4 Sheets—Sheet 1.

J. E. GILLESPIE.

CIRCULAR LOOM.

No. 189,353. Patented April 10, 1877.

Fig. 1.

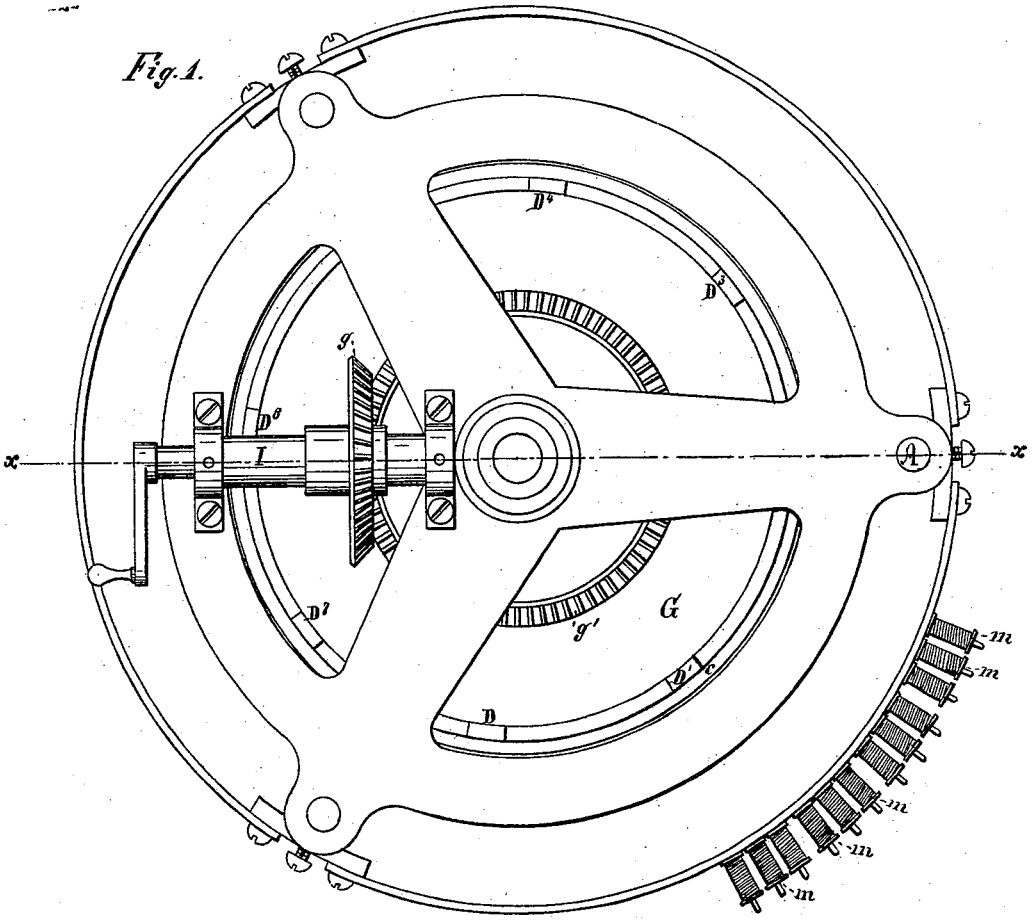


Fig. 5

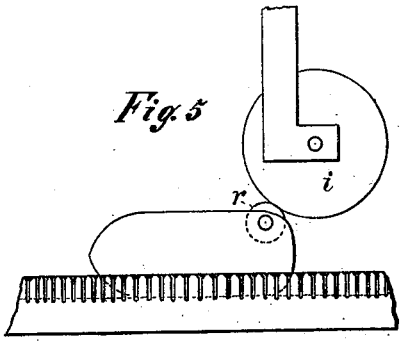


Fig. 7.

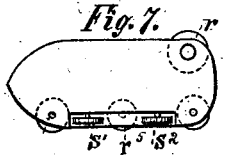


Fig. 6.

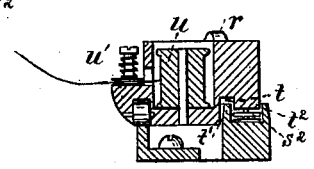


Fig. 8.

