No. 883,541. PATENTED MAR. 31, 1908.

W. W. HUBBARD.

SHEDDING MECHANISM.

APPLICATION FILED MAY 31, 1907.

4 SHEETS—SHEET 1.

Fig. 1.

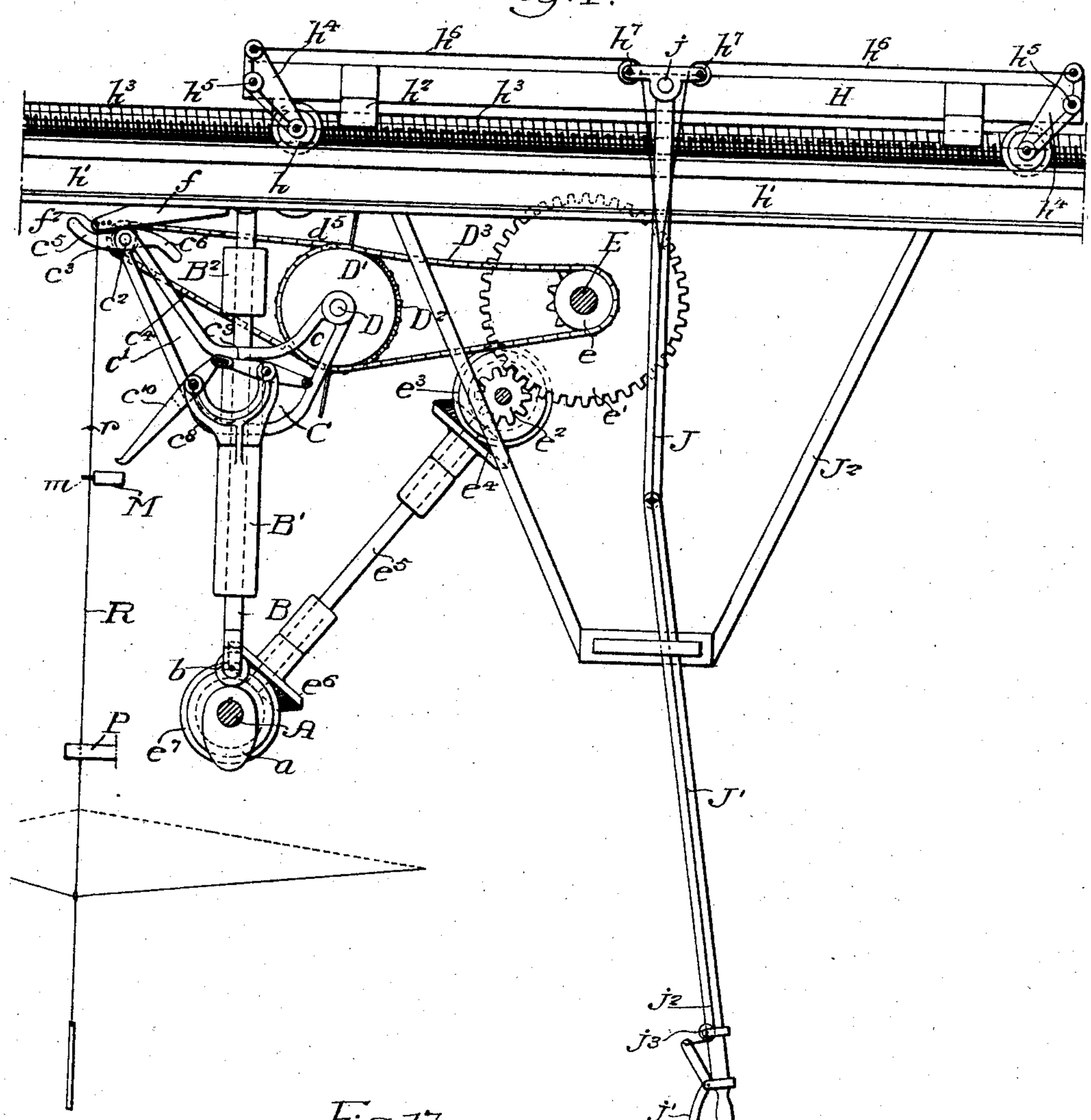

Fig. 17.

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Walter F. Pellinger

Inventor:
Walter W. Hubbard.
by his Attorneys.
Howson & Howson

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4 SHEETS—SHEET 2.

