Dec. 10, 1946. S. P. PARKER 2,412,353

WEAVING APPARATUS

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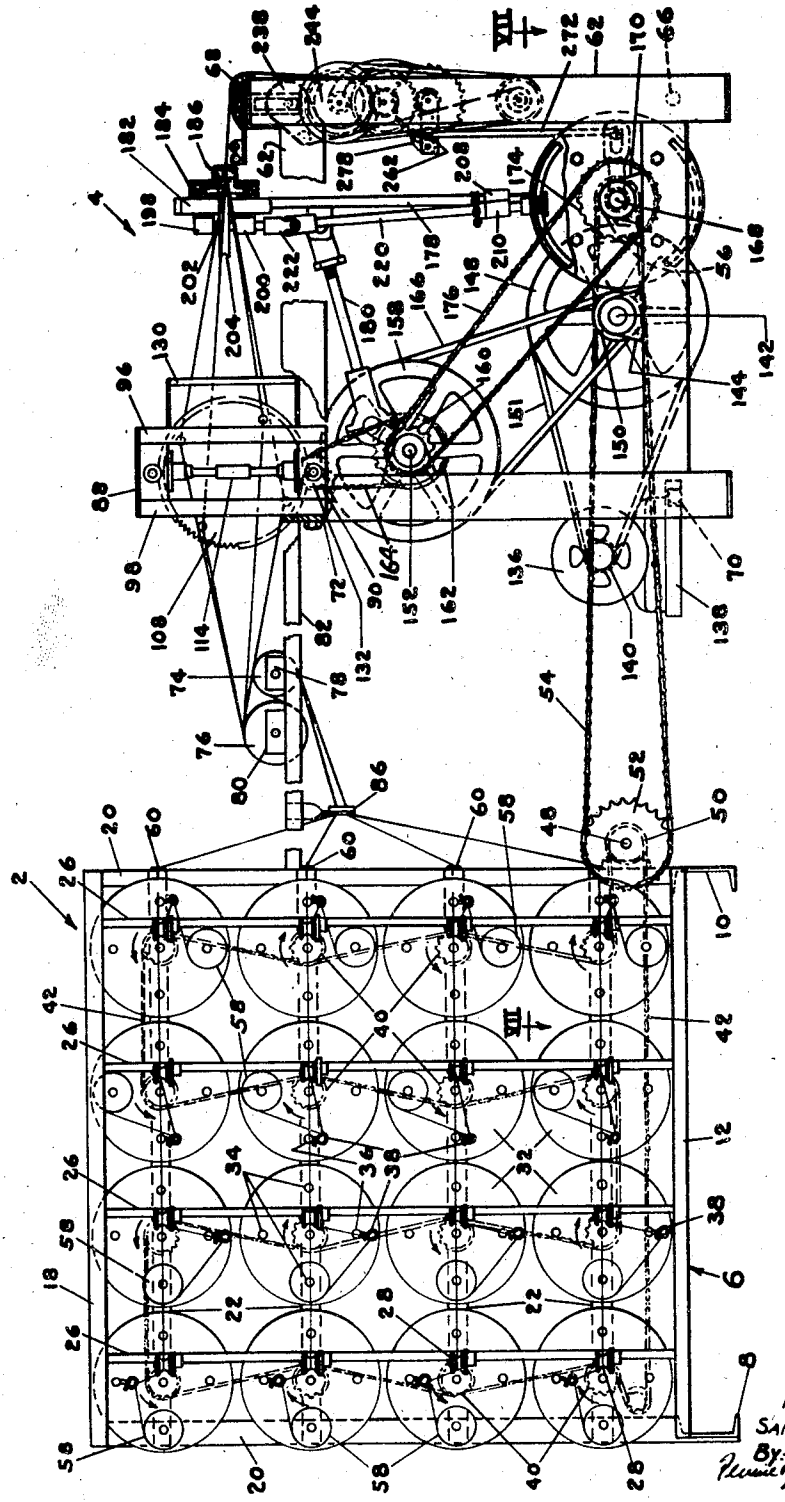


FIG. 1

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WEAVING APPARATUS

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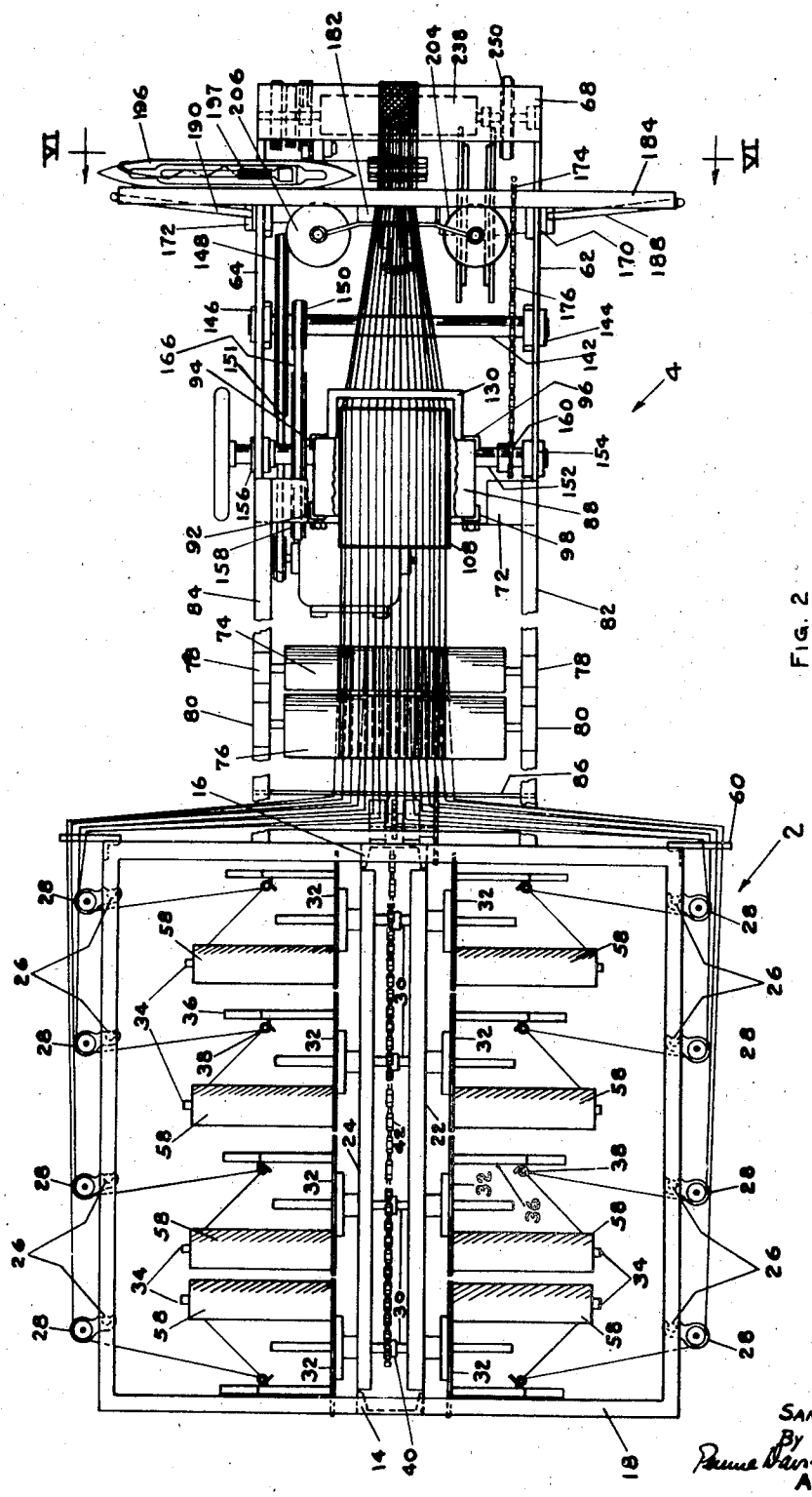