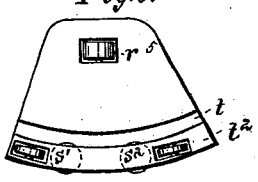
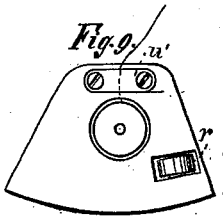


Fig. 9.



Witnesses:

Theodore L. Foster.

P. S. Clarke

Inventor:

James E. Gillespie

By D. P. Eustis

his atty.

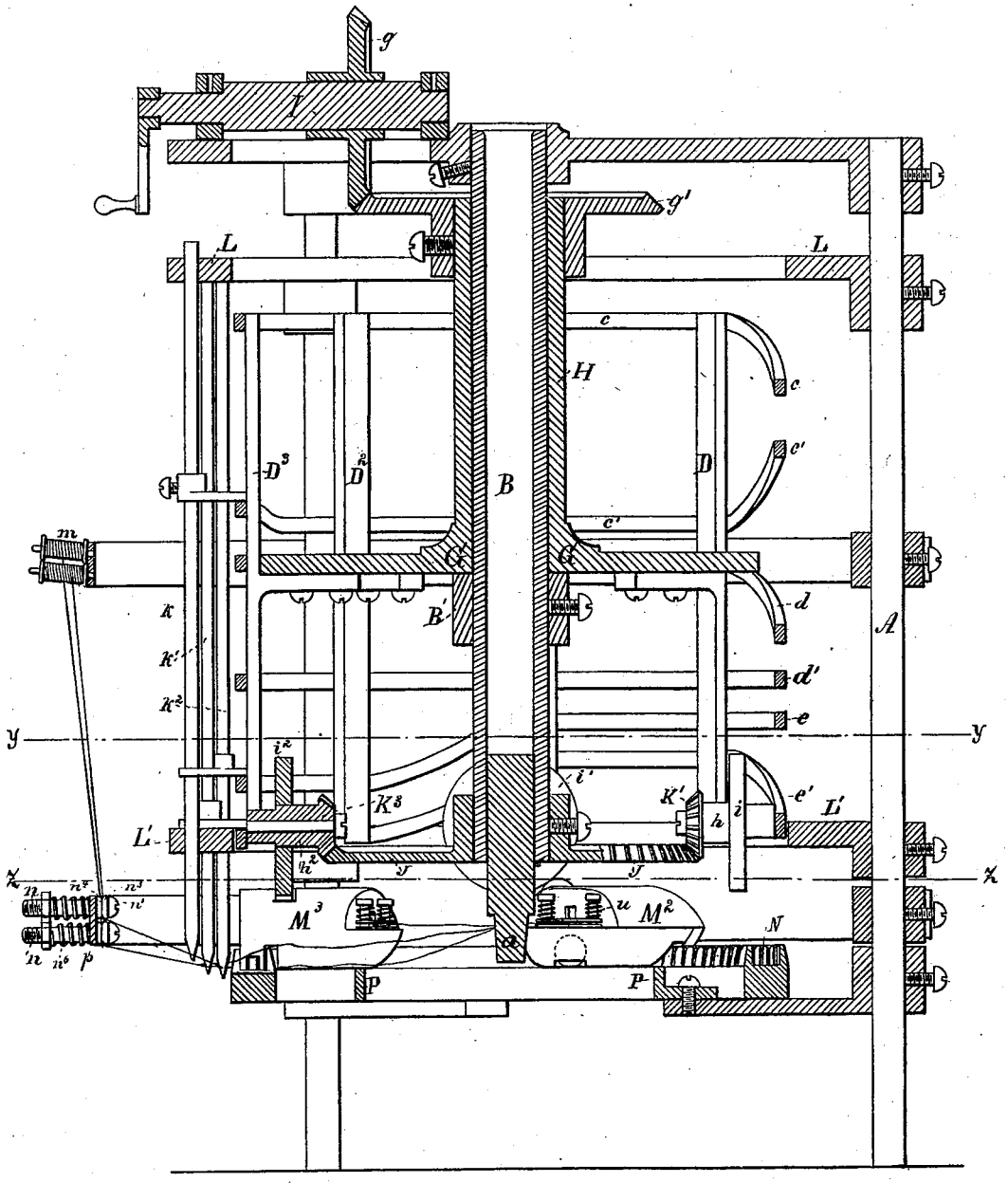
4 Sheets—Sheet 2.

