(No Model.) 3 Sheets—Sheet 1.

A. F. FIRTH.

LOOM FOR WEAVING PILE FABRICS.

No. 413,440. Patented Oct. 22, 1889.

Fig. 1.

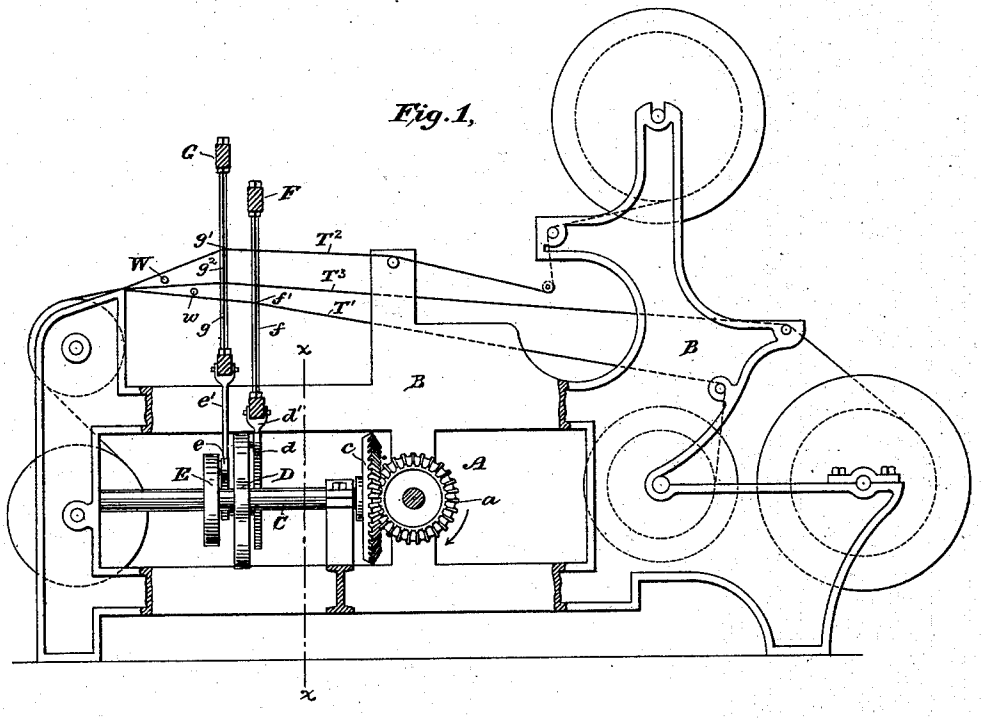


Fig. 3.

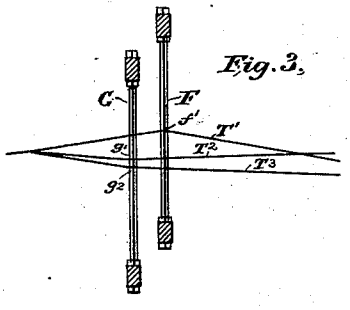


Fig. 2.

Witnesses
Geo. W. Breck.
S. G. Metcalfe

Inventor.
Algernon F. Firth.
By his Attorney
Chas. A. Murphy

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 3 Sheets—Sheet 2.

A. F. FIRTH.

LOOM FOR WEAVING PILE FABRICS.

No. 413,440. Patented Oct. 22, 1889.

Fig. 4.

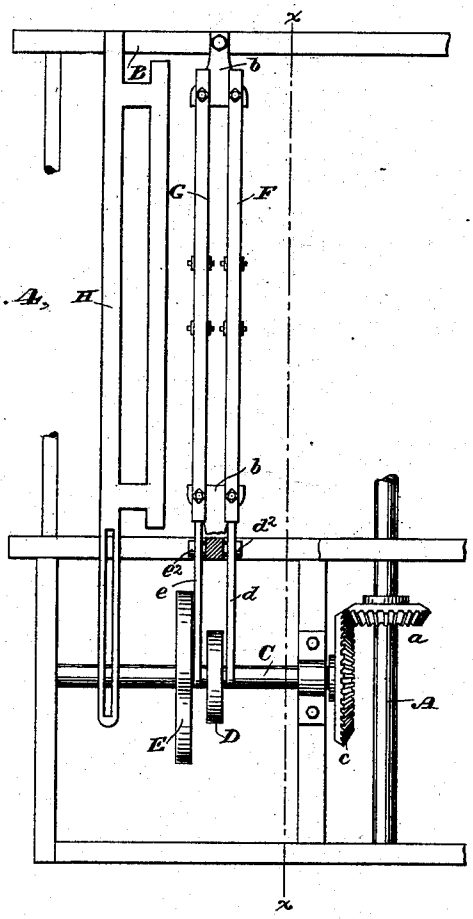


Fig. 6.