FIG. 2

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Dec. 10, 1946. S. P. PARKER 2,412,353

WEAVING APPARATUS

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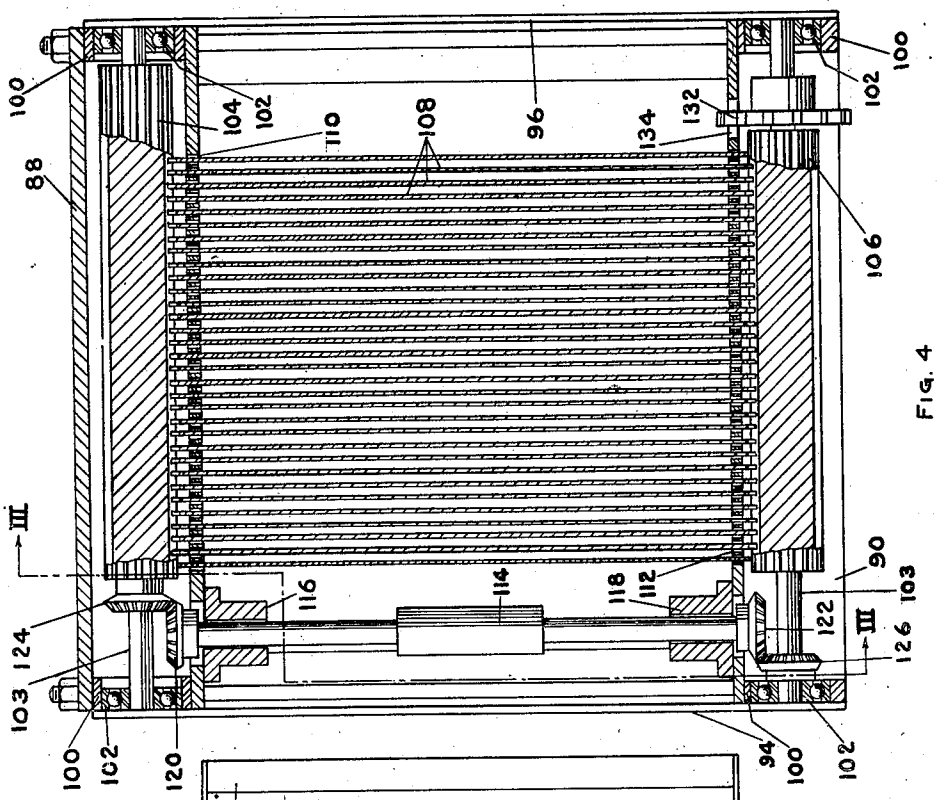


FIG. 4

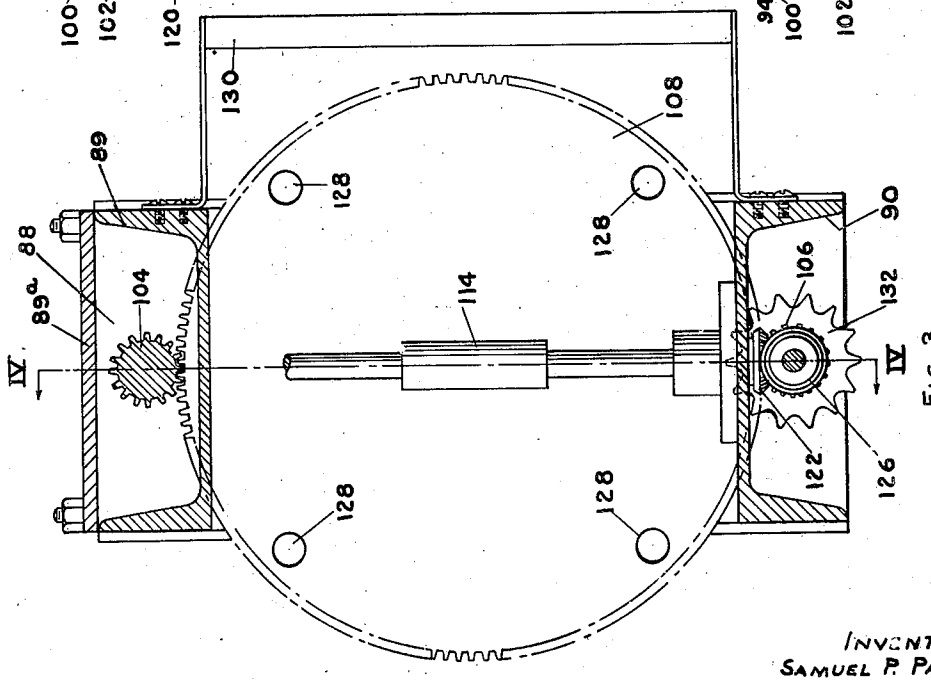


FIG. 3

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WEAVING APPARATUS

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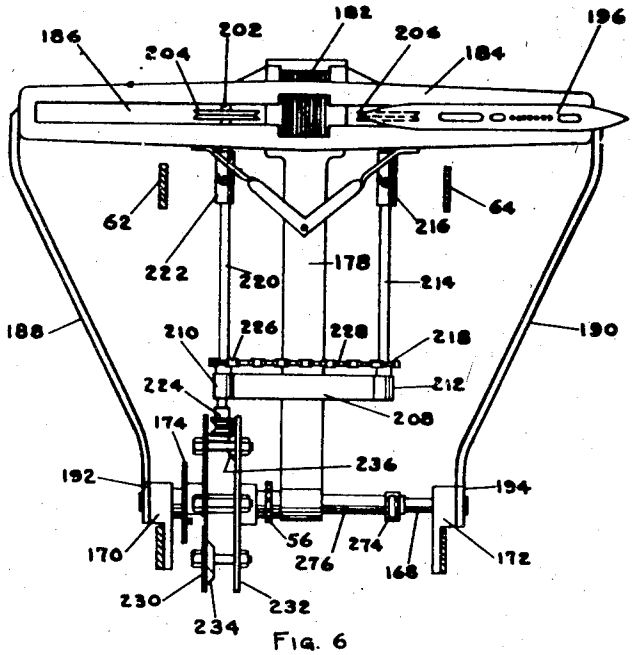


