No. 840,275. PATENTED JAN. 1, 1907.

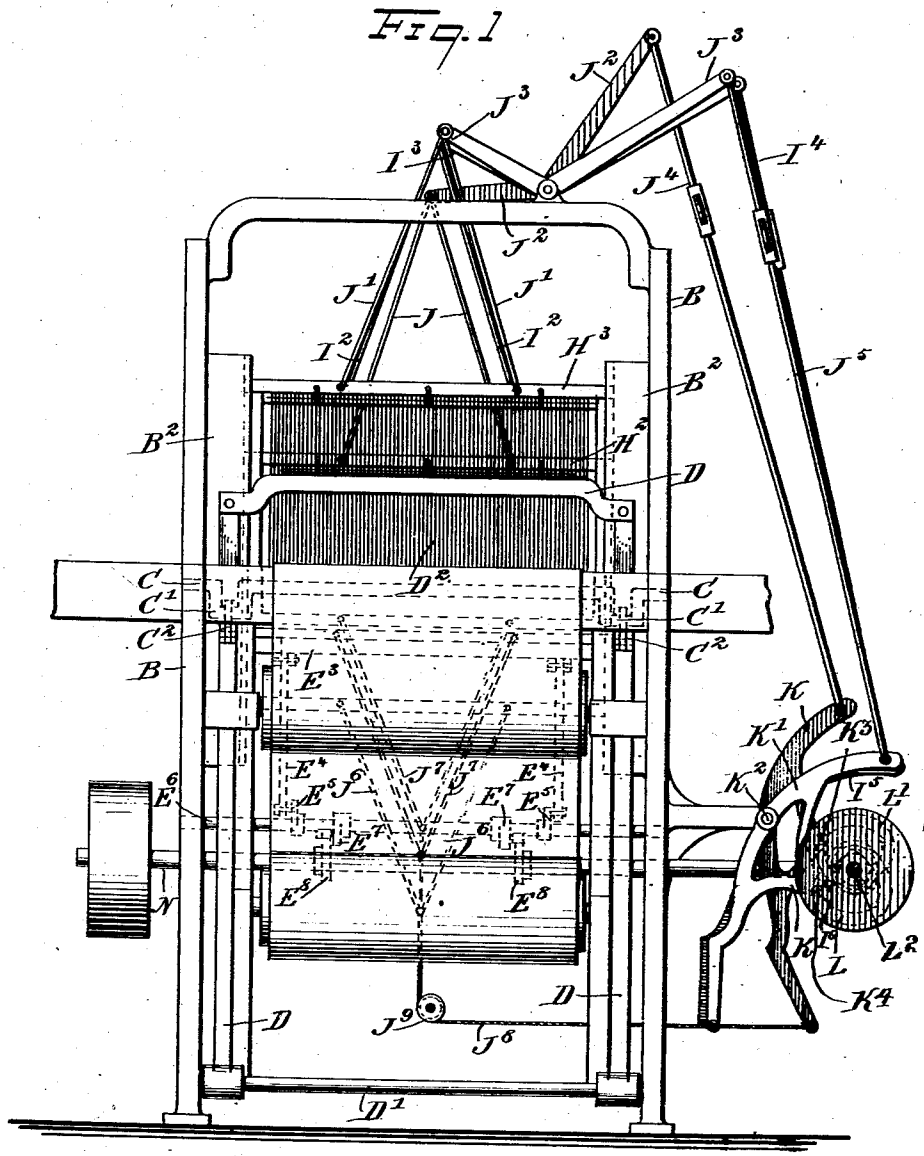
F. A. WHITMORE.

PILE FABRIC LOOM.

APPLICATION FILED JAN. 15, 1904. RENEWED SEPT. 14, 1906.

6 SHEETS—SHEET 1.

Fig. 1



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ATTORNEYS

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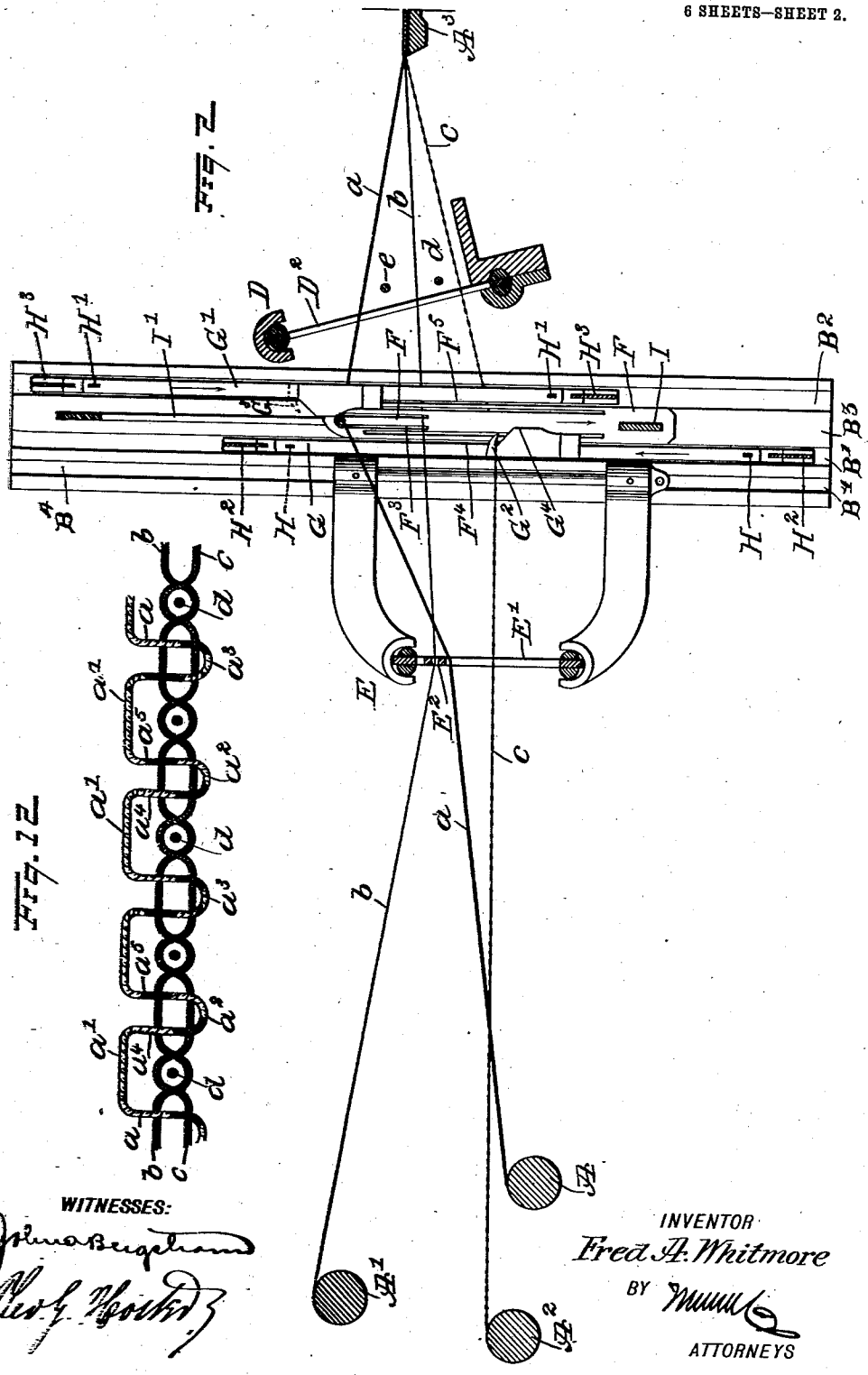