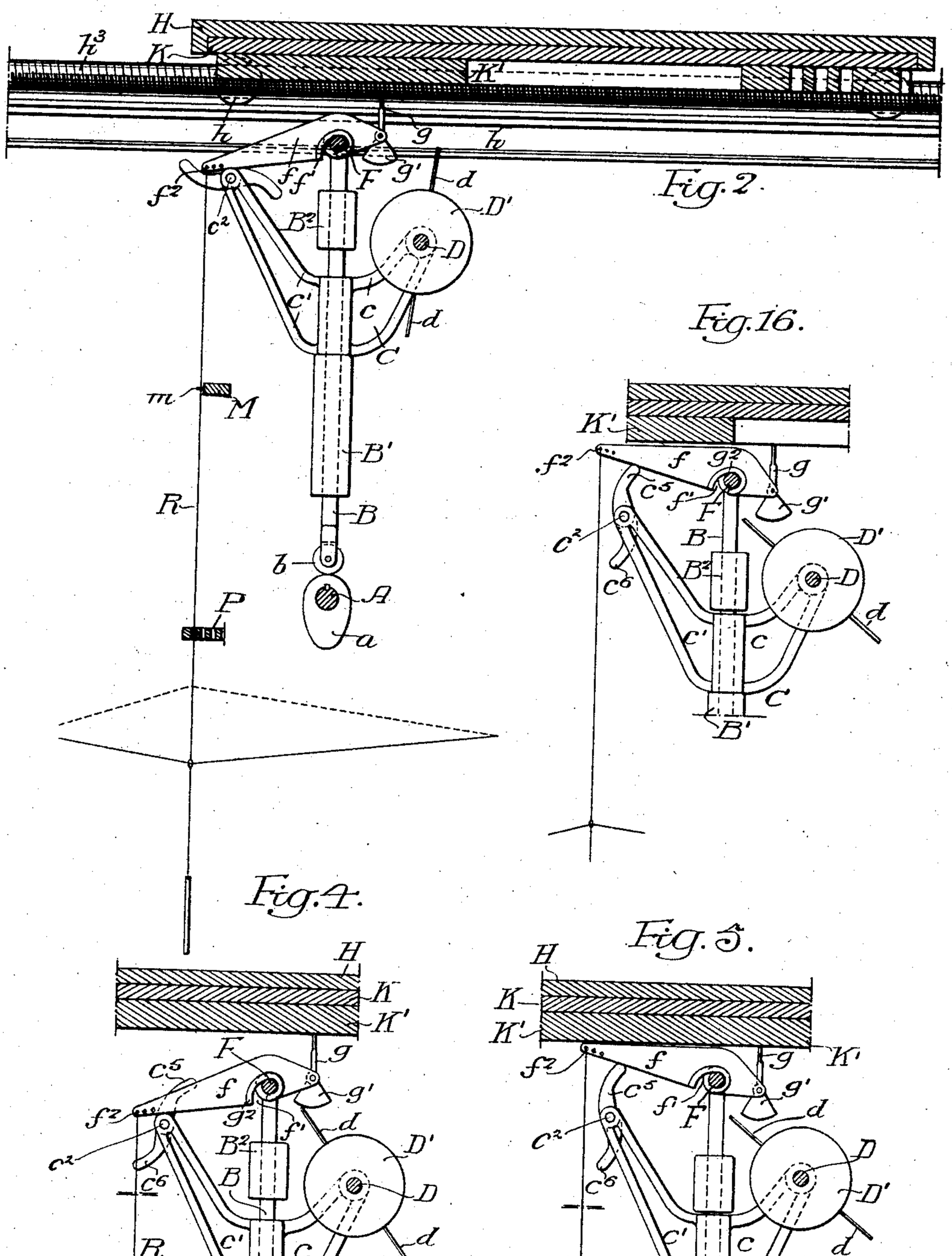

Fig. 2.

Fig. 16.

Fig. 4.

Fig. 5.

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4 SHEETS—SHEET 3.

Fig. 3.