FIG. 6

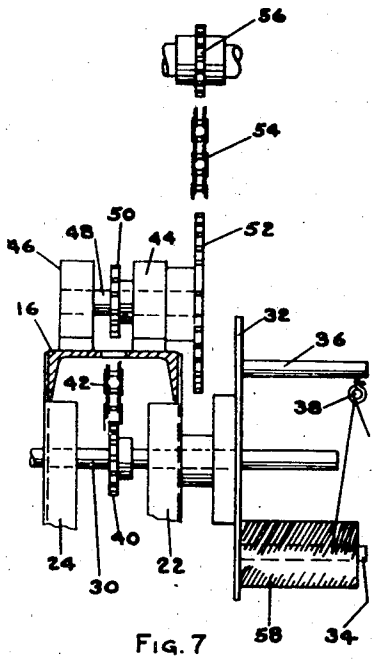


FIG. 7

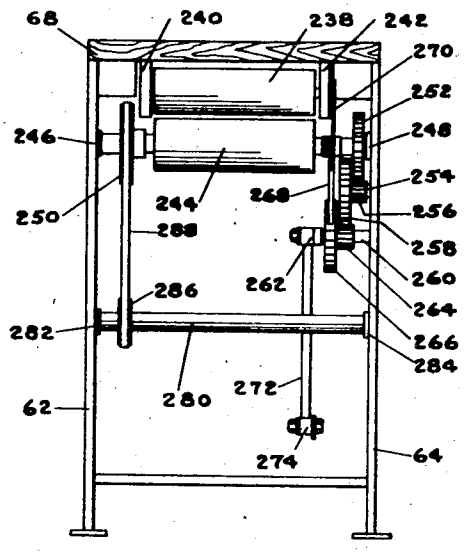


FIG. 5

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WEAVING APPARATUS

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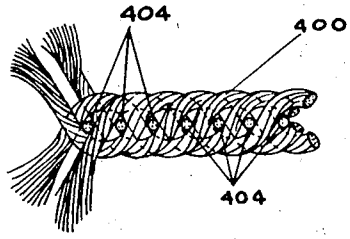


FIG. 10

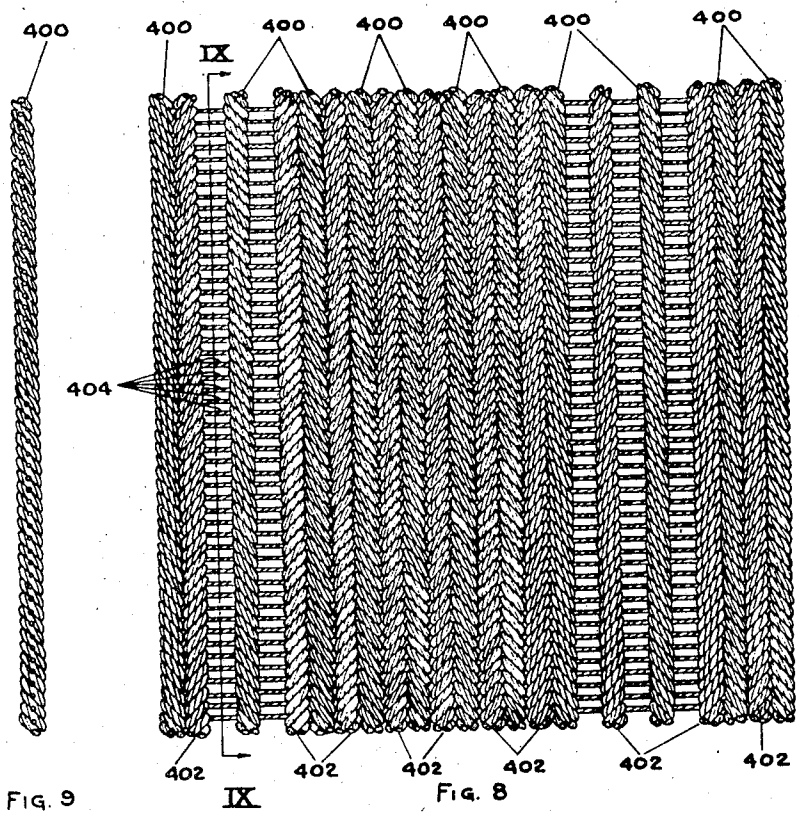


FIG. 9 FIG. 8

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WEAVING APPARATUS

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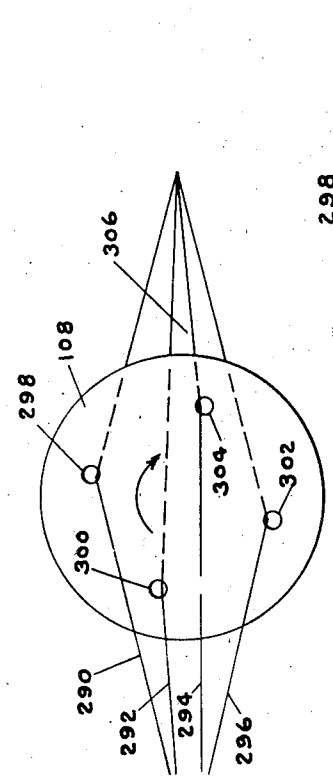


FIG. 12

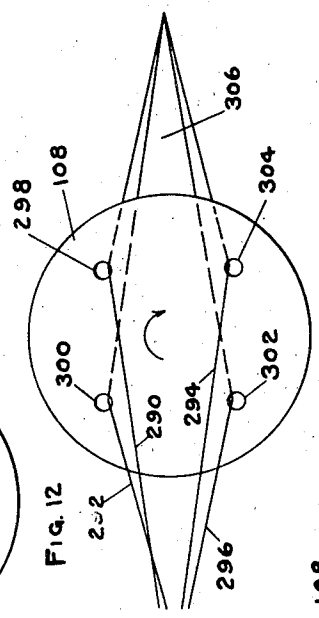


FIG. 14

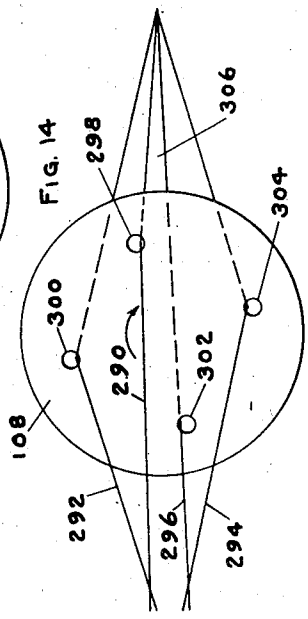


FIG. 16.