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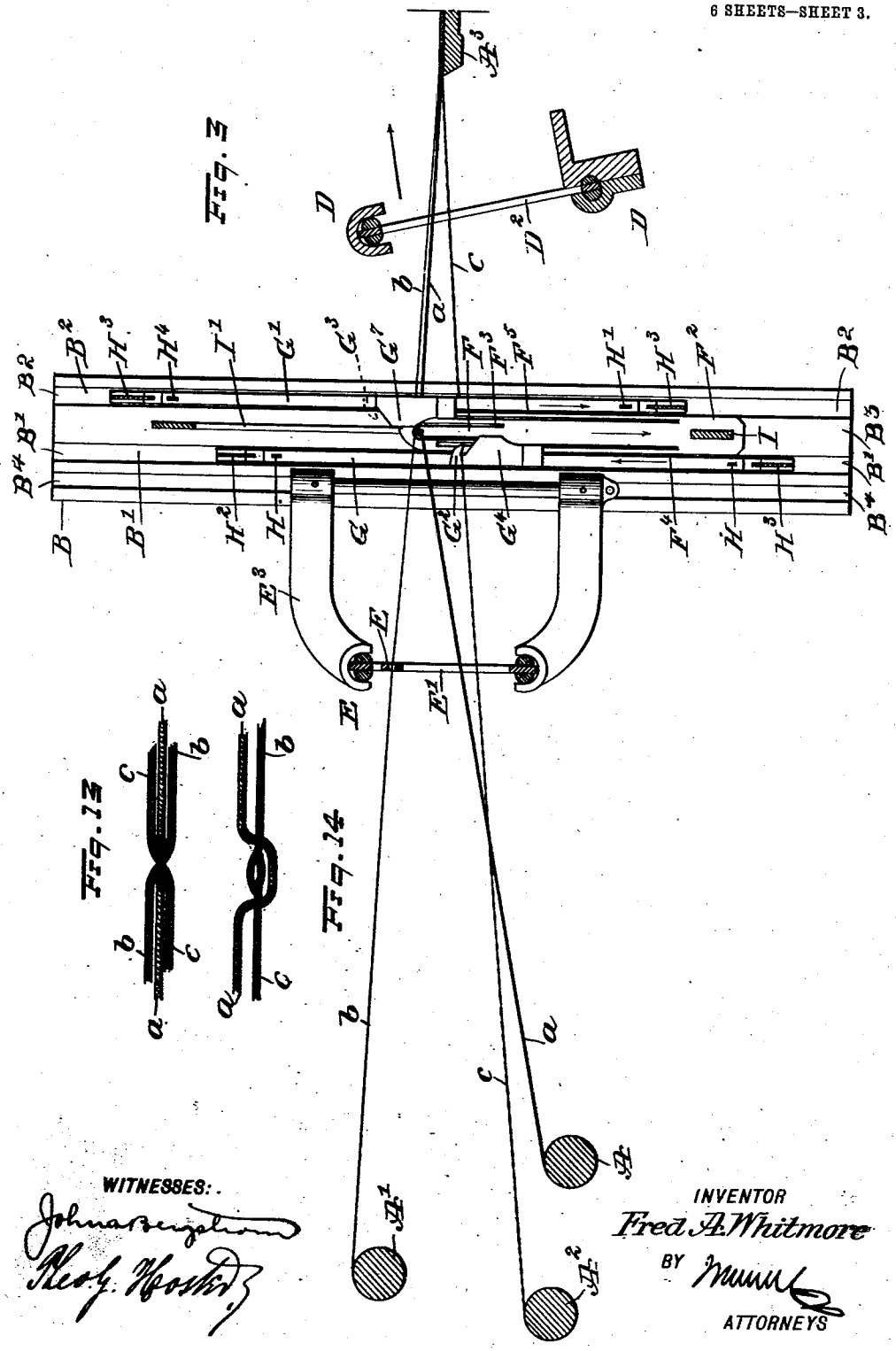