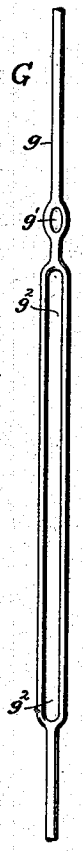


Fig. 5.

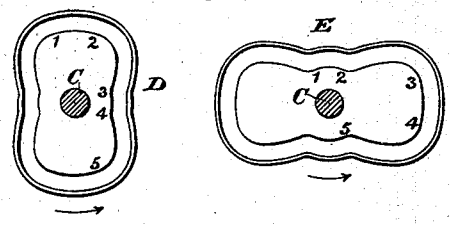
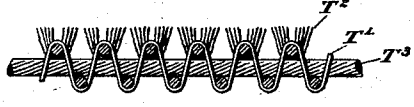


Fig. 7.



Witnesses
Geo. W. Breck.
F. Y. Metcalf

Inventor
Algernon F. Firth
By his Attorney
Chas. A. Murphy

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 3 Sheets—Sheet 3.

A. F. FIRTH.

LOOM FOR WEAVING PILE FABRICS.

No. 413,440. Patented Oct. 22, 1889.

Fig. 8.

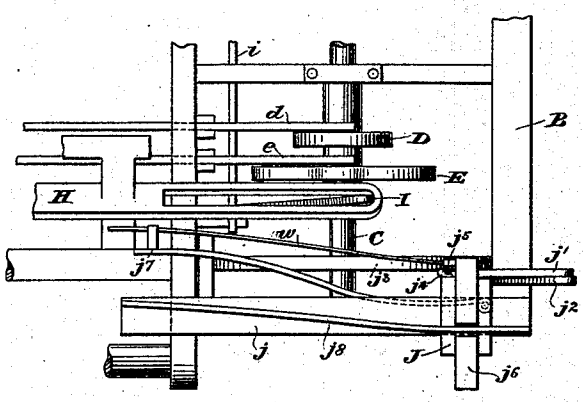


Fig. 10.

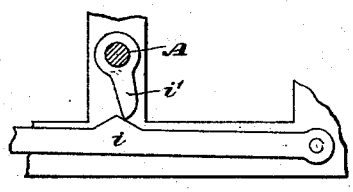
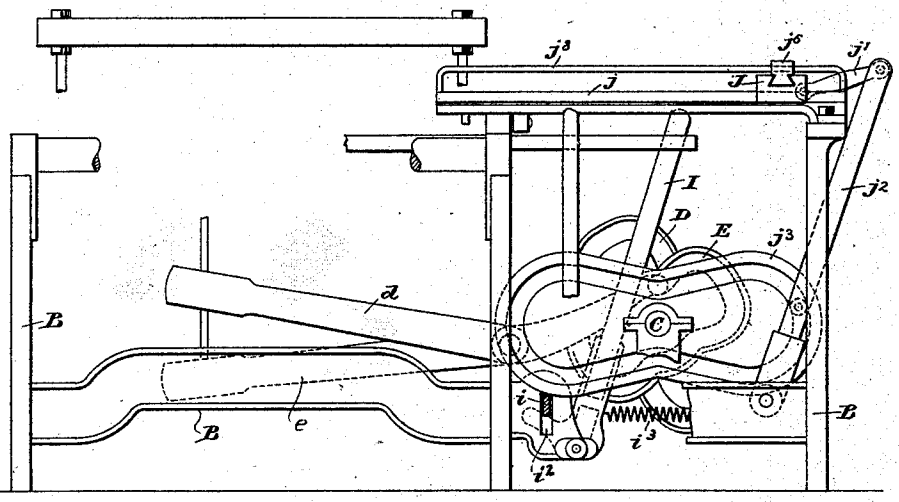


Fig. 9.



Witnesses

Geo. W. Breck.

Henry W. Lloyd.

Inventor

Algernon F. Firth

By his Attorney

Chas. A. Murphey.

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

ALGERNON F. FIRTH, OF BRIGHOUSE, COUNTY OF YORK, ENGLAND.

LOOM FOR WEAVING PILE FABRICS.

SPECIFICATION forming part of Letters Patent No. 413,440, dated October 22, 1889.