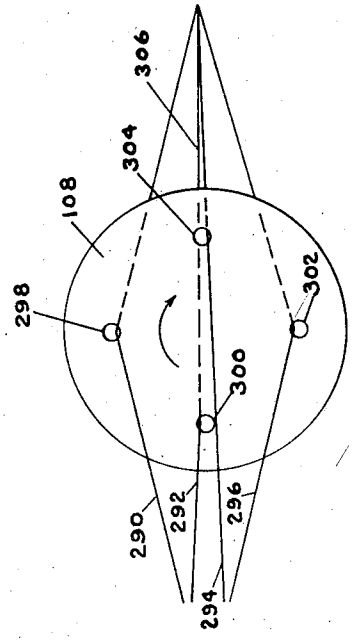
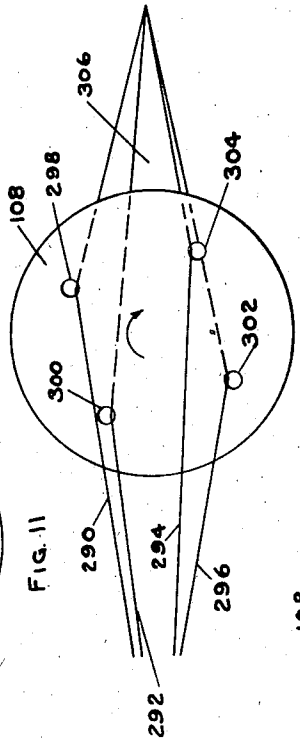


FIG. 11



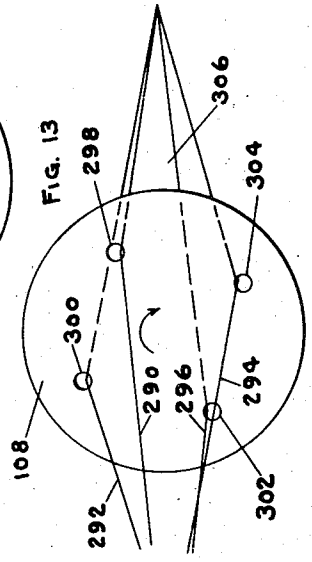


FIG. 13

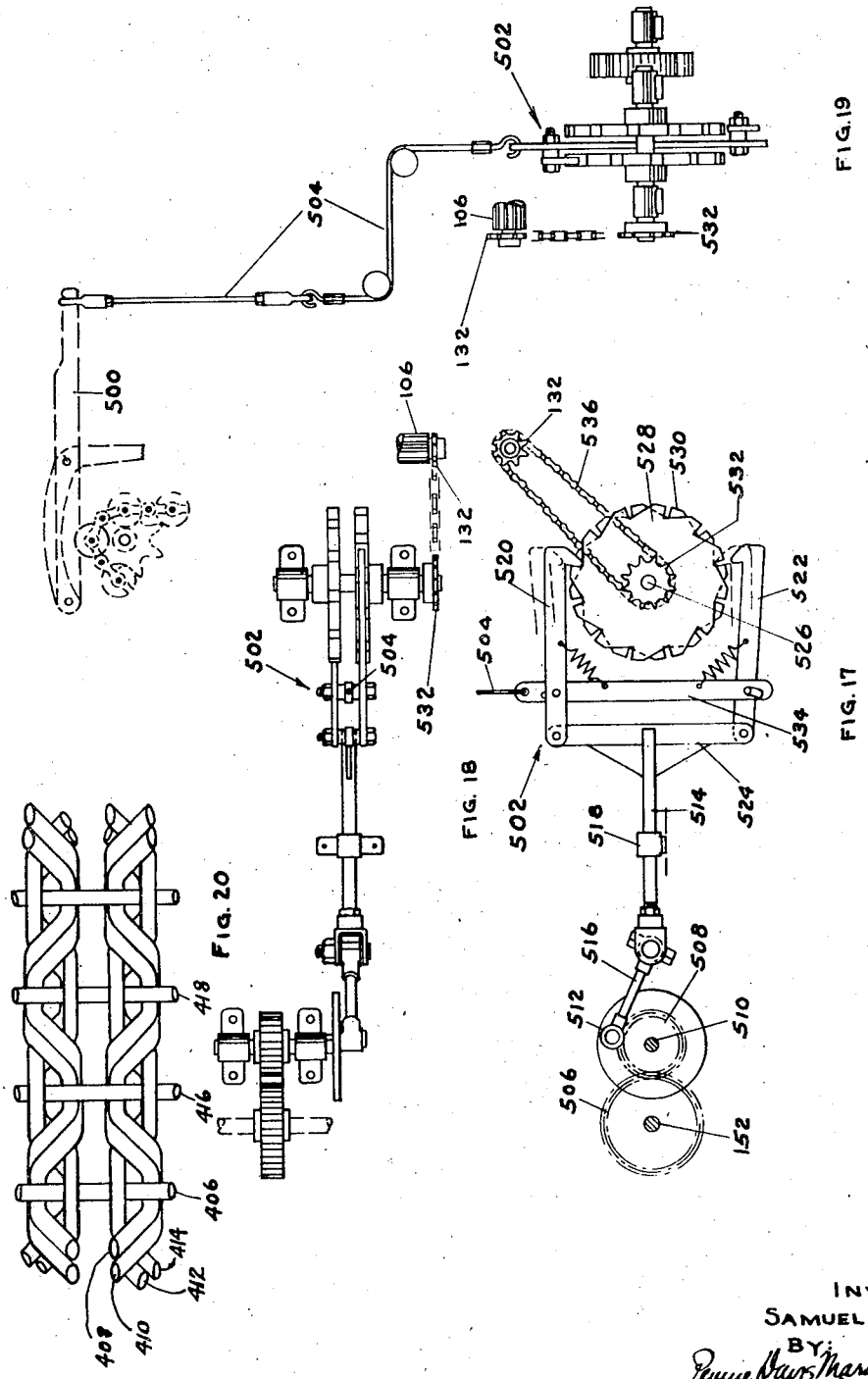
FIG. 15

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WEAVING APPARATUS

Filed Aug. 30, 1944 7 Sheets-Sheet 7



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Patented Dec. 10, 1946

2,412,353

UNITED STATES PATENT OFFICE

2,412,353

WEAVING APPARATUS

Samuel P. Parker, La Grange, Ga., assignor to Callaway Mills, La Grange, Ga., a corporation of Georgia

Application August 30, 1944, Serial No. 551,330

7 Claims. (Cl. 139—104)

1

This invention relates to apparatus for the production of fabrics, in which sets of warp and filling yarns are so interwoven that each warp yarn passes alternately over and beneath successive filling yarns along the fabric and the warp yarns are twisted together in groups to form cables. More particularly, the invention is concerned with a novel creel, in which supplies of warp yarns are mounted in groups and the supplies of a group are manipulated to twist the yarns into cables, which then pass to the shed forming means of the apparatus.