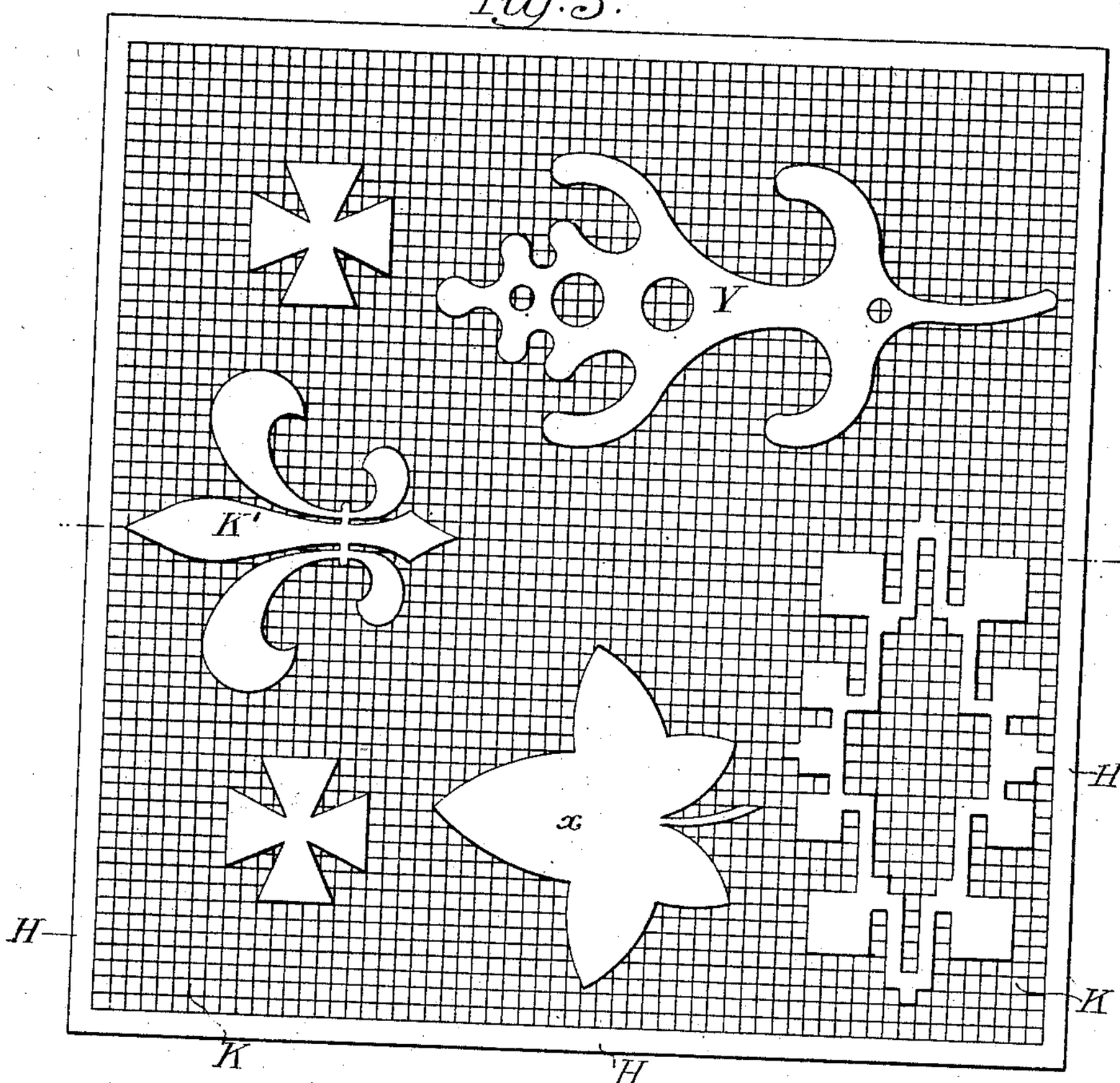


Fig. 6.