Fig. 13

Fig. 14

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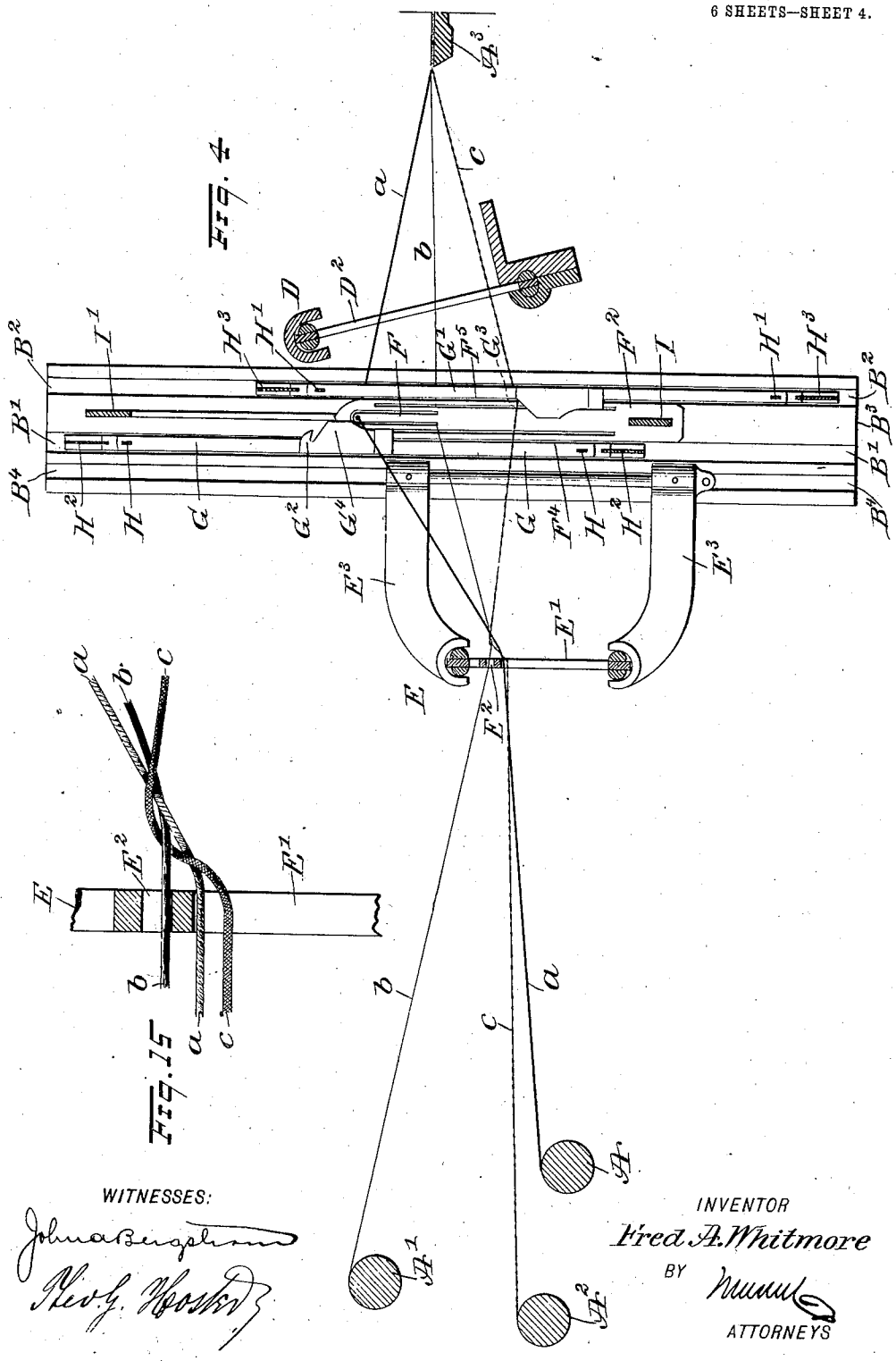
6 SHEETS—SHEET 4.



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6 SHEETS—SHEET 5.