Fabrics of the type above referred to can be produced on looms, generally termed disc or card looms, because the warp yarns are formed into sheds during the weaving operation by means of rotary discs or cards, each of which has openings through which pass the yarns making up a single group. In the operation of such looms, the rotation of the discs causes the yarns controlled by the discs to be twisted together into cables and the twist in each cable runs forward to the fell of the goods and backward to the yarn supplies. Since the continued development of the back twist would soon make it impossible to draw the yarns from the supplies and through the disc openings, it is necessary either that the direction of rotation of the discs be periodically reversed or that the supplies be rotated at a rate and in such direction as to counteract the back twist. The periodic reversal of the discs produces a weave, which is not acceptable for all purposes, while the prior looms, with which I am familiar, in which the warp yarn supplies are rotated, are objectionable in the respects that the warp supplies are not readily accessible, so that changing of the supplies is difficult and time consuming, and the yarns can not be maintained under uniform tension.

The present invention is, accordingly, directed to the provision of a creel for supporting supplies of warp yarn that are to be used in a disc loom, the new creel including readily accessible mountings for the supplies arranged in groups and means rotating the mountings so that the yarns from the supplies in a group are twisted together into a cable having a twist equal and opposite to the back twist developed by the discs. Since the yarns issue from the creel in the form of cables, the cables can be passed to a single tension means and uniform tension maintained on all of them. It is, accordingly, not necessary to provide an individual tension device for each warp yarn supply, which is an arrangement that is provided in prior looms and is objectionable,

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because of the impossibility of adjusting the many tension devices to apply uniform tension to all the yarns.

For a better understanding of the invention, reference may be made to the accompanying drawings, in which:

Fig. 1 is a view of the complete apparatus, including the new creel, in side elevation with parts broken away;

Fig. 2 is a top plan view of the apparatus;

Fig. 3 is a sectional view of a portion of the machine on the line III—III of Fig. 4;

Fig. 4 is a sectional view on the line IV—IV of Fig. 3;

Fig. 5 is a view in end elevation of the take-up mechanism;

Fig. 6 is a partial sectional view on the line VI—VI of Fig. 2;

Fig. 7 is a partial sectional view on the line VII—VII of Fig. 1;

Fig. 8 is a plan view of one form of the fabric produced on the apparatus;

Fig. 9 is a sectional view on the line IX—IX of Fig. 8;

Fig. 10 is a longitudinal sectional view of a length of the fabric on an enlarged scale;

Figs. 11 to 16, inclusive, are schematic views showing different stages in the operation of the combined shedding and twisting mechanism;

Fig. 17 is a view in side elevation of a modified drive for the shedding and twisting means;

Figs. 18 and 19 are plan and end views, respectively of the mechanism shown in Fig. 17; and

Fig. 20 is a plan view on an enlarged scale of another form of the fabric in expanded condition.

The apparatus in the form illustrated in Fig. 1 comprises two main parts, the new creel 2 and a loom 4. The creel includes a base 6 of generally rectangular form made up of parallel channel members 8, 10 connected together by cross members 12, which may be angle irons. A pair of vertical members 14, 16 are secured to the members 8, 10 at their midpoints, and members 14, 16 support a top frame 18 which is further supported from the base by vertical members 20. Extending across the creel between the vertical central supports 14, 16 are spaced horizontal members 22, 24 arranged in two vertical series, and a series of spaced vertical rods 26 extend between opposite sides of the frame 18 and the cross members 12 of the base. Each rod 26 carries a plurality of spool guides 28 in spaced re-

A number of horizontal shafts 30 are mounted in bearings at spaced intervals on the cross members 22, 24, and the shafts extend laterally beyond the cross members and with their axes substantially tangent to respective guides 28, as illustrated. A pair of discs 32 are mounted on each shaft for rotation in a vertical plane, and each disc carries a plurality of spindles 34, 36, which extend parallel to the axis of the shaft on which the disc is mounted and are spaced radially therefrom. Spindles 34 are for yarn packages, while spindles 36 carry yarn guides 38, which are of the pigtail type. These guides may, if desired, be mounted on the ends of shafts 30.

Each of shafts 30 carries a sprocket gear 40 lying between the horizontal supports 22, 24, and a chain 42 is trained about the several sprocket gears. Bearings 44, 46 are attached to the vertical member 16 near its lower end, and a shaft 48 is mounted for rotation in the bearings. Shaft 48 carries sprocket gears 50, 52 and chain 42 passes from sprocket gears 40 through a slot in member 16 and is trained about gear 50. Shaft 48 is driven by a chain 54 trained about sprocket gear 52 and driven by a sprocket gear 56 mounted on one of the shafts of loom 4.

In the construction shown, one spindle 34 on each disc 32 carries a yarn package 58 on which four ends of yarn are wrapped. If desired, single end packages may be employed, the packages being mounted on separate spindles 34 on each disc. All the ends of yarn from one or more packages on the same disc 32 are led through the guide 38 on spindle 36 on that disc and the groups of yarns pass around one of the guides 28 and through one of a number of guides 60 mounted on vertical members 20 of the creel structure on the side toward the loom.

The loom 4 includes sides 62, 64 connected by horizontal cross members 66, 68, 70, and 72. The loom is provided with friction rolls 74, 76 mounted, respectively, in bearings 78 and 80 on horizontal bars 82, 84, the bars being supported at one end on cross member 72 of the loom and at the other end on a suitable part of the creel structure. Bars 82, 84 also support a comber or guide board 86, through which the groups of yarns pass on their way from the guides 60 to friction roll 74.