J. E. GILLESPIE.

CIRCULAR LOOM.

No. 189,353. Patented April 10, 1877.

Fig. 2.



Witnesses:

Theodore G. Hester.

B. S. Clark

Inventor.

James E. Gillespie

By J. P. Lucas

his atty.

4 Sheets—Sheet 3.

J. E. GILLESPIE.

CIRCULAR LOOM.

No. 189,353. Patented April 10, 1877.

Fig. 3.

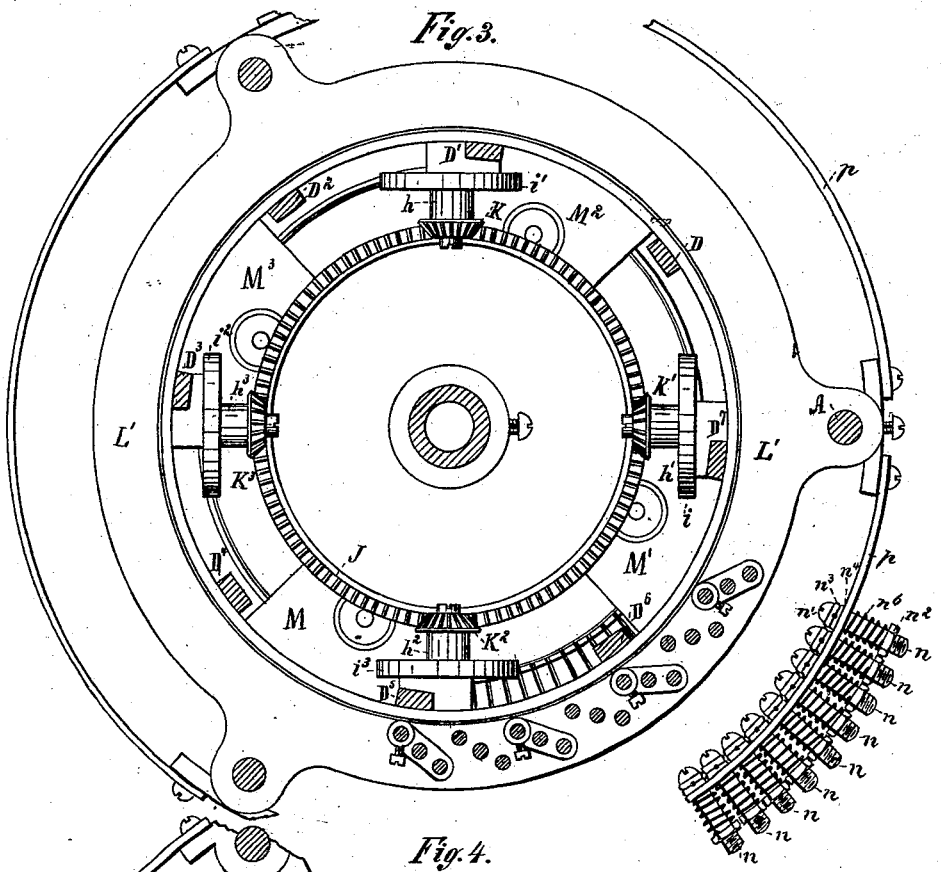
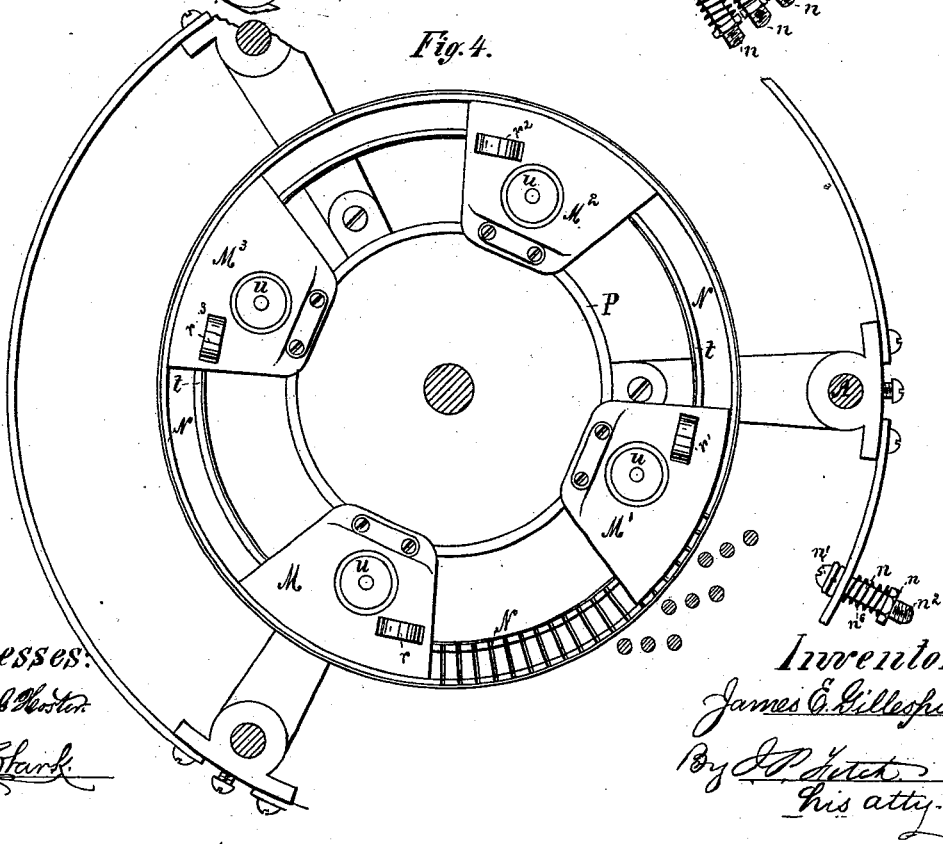


