm shafts for each of said heddle cams and contacting the corresponding heddle cams on opposite edges thereof, at least a tip portion of one of each set of lever arms being laterally offset with respect to the other, and means for rotating said heddle cam roll for rotation about an axis parallel to said lever arm shafts to contact intermediate portions of said lever arms spaced from said shafts.

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