Application filed May 22, 1889. Serial No. 311,696. (No model.)

To all whom it may concern:

Be it known that I, ALGERNON F. FIRTH, of Brighouse, in the county of York, England, have invented a new and useful Improvement in Looms for Weaving Pile Fabrics, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

My invention relates to looms for weaving pile fabrics, such as tapestry and velvet carpets, consisting of a ground fabric having a pile suitably secured thereto. These fabrics have heretofore been woven with what is technically known as a "double chain"—that is, the filling or weft threads have been bound together by a series of warp-threads, known as "fine-chain" threads, arranged in pairs, passing alternately from one side to the other of the ground or body of the fabric in opposite directions, one thread of each pair passing over every alternate weft-thread on the upper side of the fabric and under every alternate weft-thread on the other side thereof, the intermediate wefts on each side of the fabric being bound in the same manner by the other thread of the pair.

The object of my invention is to provide an apparatus for weaving such pile fabrics with a series of single fine-chain threads, of which each one shall bind all the weft-threads together by passing alternately from one side of the ground fabric to the other over each top weft and under each bottom weft, thereby dispensing entirely with one thread from each of the pairs heretofore used; and to this end it consists in the novel arrangement and combination of mechanism which I will now proceed to describe, and point out in the claims.

In the accompanying drawings, Figure 1 is a side elevation, partly in section, of a tapestry-loom, showing principally the healds and their operating mechanism embraced in my invention. Fig. 2 is a sectional view thereof in elevation on the line $x\,x$, Fig. 1, looking toward the front of the loom. Fig. 3 is a longitudinal sectional view in elevation, showing the position of the warp-threads when the healds are in the reverse position to that shown in Figs. 1 and 2. Fig. 4 is a plan view, partly in section, showing the arrangement of the healds and their operating mechanism. Fig. 5 is a perspective view of the heald-actuating cams D E. Fig. 6 is a full-size perspective view of a portion of the heald G. Fig. 7 is an enlarged sectional view of the fabric produced by my invention. Fig. 8 is a plan view of a portion of a loom, showing the arrangement of the wire and shuttle or weft actuating mechanisms. Fig. 9 is a front elevation showing the same features, and Fig. 10 is a detail view showing the cam and lever which operate the picking-stick.

A is the main driving-shaft of the loom, suitably journaled in the frame B. Upon the shaft A is secured a gear-wheel a, which meshes with a gear-wheel c on the shaft C, also suitably journaled in the frame of the loom. Upon the shaft C are also fixed tappets or cams D and E, which are shown as box-cams, having eccentric grooves in their surfaces. The inner ends of levers d e are connected by the links d' e' with the lower portions of the frame-work of the healds F and G, and said levers are pivoted between their ends to the frame-work of the loom, as shown at d^2 e^2. Studs or rollers d^3 e^3, secured upon the outer ends of the levers d e, are adapted to fit loosely in the grooves in the cams D and E, so that when rotary motion is imparted to the driving-shaft of the loom and the cams D and E are thereby revolved the eccentricity or irregularity of the grooves moves the outer ends of the levers toward and away from the shaft C, and the levers, swinging freely on their respective pivots, impart a reciprocating movement in the reverse direction to the healds F and G. The cams D and E are somewhat similar in shape; but cam E has the larger "throw," so that nearly twice as much movement is imparted by it to the lever e as is given by the cam D to lever d. The cams are secured to the shaft C at right angles to each other, so that as the roller d^3 is farthest from the center of shaft B the roller e^3 will be nearest to it, and as the outer end of the lever d is raised the corresponding end of lever e will be lowered, or, in other words, when the roller d^3 is resting upon the surface of cam D at the point marked 1, Fig. 5, the roller e^3 will rest

upon the surface of cam E at the point marked 1 on the latter cam, and as that portion of the surface of cam D lying between the points marked 1 and 2 passes under the roller d^3 that portion of the surface of cam E lying between 1 and 2 will also be traversed by the roller e^3. The frame-work of the healds is of the usual construction, and the rods constituting the sides thereof are adapted to slide in guides *b b*, which serve to maintain the healds in a vertical position as they move up and down. The wires *f* and *g* extend continuously from side to side of their respective heald-frames; but for the sake of clearness I have illustrated only a few of the wires in each heald.

The heald F carries all the fine-chain threads T′, each of which passes through an eye *f′*, supported at or near the center of the heald by wires *f*, attached to the heald-frame in the usual manner.