Fig. 6

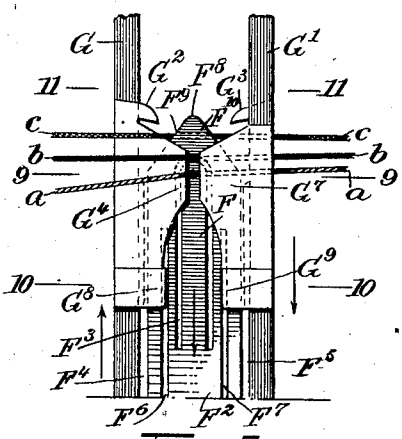


Fig. 5

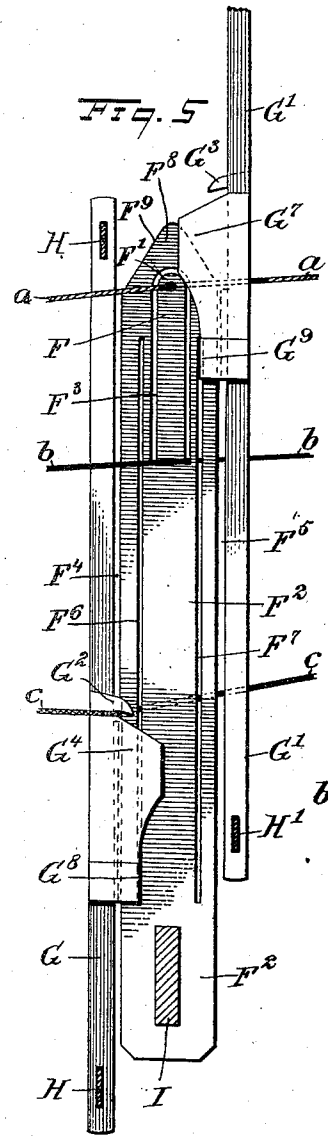


Fig. 8

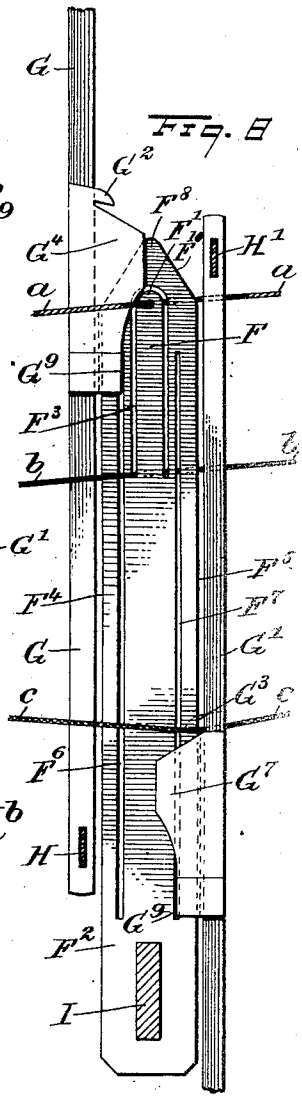


Fig. 9

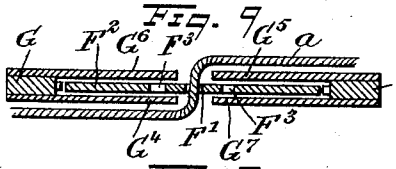


Fig. 7

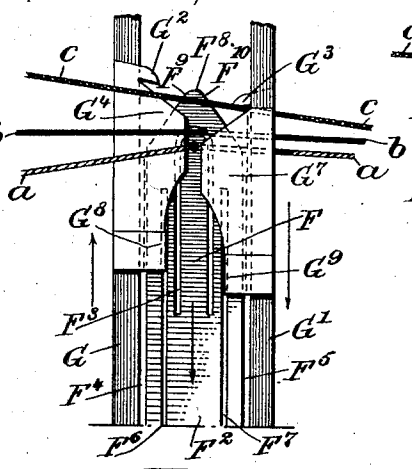


Fig. 10

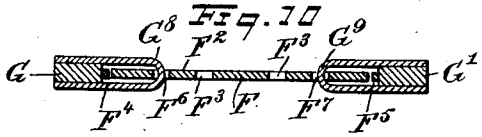
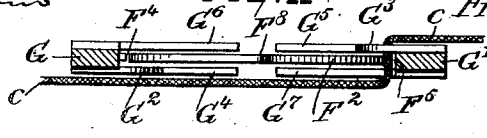


Fig. 11



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6 SHEETS—SHEET 6.

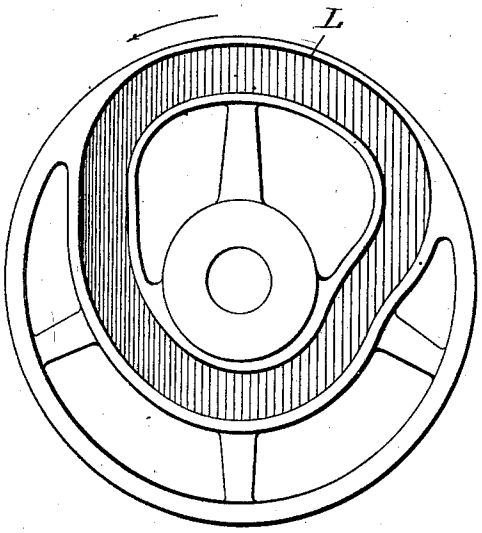

Fig. 16

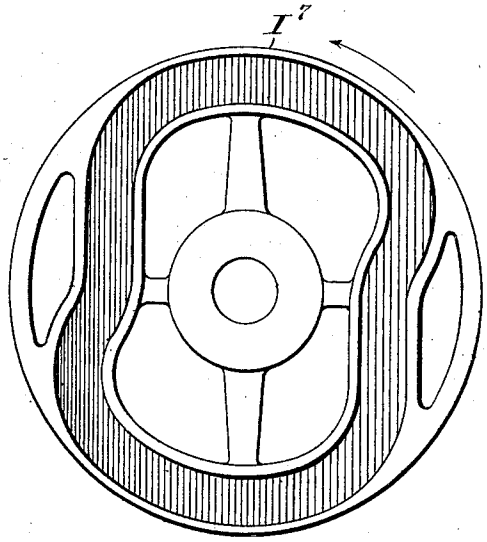

Fig. 18

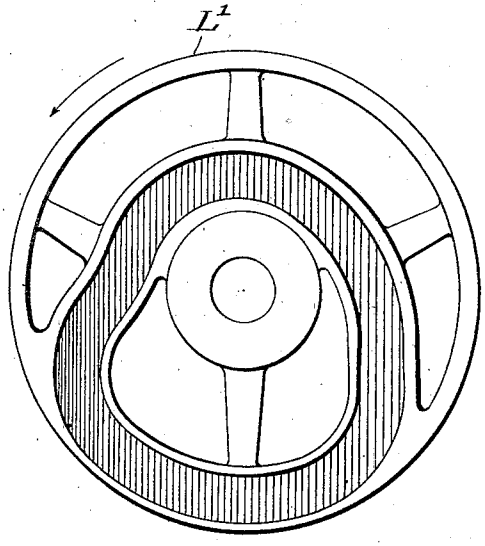

Fig. 17

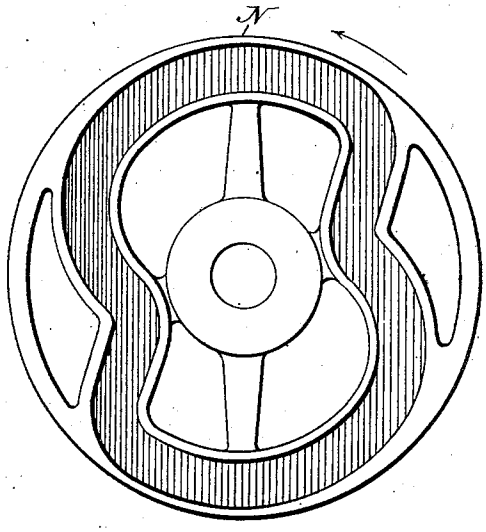

Fig. 19

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UNITED STATES PATENT OFFICE.