The mechanism in the loom, by which the warp yarns are manipulated to form sheds and are also twisted together into groups, comprises upper and lower horizontal supports 88, 90 connected by vertical members 92, 94, 96, and 98 to form a generally box-like structure. The vertical supports 92 and 98 are connected to the cross member 72 of the loom frame. Support 88 may include a channel member 89 and a top plate 89a, while support 90 may be a channel member. Blocks 100 are mounted between the legs of the channel members 89, 90 and carry upper and lower sets of bearings 102, in which are mounted upper and lower shafts 103, each of which carries a long gear 104, 106.

A plurality of discs, indicated generally by the rectangle 108, Fig. 2, are mounted in face-to-face relation between gears 104, 106 and have peripheral teeth meshing with the teeth of the gears. The edges of the discs extend through slots 110, 112 in members 88 and 90, respectively, and the engagement of the discs with the walls of the slots maintains the discs in vertical position and at the proper spacing. A vertical shaft 114 is mounted for rotation in bearings 116, 118 attached to members 88, 90, and the shaft is provided with bevel gears 120, 122 meshing, respectively, with bevel gears 124, 126 on the shafts 103. Each disc 108 is formed with openings 128 equally spaced about the center of the disc and serving as guides for the individual warp yarns. A vertical grill 130 lies in front of the group of discs 108 and is mounted on members 89, 90. A sprocket gear 132 is mounted on lower shaft 103, and the web of channel member 90 is formed with a slot 134 through which the gear projects.

The apparatus is driven by a motor 136 mounted on a base 138 attached to cross member 70 of the loom and the motor is provided with a pulley 140. A countershaft 142 is mounted in bearings 144, 146 attached to loom sides 62, 64, and shaft 142 carries pulleys 148, 150. The motor drives the countershaft by a belt 151 trained about pulleys 140 and 148.

A crankshaft 152 is rotatably mounted in bearings 154, 156 on the loom sides 62, 64, and the crankshaft is provided with pulley 158 and sprocket gears 160, 162. A chain 164 connects sprocket gear 162 with sprocket gear 132 on the lower shaft 103 of the twisting and shedding mechanism. The crankshaft is driven from the countershaft pulley 150 by belt 166 trained about pulley 158 on the crankshaft.

A shaft 168 is mounted in bearings 170, 172 on the loom sides, and this shaft carries sprocket gears 56 and 174 mounted for free rotation thereon but connected together. Sprocket gear 174 is driven from the crankshaft 152 by chain 176 trained about the gear and about sprocket gear 160 on shaft 152.

A lay sword 178 is rigidly attached to shaft 168, and the sword is reciprocated by a connecting rod 180 attached to the crank of crankshaft 152. A reed 182 is mounted on the upper end of the lay sword, and a lay 184 is secured to the reed. The lay is provided with a T-shaped slot 186 extending lengthwise thereof, and the ends of the lay are supported by rods 188, 190 rigidly attached to shaft 168 by means of collars 192, 194. A shuttle 196, carrying a bobbin 197, is provided with a T-shaped projection which lies within slot 186 in the lay and has a V-shaped friction surface extending lengthwise thereof in its rear face and exposed beyond the lay. The lay carries pairs of bearings 198, 200 on opposite sides of the reed, and a shaft 202 is mounted in each pair of bearings. Shafts 202 carry pulleys 204, 206, and each pulley has a V-shaped rim engageable with the friction member of shuttle 196.

The lay sword carries a cross bar 208, at the ends of which are mounted bearings 210, 212. A shaft 214 is mounted at one end in bearing 212, and at its other end, the shaft is connected to shaft 202 of pulley 206 through a universal joint 216. Shaft 214 is also provided with a sprocket gear 218. A shaft 220 is mounted in bearing 210 and has a portion extending below the bearing. Shaft 220 is connected at its upper end to shaft 202 of pulley 204 by means of universal joint 222 and, at its end below bearing 210, shaft 220 carries a grooved pulley 224. Shaft 220 is provided with a sprocket gear 226, and shafts 214 and 220 are connected by a chain 228 trained about the sprocket gears on the two shafts.

A pair of discs 230, 232 are rotatably mounted on shaft 168 between sprocket gears 174 and 56 and are secured together and to the gears. The discs have friction surfaces 234, 236 which extend over portions of their opposed faces and are offset so that they alternately engage pulley 224.

As the discs 230, 232 are rotated, the engagement of the surfaces thereon with pulley 224 causes shafts 220 and 214 to rotate in unison, first in one direction and then in the other. This results in the pulleys 204, 206 being rotated to move the shuttle back and forth along the lay.

The take-up mechanism of the loom comprises a roller 238 rotatably mounted in slotted bearings 240, 242, depending from cross member 68 of the loom. Another roller 244 is mounted below roller 238 in bearings 246, 248 carried by the loom sides 62, 64, respectively, and the shaft of roller 244 carries a pulley 250 and a spur gear 252. A stub shaft 254 mounted in a bearing on loom side 64 carries spur gears 256 and 258, gear 256 meshing with gear 252 on the shaft of roller 244. Another stub shaft 260 is mounted at one end in a bearing on loom side 64 and at its other end, the shaft has a lever 262 attached to it. Shaft 260 carries a spur gear 264 meshing with gear 258, and a ratchet wheel 266. A stop pawl 268 is loosely mounted on the shaft of roller 244, and the pawl is held in engagement with the teeth of ratchet wheel 266 by a leaf spring 270 attached to the cross member 66 of the loom.

A rod 272 is adjustably and pivotally connected to lever 262 near the end of the lever, and the rod is similarly connected to a lever 274 secured to a collar 276 rigidly attached to the rocking shaft 168. A spring-actuated pawl 278 mounted near the end of lever 262 engages ratchet wheel 266 and advances it by one tooth whenever rod 272 is moved upwardly.

A take-up roller 280 is rotatably mounted on bearings 282, 284 in the loom sides 62, 64 respectively, and the roller is provided with a pulley 286 driven through belt 288 from pulley 250 on the shaft of roller 244.

In the use of the apparatus illustrated, all the warp yarns that are to be twisted together in a group are drawn from supplies mounted on a single disc 32 in the creel and, for this purpose, a number of yarn packages may be mounted on spindles 34 on the disc or a single package wrapped a number of ends up may be employed. The latter type of package is shown and, as each group of yarns to be twisted together into a cable is made up of four ends, the packages 50 are wrapped four ends up. The yarns from the package on each disc pass through the guide 38 on the spindle 36 of that disc, and thence pass in cable form around a guide 28 to one of the guides 60. The cables then pass through the guide board 66, beneath and around friction roll 74, and beneath and around friction roll 76. The yarns in each cable are then passed through the openings in one of the discs 100 which form part of the twisting and shedding mechanism.