Fig. 4.



Witnesses:

Theodore B. Foster

B. S. Clark

Inventor:

James E. Gillespie

By J. P. Fitch

his atty.

4 Sheets—Sheet 4.

J. E. GILLESPIE.

CIRCULAR LOOM.

No. 189,353. Patented April 10, 1877.

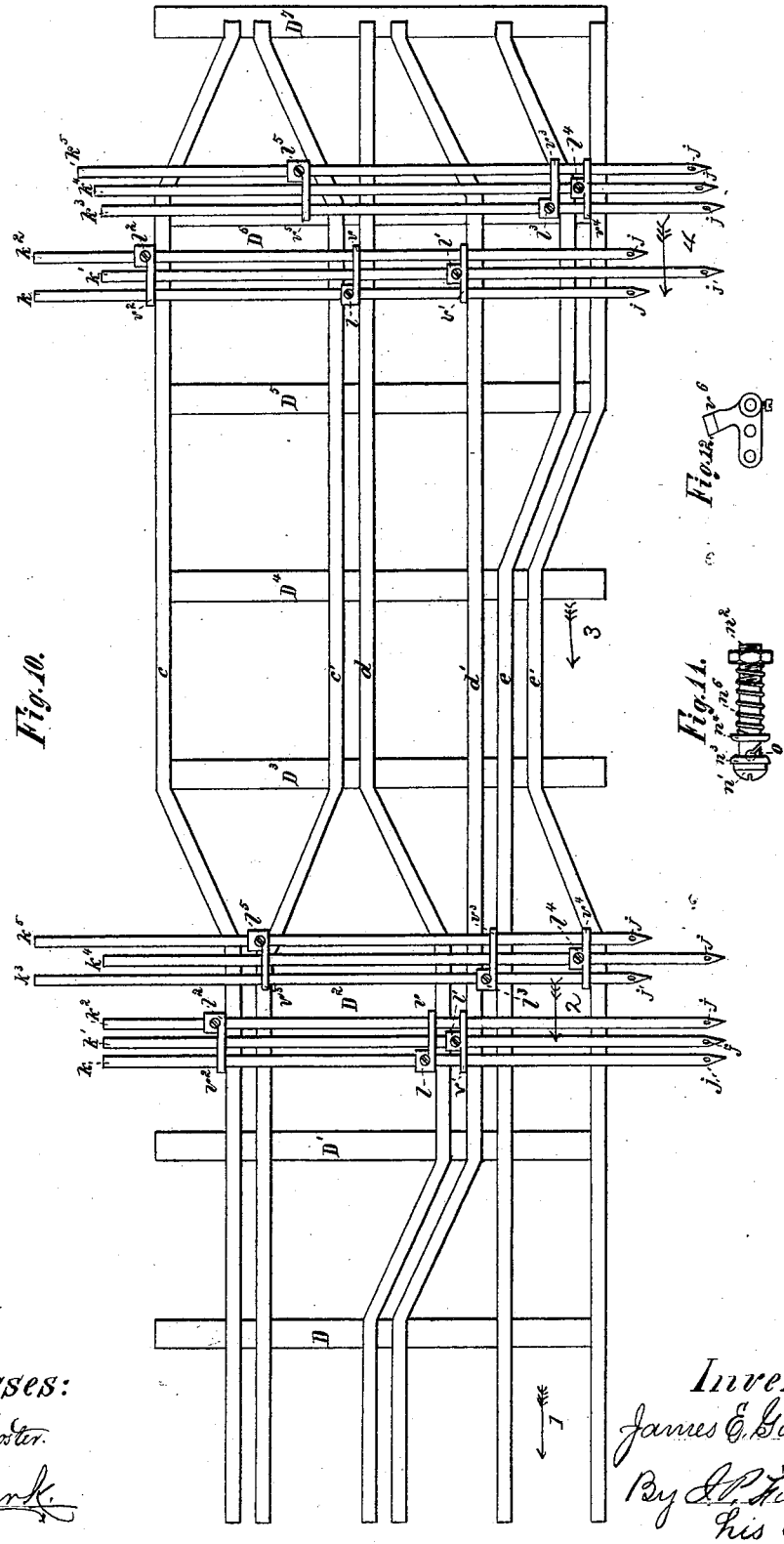


Fig. 10.

Fig. 12.

Fig. 11.

Witnesses:
Theodore G. Hoster.
B. C. Clark.

Inventor.
James E. Gillespie
By A. P. Hitch
his atty.

UNITED STATES PATENT OFFICE.

JAMES E. GILLESPIE, OF NEW YORK, N. Y., ASSIGNOR TO THE EUREKA FIRE HOSE COMPANY, OF SAME PLACE.

IMPROVEMENT IN CIRCULAR LOOMS.

Specification forming part of Letters Patent No. **189,353**, dated April 10, 1877; application filed December 4, 1876.

To all whom it may concern:

Be it known that I, JAMES E. GILLESPIE, of the city of New York, am the inventor of certain new and useful Improvements in Circular Looms, of which the following is a specification, reference being had to the accompanying drawings, forming part of the same, in which—

Figure 1 is a plan or top view of a loom containing my improvements; Fig. 2, a vertical section of same on line *x x*, Fig 1; Fig. 3, a top view of a horizontal section on line *y y*, Fig. 2; Fig. 4, a similar section on line *z z*, Fig. 2 Fig. 5 is a detached view of a broken segment of the "race" with one of the shuttles in it, with a side view of one of the rollers by which the shuttle is propelled. Figs. 6, 7, 8, and 9 are several views of the shuttle. Fig. 10 is a plane view of the harness-cams. The shape and position of these cams in the loom are circular, upon the periphery of a cylinder. In this figure they are shown straightened out to a plane, in order that they may be the more plainly exhibited. Fig. 12 is a top view of one of the warp-carrying rods or harness, cut through the collar and arms attached to it, as hereinafter described. Fig. 11 is a side view of the tension device.