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PILE-FABRIC LOOM.

No. 840,275. Specification of Letters Patent. Patented Jan. 1, 1907.

Application filed January 15, 1904. Renewed September 14, 1906. Serial No. 334,596.

To all whom it may concern:

Be it known that I, FRED A. WHITMORE, a citizen of the United States, and a resident of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented new and useful Improvements in Pile-Fabric Looms, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved loom for weaving pile fabrics.

The invention consists of novel features and parts and combinations of the same, as will be more fully described hereinafter and then pointed out in the claims.

A practical embodiment of the invention is represented in the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a front end elevation of a loom embodying my improvements, parts nonessential for the understanding of the invention being omitted. Fig. 2 is a longitudinal sectional elevation of the heddle device, the beams, lay, and rear reed. Figs. 3 and 4 are similar views of the same, showing the parts in different positions. Fig. 5 is an enlarged side elevation of the heddle device for manipulating a set of warp-threads, the parts being in a position corresponding to the one shown in Fig. 2. Figs. 6, 7, and 8 are similar views of the same, showing the parts in different positions. Fig. 9 is an enlarged sectional plan view of the heddle device on the line 9 9 of Fig. 6. Fig. 10 is a like view of the same on the line 10 10 of Fig. 6. Fig. 11 is a similar view of the same on the line 11 11 of Fig. 6. Fig. 12 is an enlarged longitudinal sectional elevation of the weave. Fig. 13 is a plan view of the interwoven warp-threads. Fig. 14 is a side view of the same. Fig. 15 is an enlarged sectional side elevation of the back reed and the warp-threads in a crossed position. Figs. 16 and 17 are enlarged face views of the cams for actuating the heddle-frames. Fig. 18 is a like view of the cam for operating the needle-plate, and Fig. 19 is a similar view of the cam for operating the back reed.

The pile fabric to be woven by the loom and illustrated in Figs. 12, 13, and 14 consists, essentially, of sets of warp-threads *a*, *b*, and *c*, the sets being bound together by weft-threads *d*, and each set of warp-threads comprises a pile warp-thread *a* and what I prefer to call an "upper ground warp-thread" *b* and a "lower ground warp-thread" *c*, the said pile warp-thread *a* being looped around the lower ground warp-thread *c* and extending between the ground warp-threads *c* and *b* to form a pile-loop *a'* above the upper ground warp-thread *b*. The successive loops a^2 and a^3 of the pile warp-thread *a* around the lower ground warp-thread *c* extend alternately in opposite directions, and the ground warp-threads *b* and *c* are twisted laterally between successive picks for the vertical members a^4 a^5 of a pile to extend on opposite sides of the upper ground warp-thread *b*, as will be readily understood by reference to Fig. 12.

In order to produce the weave described, it is necessary to manipulate the warp-threads *a*, *b*, and *c* of each set in a peculiar manner by a special heddle device for accomplishing the desired result, as hereinafter more more fully described.

The warp-beams A, A', and A^2 for the warp-threads *a*, *b*, and *c*, and the breast-beam A^3, are suitably arranged on the main frame B, in which is journaled a crank-shaft C, having crank-arms C' connected by a pitman C^2 with the lay D, fulcrumed at D' in the frame B and provided with the usual reed D^2 for beating in the weft-threads *d* and the pile-wire *e*.

The pile warp-thread *a* and the lower ground warp-thread *c* of each set of warp-threads after leaving their beams A and A' pass through the vertical slot E' of a back reed E, having an intermittent up-and-down movement, and the said reed E is provided above each slot E' with an eye E^2 for the passage of the upper ground warp-thread *b*, as plainly shown in Figs. 2, 3, 4, and 15.

The pile warp-thread *a* after leaving the slot E' extends forwardly and passes through the eye F' of a needle F, forming a part of the heddle device. The pile warp-thread *a* then extends through the reed D^2 of the lay D and to the cloth on the usual breast-beam A^3. The upper ground warp-thread *b* after leaving the eye E^2 of the back reed E extends forward and passes through an inverted-U-shaped slot F^3, formed in the needle-plate F, as will be readily understood by reference to Figs. 2 to 10, inclusive. The upper ground warp-thread *b* after leaving the slot F^3 ex-

tends forward through the reed D^2 of the lay to the cloth. The lower ground warp-thread *c* extends from the slot E′ of the back reed E forwardly and alternately through spaces F^4 F^5, formed between the left and right hand sides of the needle-plate F^2 and hook-bars G and G′, respectively. (See Figs. 2 to 11, inclusive.)

The sets of hook-bars G and G′ for the several sets of warp-threads *c* of the warp are attached at their upper and lower ends to the transversely-extending heddle-bars H and H′ of the heddle-frames H^2 and H^3, respectively, mounted to slide in vertical guideways $B' B^2$ on the main frame B, and the said heddle-frames are moved intermittently up and down alternately in opposite directions by the heddle-actuating mechanism of any approved construction and hereinafter set forth in detail. The several needle-plates F^2 and their integral needles F for the several sets of warp-threads *a* and *b* of the warp have an intermittent up-and-down movement independent of the heddle-frames H^2 H^3, as hereinafter more fully set forth. The hook-bars G and G′ are provided with hooks G^2 and G^3, extending across the spaces F^4 and F^5 onto the needle-plate F at opposite faces thereof, and the said hooks G^2 G^3 alternately engage the lower ground warp *c* and pull the same downward and alternately on the front and rear faces of the needle-plate F^2 and its needle F. (See for comparison Figs. 2 and 4 and Figs. 5 and 8.)