The heald G carries the worsted or color-warp threads T^2, which form the pile of the fabric, and also carries the stuffer-threads T^3. Each wire *g* of the heald G is provided with an eye *g′* and with an independent elongated slot g^2 immediately below the eye. The color-warp or pile threads pass through the eyes *g′* and the stuffer-threads pass through the slots g^2, the elongation of which allows considerable lost motion in the movement of the stuffer-threads. It will thus be seen that the relative positions of the pile-warp and stuffer threads are not always the same at different positions of the heald G, for when the latter is raised to its highest point the pile-warps lie in the eyes *g′*, and the stuffer-threads, which are then supported by the bottom surfaces of the slots g^2, are separated from the pile-warps by a distance equal to that between the bottoms of the eyes *g′* and the bottoms of the slots g^2. This distance is sufficient to form a shed, in which the pile-wire is inserted, as hereinafter stated. As the heald G is lowered, the stuffer-threads, after being lowered to an approximately horizontal position, are not actuated by the heald until the upper surfaces of the slots g^2 come in contact with them, when they are separated from the pile-warps only by a distance equal to that between the tops of the eyes *g′* and slots g^2, thus lying nearly in the same plane when the heald which carries them is at its lowest point.

The different warp-threads T′ T^2 T^3 are carried upon their proper beams, which are appropriately supported by the frame-work of the loom, and the woven fabric is wound upon a drum at the front of the loom in the usual manner. The loom is also provided with a lay H, of the usual and well-known form, carrying the reed and shuttle-boxes. The shuttle or weft actuating mechanism may also be of any of the usual forms. In that shown in Figs. 8 and 9 the picking-stick I is suitably pivoted to the frame of the loom, and a lever *i* is also pivoted at the rear of the loom-frame back of and beneath the main driving-shaft A. A cam or projection *i′* on the driving-shaft A will depress the lever slightly at each revolution. This causes the forward end of the lever to press down upon the toe i^2 of the picking-stick, throwing the latter forward and projecting the shuttle through its course. The coil-spring i^3 draws the picking-stick back into position as soon as the pressure of the lever on the toe i^2 is relieved. This apparatus, as will of course be understood, is duplicated on the other side of the loom, so that the shuttle is thrown alternately from each side thereof.

For inserting the wires under the pile-warp I have shown and prefer to use the wire-actuating mechanism shown, described, and claimed in the United States patent to Firth and Boothman, No. 245,291, dated August 9, 1881; but any other of the many well-known forms of apparatus adapted to this purpose may be employed. The operation of this device is well understood by those skilled in the art and is fully set forth in said patent. A sliding carriage J, fitted upon a rail *j*, is moved back and forth along said rail by means of the link *j′* and lever j^2. The lever j^2 receives its oscillatory motion from the cam j^3, mounted on shaft C. The carriage J is provided with a hook j^4, which, as the carriage is moved up toward the fabric, catches the looped end of the wire that has been longest in the fabric, and as the carriage is moved back to the position shown in Fig. 9 the wire is carried with it, and the nippers j^5, attached to the slide j^6, grasp the looped end of the wire, removing it from the hook. As the carriage J is moved forward, the wire is pushed into the proper shed between the stuffer and pile warps. This operation is assisted by the spring j^7, which supports the outer end of the wire, and by the curved guide-rod j^8, which causes the slide j^6 to move laterally over toward the shed independently of the carriage J.

I will now proceed to describe the operation of my invention. The loom being in motion, when the cams D and E are in the positions shown in Figs. 1 and 2, the heald F, carrying the fine-chain threads, is at its lowest point, and the heald G, carrying the pile and stuffer threads, is elevated to its highest point. A double shed is thus formed by these different threads, the fine-chain threads lying at the bottom of the shed, the pile-threads at the top thereof, and the stuffer-threads (which now lie at the bottoms of the slots g^2) being about midway between the pile and fine-chain threads. As the cams D and E revolve in the direction shown by the arrows, those portions of their respective surfaces lying between the points marked 1 and 2 now come in contact with the rollers d^3 e^3, and, as such portions of the cam-surfaces are concen-