My invention relates to a circular-loom, for weaving cylindrical or tubular fabrics; and consists, first, in the peculiar construction and arrangement of the harness-cams, hereinafter described, in which the said cams are separated from each other, and placed one above another around a cylindrical surface and in the same, or nearly the same, vertical plane, so that several series of vertical sliding rods, for throwing the sheds of the different plies, may be arranged around the said cams, so as to engage with and be operated by them; secondly, in the peculiar construction and combination described of the vertical sliding rods, for throwing the warp-threads to form the sheds, whereby the said rods afford each other mutual support and prevention against torsion, bending, and rotating.

A is a circular frame, upon which the several parts of my loom are mounted. B is a central stationary post, upon the lower end *a* of which the tubular web is woven. *c c' d d' e e'* are the cams by which the warp cams or harness are raised and lowered to form the sheds. In the loom, as shown in Fig. 2, these cams are seen bent into a circular form and supported on vertical bars D D^1 D^2 D^3 D^4 D^5 D^6 D^7. Each pair of the cams operate to form a shed. These cams are, in position, separated entirely from each other; but all act conjointly to produce the desired result—namely, to throw the warp-threads so as to weave a web, and, if desired, a web of more than one ply.

They are, as shown, arranged one above another in the same vertical plane. G is a disk-wheel, to the periphery of which the said bars D to D^7 are fixed. This disk is connected with the sleeve H, fitted to revolve upon the post B, and rests and has its bearing on the collar B'. Motion is communicated to this disk G from the shaft I through gears *g* and *g'*. The bars D thus constitute a revolving frame, carrying the harness-cams *c*, *d*, and *e*. J is a stationary bevel-gear wheel fixed to the lower end of the post B, and K K^1 K^3 K^3 are bevel-gear pinions, which mesh into the gear-wheel J. They are fixed upon shafts *h* h^1 h^2 h^3, which rotate in bearings in the revolving frame D, and are carried around the loom with it. *i* i^1 i^2 i^3 are plane disk-wheels fixed on the shafts *h*. By the engagement of the pinions K with the fixed gear-wheel J, said pinions, with the shaft *h* and the disk-wheels *i*, are revolved on their axes as they are carried around the loom, there being thus imparted to said wheels a positive rotary motion. The letter *k* is used to designate the warp-carriers, which are vertical rods that slide up and down in holes in the annular plates L L'.

There are as many of these carriers as there are warp-threads. The said threads pass through eyes *j* in the lower ends of these rods. These said rods *k* are arranged round the loom vertically parallel to the harness-cams, and may be said to be divided into series or groups of three each. Upon each one of the three is fixed a collar, designated by the letters *l* l^1, &c., having an arm, *v* v^1 v^2, extending laterally from it through holes in which the other two pass. Thus the several rods of each group afford each other mutual support, and prevent

each other from revolving on their axes. This construction and arrangement are plainly shown in Fig. 10. Two of these groups, or three, may be said to form a set, together carrying six of the warp-threads, which constitute the complete sheds of a two-ply web. The several collars l l^1, &c., have also arms, (one of which, marked v^6, is shown in Fig. 12,) which extend inward to the harness-cams c c', d d', and e e', and engage therewith, the arm from l^2 resting on c, that from l^5 on c', that from l on d, that from l^1 on d', that from l^3 on e, and that from l^4 on e^1. As the harness-cams shown are revolved, the several arms engaging therewith, as described, will raise and lower the rods k k', &c., so as to throw the warp-threads to weave two plies, and tie them together into a single web. The sets of these rods thus formed and connected with the harness-cams are multiplied so as to entirely surround the loom, to weave a tubular web.

The warp-threads are unwound from spools, a few only of which, designated by the letter m, Fig. 1, are shown, placed on pins, fixed in a circular bar attached to the frame of the loom. From these spools the warp-threads run down through the tension device n, thence through the eyes in the lower end of the rods k, and thence all converge to the lower end of the post B, where the web is formed.