Immediately below the hooks G^2 and G^3 and preferably forming integral parts thereof are arranged what I prefer to call "thread-cams" G^4 and G^5, extending over onto the corresponding faces of the needle-plate F^2 and beyond the sides of the slot F^3 to cover the same on the up-and-down movement of the heddles, the inner edges of the said cams leaving, however, the eye F′ of the needle F unobstructed when passing the same. (See Fig. 6.) On the hook-bars G and G′ are also formed or secured what I prefer to call "needle-guides" G^6 and G^7, similar in shape to the thread-cams G^4 G^5, but located on opposite sides of the needle-plate F^2 in transverse alinement with the thread-cams G^4 G^5, so that the left side of the needle-plate passes between the thread-cam G^4 and the needle-guide G^6, while the right-hand side of the needle-plate F^2 passes between the needle-guide G^7 and the thread-cam G^5.

By the arrangement described the hook-bar G is provided with a hook G^2, a thread-cam G^4, and a needle-guide G^6, and the hook-bar G′ is similarly provided with a hook G^3, a thread-cam G^5, and a needle-guide G^7, the corresponding parts being located, however, on opposite faces of the needle-plate F^2. Thus the thread-cam G^4 and the needle-guide G^6 form one pair of devices on the hook-bar G, and the thread-cam G^5 and the needle-guide G^6 form a like pair of devices for the hook bar G′.

The lower ends of the thread-cam G^4 and needle-guide G^6 are connected with each other by a cross-bar G^8, extending through a vertical slot F^6 in the needle-plate F, (see Fig. 10,) and the thread-cam and needle-guide G^5 G^7 are similarly connected by a cross-bar G^8, extending through a vertical slot F^7 in the needle-plate, and by this arrangement the hook-bars G and G′ and the parts carried thereby are properly guided on the needle-plate F^2 to maintain the several parts in proper relation to each other. The upper end or head F^8 of the needle-plate F^2 has beveled sides F^9 and F^{10}, assisting in directing the lower ground warp-thread *c* to pass either to the front or rear face of the needle-plate F^2, as hereinafter more fully described.

The needle-plate F^2 is engaged at its lower end by a needle-plate-lifting bar I, secured at its ends in the vertical members of an inverted-U-shaped frame I′, mounted to slide with its vertical members in guideways B^3, arranged on the main frame B intermediate the guideways B′ and B^2 for the heddle-frames H^2 H^3.

The tops of the heddle-frames H^2 H^3 are pivotally connected by links J and J′ with bell-crank levers J^2 and J^3, connected by links J^4 J^5 with the upper ends of cam-levers K and K′, fulcrumed at or near their middle at K^2 and carrying friction-rollers K^3 K^4, engaged by cams L L′, secured on the cam-shaft L^2, driven by suitable gearing from the main driven shaft N, which by the usual gearing (not shown) also rotates the crank-shaft C. The lower ends of the heddle-frames H^2 H^3 are connected by links J^6 J^7 with ropes J^8, extending under pulleys J^9 and connected with the lower ends of the cam-levers K and K′, so that when the loom is in operation and the shaft L^2 is rotated the cams L and L′ impart an intermittent swinging motion in opposite directions to the cam-levers K and K′, which by their connections with the heddle-frames H^2 H^3 move the latter intermittently up and down. The cams L and L′ are so arranged that the heddle-frames H^2 H^3 are moved whenever the lay D is in a rearmost position. A similar motion is given to the frame I′ of the needle-plate-lifting bar I, and for this purpose the upper end of the frame I′ is connected by links I^2 with a bell-crank lever I^3, connected by a link I^4 with a cam-lever I^5, similar to the cam-levers K and K′ and likewise fulcrumed at K^2.

The cam-lever I^5 is connected by a friction-roller I^6 with a cam I^7, secured on the cam-shaft L^2, and the said cam-lever I^5 is also connected by a rope and links (not shown) with the needle-plate-lifting bar I the same as the lower ends of the heddle-frames H^2 and H^3 are connected with their cam-levers K and K′. When the shaft L^2 and the cam I^7 are

rotated, a swinging motion is given to the cam-lever I^5, which by its connection with the frame I′ and needle-plate-lifting bar I moves the latter intermittently up and down.

The cam I^7 is so arranged that the needle-lifting bar I, and with it the needle-plate F^2 and needle F, moves upward with the upward-going heddle-frame and with the thread-cam and needle-guide of this heddle engaging the needle-point at one side until the downward-moving heddle-frame has descended far enough for its pair of thread-cams and needle-guides to engage the other side of the needle-point, (see Fig. 6,) it being understood that this condition occurs when the shed is closed with respect to all of the warps. By thus engaging the point of the needle F on opposite sides the needle is prevented from being bent laterally by a possible strain exerted by the pile warp-thread, (see Fig. 9,) and hence the thread-cams and needle-guides are not liable to be caught by the needle. When the position shown in Fig. 6 has been reached, then the needle, needle-plate, and its lifting-bar in their upward movement move sufficiently slowly for the still upward-going heddle-frame H^2 to bring its pair of thread-cams and needle-guides to an uppermost position on the head F^8 of the needle-plate, (see Fig. 8,) and then the needle F, needle-plate F^2, and lifting-bar I follow the upward-moving heddle-frame to their uppermost positions. The needle F, needle-plate F^2, and its lifting-bar I move downward during the last portion of the stroke of the downward-moving heddle-frame to move upward with this heddle-frame at the next pick. Thus the needle and needle-plate move up and down during the time a heddle-frame moves in one direction only. The back reed E also has an intermittent up-and-down movement, and for this purpose the reed is mounted in a frame E^3, mounted to slide up and down in guideways B^4, arranged on the main frame B. The frame E^3 is pivotally connected by pitmen E^4 (see Fig. 1) with arms E^5, held on a rock-shaft E^6, journaled in the main frame B, and the said rock-shaft E^6 is provided with arms E^7, having friction-rollers engaging cams E^8 on the main shaft N. When the latter is rotated, the cams E^8 and arms E^7 impart an intermittent rocking motion to the rock-shaft E^6, which by the arms E^5 and pitmen E^4 gives the desired intermittent up-and-down movement to the back reed E. The back reed E serves to carry the upper ground warp-thread *b* ahead of the lower ground warp-thread *c* when going up and at the time the lower ground warp-thread *c* starts upward and to then instantly start the upper ground warp-thread *b* downward as soon as it has crossed to its alternate position to bring it past the point or top of the needle F.