tric with the shaft C, no movement occurs in the healds while the rollers are traversing such portions of the cams. During this "dwell" of the healds the shuttle carrying the weft-thread is, by the action of picking-stick I, projected through the lower portion of the open shed, between the fine-chain and stuffer threads, the plane of its course being approximately indicated by the small circle *w*, Fig. 1, and the wire around which the pile is looped and formed is carried forward by the wire-actuating mechanism above described and inserted in the upper portion of this open shed between the pile and stuffer threads, the plane of its course being approximately shown by the circle W. When the revolution of the cams brings the points thereon marked 2 beneath the rollers d^3 e^3, on account of the eccentricity of the cam-surfaces, which commence at or about this point, the outer end of the lever *d* will commence to fall and the outer end of lever *e* to rise, whereby heald F will begin to rise and heald G to fall. During this movement of the healds the lay H advances and beats the weft-thread just inserted up to the fell of the fabric and returns to its position again. When the eccentric surfaces of the cams lying between the points marked 2 and 3 have been traversed by the rollers d^3 e^3, the positions of the healds will have been reversed, the heald F having reached its highest and heald G its lowest point, as shown in Fig. 3. This reversal of their positions causes a new shed to be formed, in which the fine-chain threads are at the top, and the pile and stuffer threads, which have been brought nearly together during the descent of the heald G, are at the bottom. Owing to the concentricity of those portions of the cam-grooves lying between the points 3 and 4, which now come in contact with the rollers d^3 e^3, a dwell is again imparted to the healds, and, the fabric having in the meantime been moved forward sufficiently to permit it, the shuttle is projected on its return flight to the box from which it was first thrown, and carries the weft through the open shed under the fine-chain threads and over the pile and stuffer threads. No pile-wire is inserted while the shuttle is making this flight, the wire mechanism being employed in removing a wire from the fabric for insertion in the next succeeding shed. Those portions of the cam-grooves lying between the points 3 and 4 having been traversed by the rollers d^3 e^3, the heald F now commences to fall and the heald G to rise, the lay during this movement again advancing and beating up the weft-thread last inserted. The downward movement of heald F carries the fine-chain threads again to the bottom of the fabric, and the upward movement of heald G carries the pile-warps to the top of the fabric, the elongation of the slots g^2 permitting the stuffer-threads to lie far enough below the pile-threads to admit the pile-wire. The healds are now once more in the position shown in Fig. 1, and the double shed first described is thus again formed. The cams D and E have now made one-half of one revolution, and during the remainder thereof and until the fabric is completely woven the operations just described are repeated alternately, the sheds recurring successively at each quarter-revolution of the cams, and the weft being carried through the sheds above the fine-chain threads on one flight of the shuttle and below them on its return flight.

It will thus be seen that by my novel arrangement of the warp-threads, healds, and actuating mechanism all the fine-chain threads in the fabric are carried to one side of the course of the shuttle for one flight of the same and to the opposite side of its course for its return flight, thereby producing a fabric in which the weft-threads are bound together by a series of single fine-chain threads, each one of which passes over each top weft-thread and under each bottom weft-thread in the fabric alternately, as shown in Fig. 7. By means of my invention I am enabled to produce a woven pile fabric with a single chain which is quite as durable and fully equal in appearance to that woven with a double chain, thereby saving considerably—nearly one-half—in the cost of the material for the fine chain. My invention also simplifies the loom very much, as only two healds are required instead of three or more, and a "wrong shoot," which so often occurs in the tapestry-looms heretofore used, is rendered impossible, since with my invention it makes no difference from which box or through which shed the shuttle is first thrown.

I wish it distinctly understood that my invention is not limited to the specific devices shown and described for operating the healds, since it is obvious that the same end can be attained in various ways. For instance, cams may be used having only one rising and one falling grade, the speed of the shaft C being doubled and that of shaft A remaining the same; and, again, the levers *d e* may, if desired, be entirely dispensed with and the cams arranged to engage directly with the links *d′ e′* or with the lower parts of the healds. I do not, however, claim herein the fabric produced by my invention, as that forms the subject of my application, Serial No. 311,110, filed May 17, 1889.

Having shown and described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a loom for weaving pile fabrics, the heald F, having the wires with eyes *f′*, mechanism for actuating said heald, the heald G, having wires with eyes g' g^2, and mechanism for actuating said heald, in combination with

a lay, wire-actuating mechanism, and weft-actuating mechanism, substantially as and for the purposes set forth.

2. In a loom for weaving pile fabrics, the heald F, having wires with eyes f', cam D, provided with two rising and two falling grades, connections between said heald and said cam, the heald G, having wires with eyes g' g^2, the cam E, and connections between said heald and said cam, in combination with a lay, wire-actuating mechanism, and weft-actuating mechanism, substantially as and for the purposes set forth.

ALGERNON F. FIRTH.

Witnesses:
WM. FINDLAY,
Clifton Mills, Brighouse.
W. NAYLOR,
Bailiffe Bridge, near Brighouse.