The tension device consists of a small rod, having a head, n^1, at one end, and a screw-thread and nut, n^2, at the other. (See Fig. 11.) Near the head is an eye or hole, o, with a notch or slot cut inclined away from the head, and opening out on one side of the rod, thus permitting the thread to be passed through the notch into the eye without passing the end through it. n^3 and n^4 are two small washers or flat rings in the said rod, between which the thread runs. These rods are fitted into holes in a circular bar, p, (seen in Fig. 3,) and between the said bar and the nuts n^2 are spiral springs n^6, which act to press the rods outward, and force the disks n^3 n^4 together between the heads n^1 and bar p, thus giving tension to the thread as it passes through the eye o. By this arrangement the tension will be uniform, and just what is made by the stress of the spiral spring n^6; for if there should be any obstruction to the thread running out between the rings n^3 n^4, the increased tension thereby caused will pull the rod inward against the stress of the spring, thereby separating the said rings, and relieving the friction upon the threads.

M M^1 M^2 M^3 are the shuttles, and N is the circular race in which they run. Four shuttles are shown, designed for rapid weaving by delivering two woof-threads, one after the other, into the same ply. The race is, in fact, a circular groove having lateral walls, between which the shuttles, or portions of them, are confined, and are thereby kept in their orbits, both against the tendency to fly outward from the centrifugal force generated by their movement around the loom and against the tension of the woof-thread, which tends to draw them inward toward the center of the loom. Notches are cut in the side walls of the race, as shown in Figs. 4 and 5, into which the lower threads of the sheds fall, thus permitting the said threads to rest on the floor of the race and the shuttles to run over them. The shuttles are driven around the race by the disk-wheels i i^1 i^2 i^3 as they are carried around the loom with the harness-cam frame D. At the heel of the shuttle in its upper face is a friction-roller, r, and the shuttle is propelled by contact of the wheel i with this friction-roller r. As has been shown, the wheels i i^1, &c., have a positive rotation on their axes by means of the pinions K K^1, &c., and fixed gear-wheel J. The wheels i will, of course, rotate the rollers r on their axes as the shuttles are propelled around the loom in the race. The wheels i are above the upper shed-thread of the web, and the shuttles are below them, and the arrangement described of the wheels i^1 and the rollers r are for the purpose of permitting the upper threads of the sheds to pass between the propelling-wheel i^1 and the shuttle without disarranging the threads. The under surface of the shuttle is provided with friction-rollers, as seen in Figs. 7 and 8, to facilitate their movements over the warp-threads on the floor of the race N. The preferable method of constructing and arranging the shuttles in the race is shown in Fig. 6, in which t is a curved recess cut into the under face of the shuttle, into which projects the inner wall t^1 of the race, and the under face of the part t^2 of the shuttle, which projects down into the race, is provided with friction-roller s^1 s^2.

Thus only the portion t^2 of the shuttle lies within the race, the opposite end of the shuttle, provided with a friction-roller, r^5, running upon a curved rail, P. By this construction the race may be quite narrow, and only of sufficient width to receive the portion t^1, and a single pair of friction-rollers, s^1 s^2, will serve to relieve the friction between the shuttles and both walls of the race.

Tension may be given to the woof-threads as it is unwound from the spool u by the tension device u', which, as shown, consists of two plates pressed together by spiral springs the thread running between the plates. Any suitable tension device may be used.

The end of each of the warp-threads, being taken from the warp-spool m, and passed through their respective tension devices and harness-rods k, are carried into and secured about the central post a.

The ends of the woof-threads are also taken from the shuttle-bobbins, and after threading through their tensions are also fastened at the central post. Motion now being given to the harness-cam cylinder or frame D D', &c., by means of the hollow shaft H, bevel-gears g g', and the shaft I, the harness-rods k are raised and depressed to form the warp-shed, in the manner which I will now proceed to describe.