It is understood that the upper ground warp-thread *b* is shifted alternately to opposite sides of the needle F for taking the said ground warp over the pile warp-thread *a* and alternately to opposite sides thereof to cross the other ground warp-thread *c*, as will be readily seen by reference to Figs. 13 and 14.

The shuttle mechanism is of the usual construction, and hence a detailed description of the same is not deemed necessary.

The operation is as follows: The warp-threads *a*, *b*, and *c* on successive movements of the lay D assume alternate crossed and uncrossed positions (see Figs. 4 and 2, respectively) in front of the back reed E and crossed positions only between the lay D and the cloth, as the warp-threads are bound in at the cloth, but are free to change positions at the back reed E owing to the relative location of the warp-beams A, A′, and A^2 to the slot E′ and eye E^2 of the vertically-reciprocating reed E. When the machine is in operation and the several parts are in the position shown in Figs. 2 and 5, then the warp-threads are in the uncrossed position and it is assumed that the shuttle has passed through the open shed and the pile-wire has been inserted between the pile warp-thread *a* and the upper ground warp-thread *b*. Now while the lay D moves forward for beating in purposes and reaches a half-way position the heddles move, and the hook-bar G′, as well as the needle-plate F^2, moves down, while the hook-bar G moves upward. When the hook-bar G begins to move upward, then the back reed E moves quickly up to an extreme top position to bring the upper ground warp-thread *b* into its extreme upward position—that is, it passes the pile warp-thread *a* and extends through the top of the slot F^3. (See Fig. 3.) At the same time the lower ground warp-thread *c* moves upward with the hook G^2 into its uppermost position, so that the lower ground warp-thread *c* passes both the pile warp-thread *a* and the upper ground warp-thread *b*. When the pair of thread-cams and needle-guides G^4 G^5 has passed up until they are half-way on the point of the needle F and the head F^8 of the needle-plate F^2, then the latter is moved upward by the needle-plate-lifting bar I in the same time that the pair of thread-cams and needle-guides G^4 and G^5 is moving and until the pair of thread-cams and needle-guides G^5 and G^7 has moved downward to such a position that the said pairs are half-way on the needle-point and the head F^8—that is, the said pairs have moved into a position directly opposite each other, as indicated in Fig. 6. The upper ground warp-thread *b* is still in its position on the top of the needle F, but the lower ground warp-thread *c* has slipped down on the cam G^4 until it lies at rest between the cam G^5 and the guide G^7. (See Fig. 6.) The lay is now beating in.

The needle-plate F^2 now rises until the pair of thread-cams and needle-guides G^4 G^6 has passed into its uppermost position on the needle-plate F^2 and has freed the left-hand side of the slot F^3, and as the lower ground warp-thread *c* now follows the downwardly-receding thread-cams and needle-guides G^5 and G^7 it is evident that it slips down over the beveled side F^{10} of the head F^8 and passes into the space F^5 and extends in front of the needle-plate F^2 to be engaged by the hook G^3. (See Fig. 7.) At the same time the back reed E drops all the way down, thus causing the upper ground warp-thread *b* to start on its downward course in the left-hand side of the slot F^3. Now as the hook G^3 takes hold of the lower ground warp-thread *c* it carries it down past the pile warp-thread *a* and the upper ground warp-thread *b* to finally move the lower ground warp-thread *c* into its extreme lowermost position. (See Figs. 4 and 8.) The lay now comes back to allow the shuttle and the pile-wire *e* to pass through the open shed. During the movement described the warp-threads *a*, *b*, and *c* have been crossed—that is, the pile warp-thread *a* now stands on top, the upper ground warp-thread *b* is next below, and the lower ground warp-thread *c* is down in its lowermost position. This shifting of both ground warp-threads *b* and *c* has taken place at the time the said ground warp-threads were standing above the pile warp-thread *a*. By the above movement of the needle-plate F^2 and the hook-bar G the pile warp-thread *a* is passed between the two ground warp-threads *b* and *c*. Now this makes a cross of the threads from the right to the left, and when the hook-bar G moves into its extreme uppermost position a cross is also made in an up-and-down direction of the ground warp-threads *b* and *c* as they pass each other in a vertical direction, or, in other words, a complete twist is produced, as illustrated in Figs. 4 and 15. During the next full stroke of the lay the heddle-frames H^2 H^3, the needle, and the needle-plate F^2 are again operated as above described in order that the heddle-frames may move in opposite directions, and during this operation the warp-threads are uncrossed—that is, the lower ground warp-thread *c* during the full movement of the lay is moved from the space F^5 and the front face of the needle-plate back to the space F^4 on the left-hand side of the needle-plate and to the rear thereof (see Figs. 2 and 5) and the upper ground warp-thread *b* has been moved from the left-hand side of the slot F^3 to the right-hand side thereof, and the warp-threads now stand in the position of a plain open weave.

By the arrangement described the pile warp-thread *a* is looped around the lower ground warp-thread *c* and is then passed between the ground warp-threads *c* and *b*, and the ground warp-threads *c* and *b* are twisted between successive picks, so that the members a^4 and a^5 of a pile extend on opposite sides of the upper ground warp-thread *b*, as shown in Fig. 12.