It will be noted that the discs 32 on alternate shafts 30 in a vertical row in the creel are rotated in one direction, while the discs on the remaining shafts are rotated in the reverse direction. As a result, certain of the cables issuing from the creel have an S-twist while the remainder have a Z-twist. The warp yarns so twisted together into cables in the creel are untwisted by the action of discs 100 and then retwisted and, at the same time, the discs perform their shedding function. The operation of the discs is made clear in Figs. 11 to 16, inclusive.

Referring to Fig. 11, the four warp ends 290, 292, 294, and 296 in a single cable are passed, respectively, through openings 298, 300, 302, and

304 of their disc 100. As all of the discs rotate clockwise and some of the cables to be acted thereon have one twist and the others have the reverse twist, the yarns in a particular cable will be passed through the holes in their discs either from front to back, as the disc is viewed in Fig. 11, or from back to front, so that the disc rotating clockwise will perform its untwisting and retwisting function. When the disc is in the position shown in Fig. 11, the openings 300 and 304 lie in a horizontal line across the disc, and yarns 292 and 294 lie close together so that there is no shed through which the shuttle may pass. As the disc rotates to the position shown in Fig. 12, yarns 292 and 294 begin to separate so that the shed 306 begins to open. As the rotation of the disc continues through the position shown in Fig. 13, the disc ultimately reaches the position shown in Fig. 14, in which openings 298 and 300 are in a horizontal line and openings 302 and 304 are similarly aligned horizontally. With the disc in this position, yarns 290 and 292 lie in the upper level of shed 306 and yarns 294 and 296 lie in the lower level. At this time, the shed is sufficiently open to permit the passage of the shuttle. As the discs continue to rotate through the positions shown in Figs. 15 and 16, the shed closes, and when the openings 300 and 302 are in an upper horizontal line and openings 298 and 304 are in a lower horizontal line, the shed is again opened for the passage of the shuttle. An open shed is formed four times during the rotation of the discs, and the shuttle is passed through each open shed.

The discs 100 are rotated in synchronism with the discs 32, and when the warp ends in a cable which have been twisted together by rotation of their disc 32 are passed through the openings in a disc 100 in the proper direction, the rotation of disc 100 causes the twist to be removed from the yarns in the cable as the yarns approach the disc. As the yarns leave the disc, their original twist is restored. The discs thus serve to untwist and retwist the warp cables, and, during that operation, the discs separate the yarns to form a succession of sheds for the passage of the shuttle.

The lay 104 is swung back and forth by the action of crankshaft 152 in timed relation to the rotation of discs 100 so that the lay is in its left-hand position each time a shed is formed. After the passage of the shuttle through the shed, the lay moves to the right and the inserted filling yarn is beaten up in the usual way.

The fabric produced passes over the cross member 68, and then under and around roll 244, over and around roll 238, and over and downwardly around take-up roll 280. The rolls are actuated by ratchet wheel 266 and pawl 278 mounted on lever 262, the lever being actuated by rod 272 connected to yarn 274 on the rock shaft 168.

Various types of fabric may be produced by means of the apparatus described, and one such fabric is illustrated in Figs. 8 to 10, inclusive. The fabric comprises warp yarn cables 400, 402, each cable containing four ends and the ends of cables 400 having an S-twist while those of cables 402 have a Z-twist. The cables 400, 402 are arranged in alternation across the fabric, but the arrangement used is a matter of choice. The filling yarns 404 are inserted to pas through each warp cable, so that two ends of the cable pass over and two pass beneath the filling yarn at each point of crossing of the warp and filling yarns. The filling yarns may, accordingly, be wholly concealed and lie in a plane intermediate the planes of the faces of the fabric, as shown

in Figs. 9 and 10. It is to be understood that all the warp cables in the fabric may have the same twist, and the number of ends in each cable may be greater or less than four, as desired. When the fabric is made with comparatively heavy warp yarns and a light filling, the product is suitable for use as a floor covering. Various novel effects may be obtained by varying the twist in the warp cables and, if desired, certain cables may be omitted for decorative effects. In all forms of the new fabric, the warp and filling yarns are tightly bound together by reason of the warp yarns being twisted together into cables and the filling yarns passing through the cables.

Fabrics in which the individual warp cables have the same twist throughout the length of the fabric can best be made by the use of the apparatus including the new creel provided with means for twisting the warp yarns together in cables. The reason for this is that the discs 108 cause the twist to run backward toward the yarn supplies and this would soon interfere with the free movement of the yarns from the supplies, if not prevented from doing so. The twisting means on the creel counteracts the twist at the rear sides of the discs, and by twisting the yarn leaving the supplies into cables of proper twist, the continued rotation of the discs in one direction does not produce a twist at the rear side which would ultimately prevent the yarns being supplied to the discs.

Instead of twisting the warp ends together into cables on the creel, the cables may be formed in a preliminary operation. Such cables may then be supplied to the loom in any convenient manner and the yarns in each cable will be passed through respective openings in a disc 108. The cable twist will counteract the backward twist effected by the disc, and the discs may run continuously in one direction so that the final product, the individual warp cables will have the same twist throughout.

A creel provided with twisting means may be omitted provided the direction of rotation of discs 108 is periodically reversed, and when the discs are thus operated, fabrics differing in appearance from that shown in Fig. 8 may be obtained.

One such fabric is illustrated in Fig. 20 and it includes filling yarns 406 interwoven with warp cables containing four ends in each cable. The ends making up one such cable are designated 408, 410, 412, and 414, respectively, and it will be noted that the ends 408 and 410 pass beneath the pick of filling yarn 406 at the extreme left of the figure, the ends lying one above the other directly beneath the pick. The ends 412 and 414 pass over the same pick in the same manner. Between that pick and the next one to the right, designated 416, the ends 408, 410, 412, and 414 are twisted together with an S-twist and the ends 408 and 410 pass beneath pick 416, while the ends 412 and 414 pass over it. Beyond pick 416 to the right, the twist in the cable is reversed and the ends have a Z-twist. The ends 408 and 410 then pass beneath the next pick 418, while the ends 412 and 414 pass over that pick. The reversals in the warp cable twist continue throughout the length of the fabric. The yarns in adjacent cables may be manipulated in the same manner as ends 408-414, inclusive, but, preferably and as illustrated, the twist in these cables between adjacent picks is the opposite of the twist in the cables made up of ends 408-414, inclusive, between the same pair of picks.

A mechanism by means of which the direction of rotation of discs 108 can be periodically reversed is disclosed in Figs. 17, 18, and 19. This mechanism includes a dobby head provided with a harness lever 500 which controls the action of a double-acting pawl 502 through cord 504. The pawl is operated by the following means: A gear 506 mounted on crankshaft 152 of the loom meshes with a gear 508 fast on a shaft 510, which carries an eccentric 512 operating a reciprocating rod 514 by means of connecting rod 516. Rod 514 is movable through a guide 518. The double pawl mechanism comprises individual pawls 520, 522, each of which is pivotally secured at one end to a bar 524 and has a pawl hook at the other end. The bar 524 is attached to rod 514 and reciprocated thereby.