We will suppose at the start that we are

looking at that portion of the harness-cam cylinder or frame shown at the extreme left of the drawing, Fig. 10. For weaving a two-ply web the harness-rods will be, preferably, arranged about the loom in groups of six, two for operating the strands that belong exclusively to the inner ply, two others for the strands belonging exclusively to the outer ply, and the remaining two operating those strands which pass entirely through the fabric from outer to inner side, and vice versa, binding the two plies firmly together into one web. In the drawing, the lug upon the first vertical harness-rod projects inward, and rests upon the horizontal rod or cam *d*, the second upon the rod or cam *d'*, the third upon rod or cam *c*, the fourth upon rod or cam *e*, the fifth upon rod or cam *e'*, and the sixth upon rod or cam *c'*. Of these *e d* belong to the inner ply, *d' e'* to the outer ply, and *c c'* are the ones belonging to the tying-strands. Now, it will be seen, by looking at the drawing at the point indicated, that the group of six rods, and therefore the strands operated by them, will be in the following positions while this portion of the harness-cam frame is passing, viz: the first *d* is raised, the second *d'* raised, the third *c* depressed, the fourth *e* raised, the fifth *e'* depressed, the sixth *c'* raised, thereby forming a double-warp shed, of which the upper part consists of the *d*, *d'*, *e*, and *c'* strands, and the lower of the *c* and *e'* strands. Now, supposing the harness-cam frame to be revolved, this shed will remain, while the lugs of the harness-rods remain in the section of the harness in which the horizontal rods are parallel, and during this time the first shuttle, held in its position laterally by the raceway, but (propelled forward by the roller, which receives a positive motion through its shaft and gear from the stationary gear J, in such a direction that while pushing the shuttle forward it allows the strands to roll between itself and the small roller in the shuttle without changing their position) will pass through this shed, causing a weft to be deposited about the central post under all strands that are in the upper position, and over all in the lower position. The result of this motion will have been to weave one row of the outer ply. Advancing the harness-cam frame, it will be seen that while *c*, *c'*, *e*, and *e'* remain in the same position when the next parallel section of the harness-cams is reached *d d'* are depressed, forming a shed, of which the upper part consists of the *e* and *c'* strands, and the lower of the *d*, *d'*, *c*, and *e'* strands, through which the second shuttle will pass, winding its weft about the central post, weaving one row of the inner ply. Advancing to the next position, the *c* and *c'* strands are reversed in their positions, the *c* strand now being in its upper and the *c'* in its lower position. As these are the tying-strands, which pass entirely through the fabric, the result of this change of position will be, when the next wefts are deposited, to bind the two plies firmly together. The cause of these strands, and of no others, passing entirely through the two wefts, as described, will be understood when it is noticed that while these strands alternately enter into the construction of the inner wall of the inner ply and the outer wall of the outer ply, those strands belonging exclusively to the inner ply never enter into the outer wall of the outer ply, and, likewise, those belonging exclusively to the outer ply never enter into the inner wall of the inner ply. In the third position we find that besides the *c* cl the *d* and *e'* strands also have changed their positions, and the shed now formed has the *d*, *c*, *e*, and *e'* strands in its upper portion, and the *d' c'* strands on its lower part. The third shuttle will now pass through this shed, weaving a second row of the outer ply. In the fourth and last position we have *c c' d d'* remaining as before, while the *e e'* strands have been depressed, and consequently we have a shed of which the *d* and *c* strands comprise the upper part, and the *d'*, *e*, *e'*, and *c'* strands the lower part, through which the fourth shuttle will pass and deposit another weft upon the inner ply. The harness-cam frame has now made a complete revolution, and during the revolution has woven two rows of two-ply web. Of course, another revolution will be but a repetition of the one already described.

What I claim, and desire to secure Letters Patent, is—

1. In a circular loom, the combination of two or more harness-cams, separate from each other, and arranged upon the periphery of a revolving vertical and cylindrical frame, with the vertically-sliding rods *k* arranged substantially as described, whereby the warps are separated into sheds, and a web of more than one ply is woven, as and for the purpose specified.

2. In a circular loom, the combination of the warp-carrier rods *k*, arranged in groups of two or more, each rod of the group carrying an arm, *v*, through which the other rods of the group pass, with the mechanism for inserting into the sheds two or more weft-threads, all constructed and arranged to operate as and for the purpose described.

Witness my hand this 25th day of November, 1876.

JAMES E. GILLESPIE.

Witnesses:
B. S. CLARK,
M. F. CLIFTON.