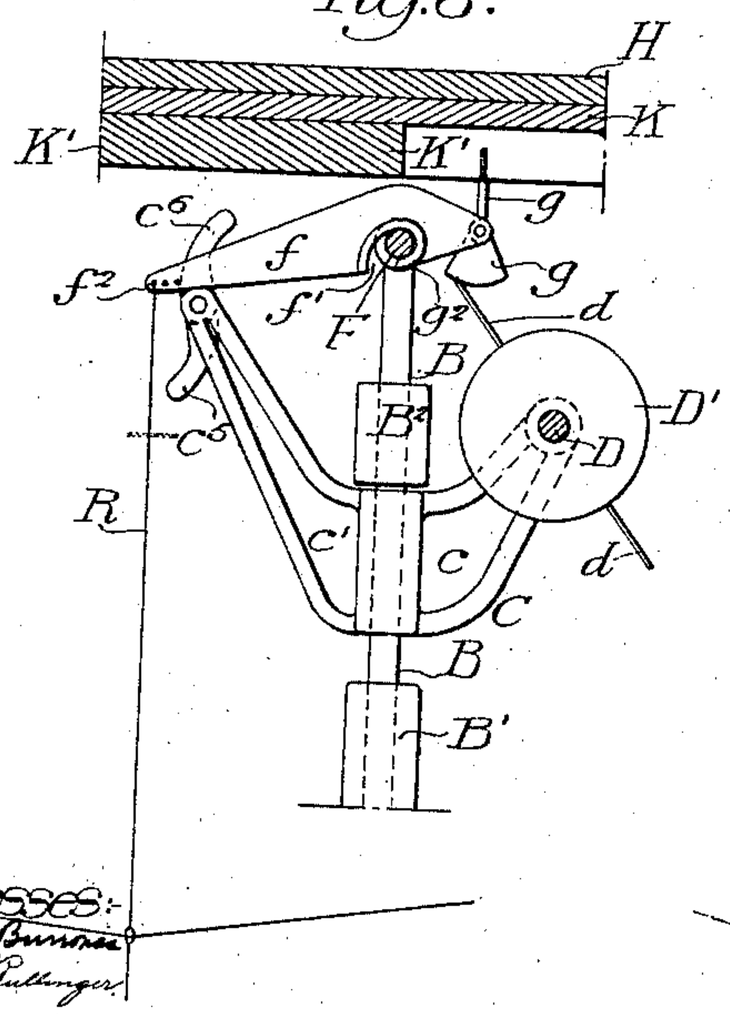
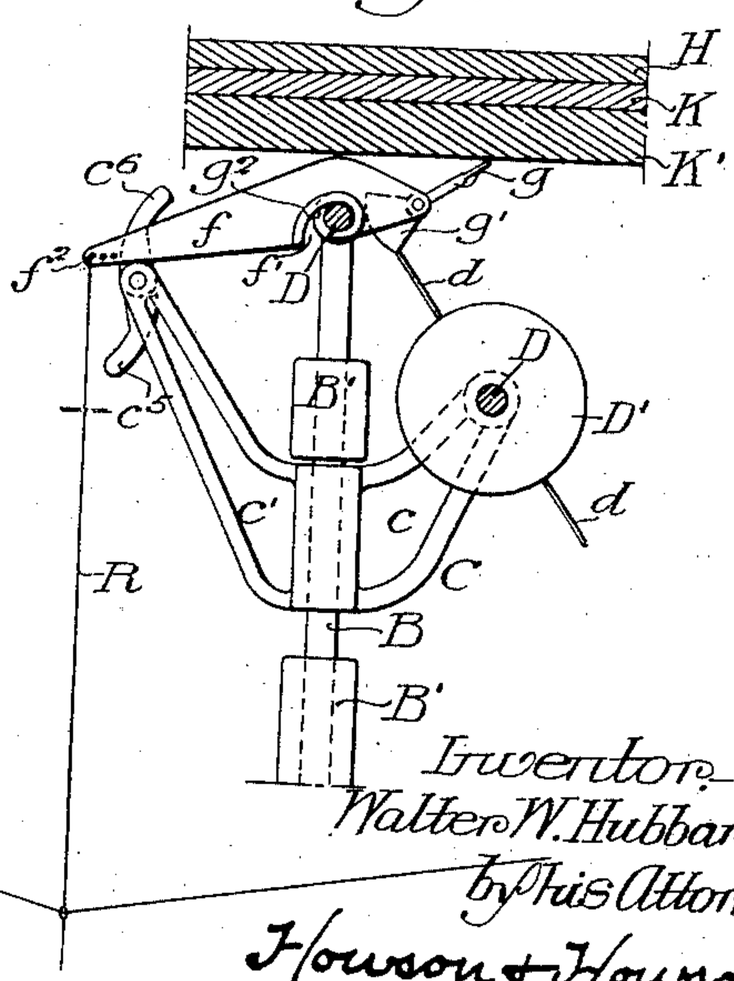


Fig. 7.