Pawls 520, 522 operate, respectively, on ratchet wheels 526, 530 fast on shaft 526, and the shaft also carries a sprocket wheel 532 connected by a chain 536 to sprocket wheel 132 on the lower shaft 103 of the mechanism for rotating discs 108. The pawls 520, 225 are operated in alternation under the control of the dobby head by means of a bar 534 attached to cord 504 and having pin and slot connections to each of pawls 520, 522.

In the operation of the mechanism described, the rotation of the crankshaft 152 of the loom effects reciprocation of bar 524 and of pawls 520, 522 attached thereto. Only one of these pawls operates at any time, and the effective pawl causes stepwise rotation of shaft 526 and of shaft 103 of the mechanism which rotates discs 108. From time to time, under the control of the dobby head, the pawl previously effective is put out of action and the other pawl made effective. A change in the pawl operation produces a change in the direction of rotation of shaft 526, shafts 103, and discs 108.

In the foregoing, I have illustrated and described a loom in which all of the warp ends across the fabric are manipulated in groups for shedding purposes and the ends forming each group are twisted together into a cable. A fabric made on such a loom has a distinctive appearance and the warp and filling yarns are firmly bound together. In the production of some fabrics, it may be desirable to form a portion of the fabric, such as the central longitudinal area, of warp and filling yarns interwoven in the usual way and without twist, or to produce a fabric in which there are longitudinal strips of warp and filling yarns so interwoven. This is readily accomplished by providing the loom with the usual harness motion disposed at the left of the group of discs 108 as seen in Fig. 1 and by omitting such of the discs 108 as would otherwise be required to handle the warp ends which are to be handled by the heddles in the formation of the shed. The provision of such a harness motion in the loom of the invention will be readily understood by those skilled in loom construction.

The means for applying tension to the warp yarn cables disclosed in the foregoing is the subject matter of application Serial No. 591,265, filed May 1, 1945. The mechanism for reversing the direction of the shedding discs disclosed herein is the subject matter of application Serial No. 591,266, filed May 1, 1945. The shedding mechanism disclosed herein is the subject matter of application Serial No. 591,267, filed May 1, 1945. Each of the three later applica-

tions is a continuation-in-part of this application.

I claim:

1. In a weaving apparatus, a creel for supplying cables, each consisting of a plurality of yarns twisted together, which comprises a supporting structure, a plurality of shafts mounted for rotation on the structure, each shaft being supported between its ends only, supports for yarn packages mounted on the free portions of the shafts, yarn guides mounted for rotation with the shafts, one guide for each yarn package, a yarn guide on the supporting structure beyond each end of each shaft, the yarns passing from the packages to the rotating guides and thence to those on the structure, and means for rotating the shafts to cause the yarns to be twisted together between the packages and the guides on the structure to form cables.

2. In a weaving apparatus, a creel for supplying cables, each consisting of a plurality of yarns twisted together, which comprises a supporting structure, a plurality of shafts mounted for rotation on the structure, each shaft being supported between its ends only, supports for yarn packages mounted on the free portions of the shafts, yarn guides mounted for rotation with the shafts, one guide for each yarn package, a yarn guide on the supporting structure beyond each end of each shaft, the yarns passing from the packages to the rotating guides and thence to those on the structure, means for rotating the shafts to cause the yarns to be twisted together between the packages and the guides on the structure to form cables, and guides for the cables at one end of the structure.

3. In a weaving apparatus, a creel for supplying cables, each consisting of a plurality of yarns twisted together, which comprises a supporting structure having open sides, a plurality of horizontal shafts mounted for rotation between the sides of the structure, each shaft being supported on the structure between its ends only, supports for yarn packages mounted on the free portions of the shafts, the packages being accessible through the sides of the structure, yarn guides mounted for rotation with the shafts, one guide for each yarn package, a yarn guide on the supporting structure beyond each end of each shaft, the yarns passing from the packages to the rotating guides and thence to those on the structure, and means for rotating the shafts to cause the yarns to be twisted together between the packages and the guides on the structure to form cables.

4. In a weaving apparatus, a creel for supplying cables, each consisting of a plurality of yarns twisted together, which comprises a supporting structure, a plurality of shafts mounted for rotation on the structure, each shaft having a free end portion, supports for yarn packages mounted on the free portions of the shafts, yarn guides mounted for rotation with the shafts, one guide for each yarn package, yarn guides on the supporting structure beyond the free ends of the shafts, the yarns passing from the packages to the rotating guides and thence to those on the structure, and means for rotating the shafts in unison to cause the yarns to be twisted together between the packages and the guides on the structure to form cables.

5. In a weaving apparatus, a creel for supplying cables, each consisting of a plurality of yarns twisted together, which comprises a frame work, a plurality of horizontal shafts mounted for rotation within the frame work, each shaft having a free end portion, supports for yarn packages mounted on the free portions of the shafts and lying within the frame work, yarn guides mounted for rotation with the shafts, one guide for each yarn package, yarn guides on the frame work beyond the ends of the shafts, the yarns passing from the packages to the rotating guides and thence to those on the structure, and means for rotating the shafts to cause the yarns to be twisted together between the packages and the guides on the structure to form cables.

6. In a weaving apparatus, a creel for supplying cables, each consisting of a plurality of yarns twisted together, which comprises a supporting frame work, a plurality of shafts mounted for rotation within the frame work and arranged in rows, each shaft being supported to have a free portion, supports for yarn packages mounted on the free portions of the shafts, yarn guides mounted to rotate with the shafts, one guide for each yarn package, yarn guides on the frame work beyond the ends of the shafts, the yarns passing from the packages through the rotating guides and thence to those on the frame work, and means for rotating the shafts in unison to cause the yarns to be twisted together between the packages and the guides on the frame work, adjacent shafts in a row being rotated in opposite directions.

7. In a weaving apparatus, a creel for supplying cables, each consisting of a plurality of yarns twisted together, which comprises a supporting structure, a plurality of parallel shafts mounted for rotation on the structure, each shaft being supported to have a free portion, supports for yarn packages mounted on the free portions of the shafts, yarn guides mounted to rotate with the shafts, one guide for each yarn package, yarn guides on the supporting structure beyond the ends of the shafts, the axes of the shafts lying substantially tangent to the associated guides on the structure, the yarns passing from the packages through the rotating guides to those on the structure, and means for rotating the shafts to cause the yarns from the supplies on the supports on respective shafts to be twisted together between the packages and the guides on the structure to form cables.

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