It is understood that when the warp-threads are crossed the shuttle runs across between the up and down crossed ground warp-threads *b* and *c*, and the pile-wire is extended between the upper ground warp-thread *b* and the pile warp-thread *a*, and the lay D beats up the weft and the pile-wire against the cross and twist in front of the lay D. At the next full movement of the lay D the warp-threads are uncrossed—that is, are returned to the first position above described and shown in Figs. 2 and 4.

By an "uncrossed" position is meant that the threads *a*, *b*, and *c* are uncrossed in the front of the back reed E; but they remain crossed at the fabric in front of the lay D, as the threads at the fabric are bound in, and consequently at the next movement of the lay and the heddles, as described, the pile warp-thread again loops around the lower ground warp-thread, only in a reverse direction, and then passes between the ground warp-threads *c* and *b*.

The upper edges of the thread-cams and the needle-guides are beveled downwardly and inwardly to allow a ready downward passage of the lower ground warp-thread onto the corresponding beveled edge F^9 or F^{10} on the head F^8 of the needle-plate at the time the back reed E moves downward. The lower edges of the thread-cams and needle-guides are curved to allow a ready passage of the upper ground warp-thread from either side of the slot F^3 to the top thereof at the time the back reed E moves upward and also to allow the upper ground warp-thread to pass from the top of the slot down either side of the slot at the time the back reed moves downward. It is understood that the function of the thread-cams and needle-guides is to insure a proper shifting of both ground warp-threads *b* and *c* relative one to the other and both relative to the pile warp-thread *a* in the needle F to produce the desired result in the weave.

As the several parts are all driven from the main shaft N, they move synchronously to accomplish the desired result; but I do not limit myself to any particular actuating mechanism described, as the same may be varied to produce the same result.

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

1. A loom for interweaving ground warp-threads and a pile warp-thread, provided with a reciprocating needle-plate, a needle integral on the needle-plate and forming with the latter a slot extending around the sides and point of the needle, the needle having an

eye for the passage of the pile warp-thread and one of the ground warp-threads extending through the said slot, means for carrying the other ground warp-thread up and down past the pile warp-thread and the said ground warp-thread in the slot, and alternately to opposite faces of the needle-plate and its needle, and a reciprocating back reed having an eye for the passage of the ground warp-thread which passes through the said needle-plate slot, the back reed also having a vertical slot for the passage of the other ground warp-thread and the said pile warp-thread, as set forth.

2. A loom for interweaving ground warp-threads and a pile warp-thread, provided with a reciprocating needle-plate, having a beveled head, a needle integral on the needle-plate and forming with the latter a slot extending around the sides and point of the needle, the needle having an eye for the passage of the pile warp-thread, and one of the ground warp-threads extending through the said slot, reciprocating hook-bars on opposite sides of the needle-plate, spaced therefrom to form spaces into which passes alternately the other ground warp-thread, the hook-bars having hooks extending across the spaces onto the needle-plate at the opposite faces thereof, the hooks being adapted to alternately engage the last-mentioned ground warp-thread, and a thread-cam and needle-guide on each hook-bar, immediately below the corresponding hook, each pair of thread-cams and needle-guides engaging opposite sides of the needle-plate and extending beyond the sides of the said slot, as set forth.

3. A loom for interweaving ground warp-threads and a pile warp-thread, provided with a reciprocating needle-plate, having a beveled head, a needle integral on the needle-plate and forming with the latter a slot extending around the sides and point of the needle, the needle having an eye for the passage of the pile warp-thread, and one of the ground warp-threads extending through said slot, reciprocating hook-bars on opposite sides of the needle-plate, spaced therefrom to form spaces into which passes alternately the other ground warp-thread, the hook-bars having hooks extending across the spaces onto the needle-plate at the opposite faces thereof, the hooks being adapted to alternately engage the last-mentioned ground warp-thread, a thread-cam and needle-guide on each hook-bar, immediately below the corresponding hook, each pair of thread-cams and needle-guides engaging opposite sides of the needle-plate and extending beyond the sides of the said slot, and a reciprocating back reed having an eye for the passage of the ground warp-thread which passes through the said needle-plate slot, the back reed also having a vertical slot for the passage of the other ground warp-thread and the said pile warp-thread, as set forth.

4. A loom for interweaving ground warp-threads and a pile warp-thread, provided with a needle-plate, a needle thereon for the passage of the pile warp-thread and forming a slot with the needle-plate for the passage of one of the ground warp-threads, a reciprocating device having hooks moving alternately in opposite directions for alternately carrying the other ground warp-thread in front and rear of the needle-plate and its needle, a needle-guide for each hook, and a thread-cam for each hook, as set forth.

5. A heddle device for a loom for interweaving ground warp-threads and a pile warp-thread, comprising a pile warp-needle, a needle-plate having a slot for one of the ground warp-threads, and hooks reciprocating in opposite directions on opposite sides of the needle-plate and needle for manipulating the other ground warp-thread, as set forth.

6. A heddle device for a loom for interweaving ground warp-threads and a pile warp-thread, comprising a reciprocating needle-plate, a needle carrying the pile warp-thread and moving in unison with the said needle-plate and forming with the needle-plate a slot for the passage of the other ground warp-thread, hooks reciprocating in opposite directions on opposite sides of the needle-plate, each hook having a needle-guide and a thread-cam, as set forth.

7. A heddle device for a loom for interweaving ground warp-threads and a pile warp-thread, comprising a reciprocating needle-plate having a head beveled on the sides, a needle moving with the needle-plate and forming with the same a slot extending around the sides and top of the needle, hooks reciprocating in opposite directions on opposite sides of the needle-plate, a needle-guide for each hook, and a thread-cam for each hook, as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FRED A. WHITMORE.

Witnesses:

THEO. G. HOSTER,

HAIL D. MUGERDITCHYAN.