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4 SHEETS—SHEET 4.

Fig. 8.

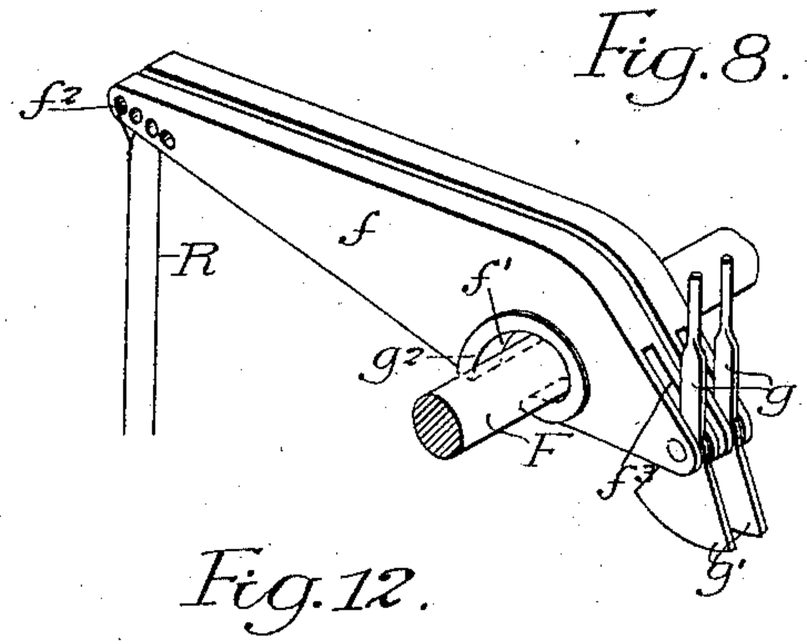


Fig. 12.

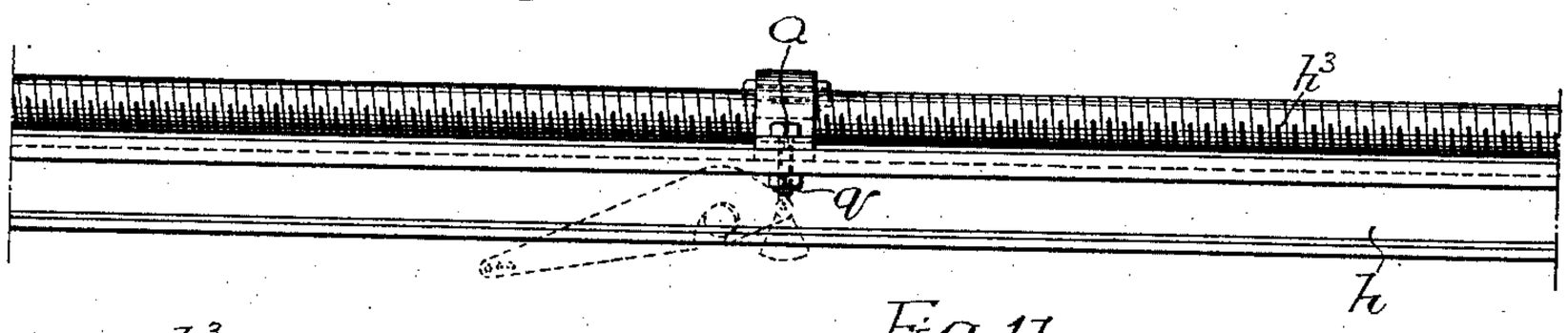


Fig. 11.

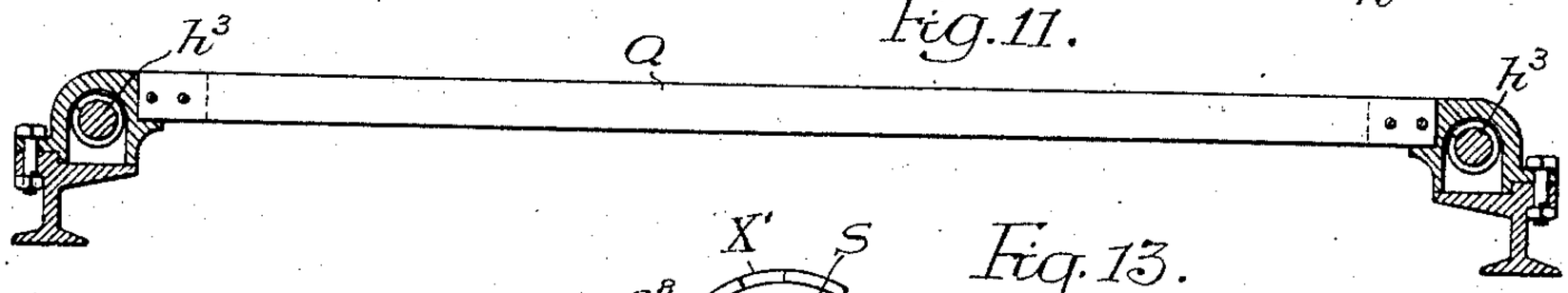


Fig. 13.

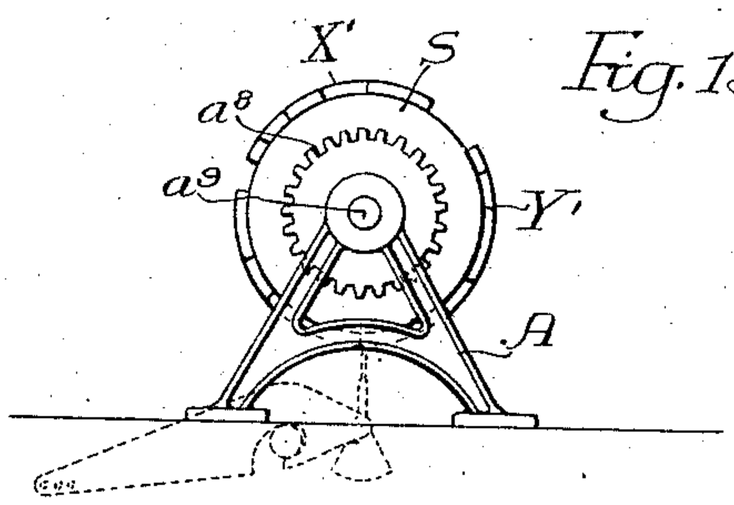


Fig. 10.

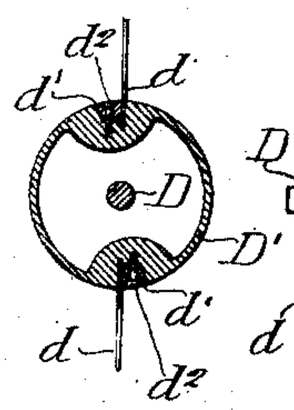


Fig. 9.

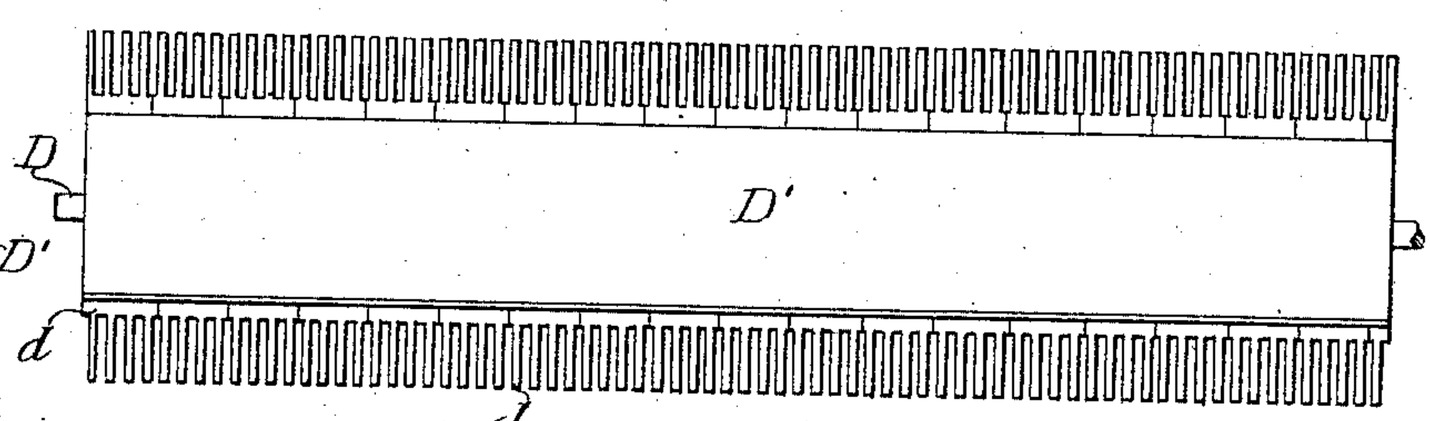
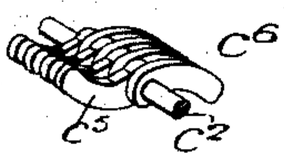
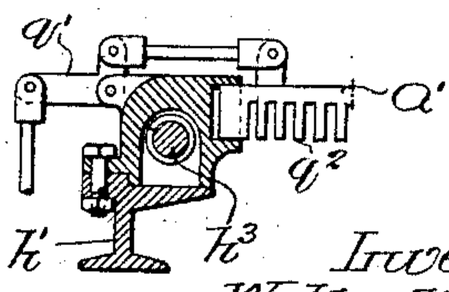


Fig. 15.



Witnesses:-
Wills A. Burrows
Walter F. Pellinger

Fig. 14.



Inventor:
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UNITED STATES PATENT OFFICE.

WALTER W. HUBBARD, OF PHILADELPHIA, PENNSYLVANIA.

SHEDDING MECHANISM.

No. 883,541. Specification of Letters Patent. Patented March 31, 1908.

Application filed May 31, 1907. Serial No. 376,510.

To all whom it may concern:

Be it known that I, WALTER W. HUBBARD, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Shedding Mechanism, of which the following is a specification.

My invention relates to a shed forming machine for use in connection with weaving mechanism, one object being to provide mechanism whereby the scope of fabric production of any weaving machine may be broadened both in design and structure; it being also desired to reduce the cost of the production of the fabric woven.

Another object of my invention is to provide mechanism of such a nature as will permit of a great variety of inexpensive methods for the expeditious changing from one weave to another, either in structure or in design or both.

It is further desired to provide a device which in many respects shall, for a large class of work, serve as a desirable substitute for jacquard machines, dobbies and harness shafts.

These objects I attain as hereinafter set forth, reference being had to the accompanying drawings, in which

Figure 1, is a side elevation of my invention showing it as applied to a loom; Fig. 2, is a sectional elevation of the mechanism shown in Fig. 1; Fig. 3, is an inverted plan of one form of fretwork pattern plate which I may employ; Figs. 4, 5, 6 and 7, illustrate the different positions occupied by the levers during the operation of the machine; Fig. 8, is a perspective view of two of the lift levers and their associated parts; Fig. 9, is a longitudinal view of the toothed cylinder employed as part of my invention; Fig. 10, is a transverse section of the cylinder shown in Fig. 9; Fig. 11, is a front elevation of an attachment which may be used for the production of plain weaves; Fig. 12, is a side elevation of the device shown in Fig. 11; Fig. 13, shows a modification of my invention in which instead of the flat-work pattern plate shown in Fig. 3, I employ a cylinder; Fig. 14, is a vertical section of a modification of my invention; Fig. 15, is a perspective view of a number of the cams for operating the lifting levers in order to form the foundation weave; Fig. 16, is a vertical section illustrating one of the features of operation of the machine, and Fig. 17, is an elevation, on a reduced scale, of a device for indicating the part of a pattern being woven at any given time, and for various other purposes.

In the above drawings, A represents the main power shaft of a loom making one revolution for every throw of the shuttle and having mounted upon it two cams *a*, *a*, at opposite sides of the loom. On these cams rest rollers *b* rotatably attached to the lower ends of vertical bars B slidably mounted in fixed bearings B′, B² also supported at opposite sides of the loom. Rigidly attached to the bars B are brackets C having arms *c* respectively providing bearings for a horizontal shaft D which carries a rotatable toothed cylinder D′. In addition the brackets C have arms *c′* in which are bearings for a shaft *c²* extending transversely of the machine, and carrying a sprocket *c³* driven by a chain *c⁴* from a sprocket *d⁵* on a comb tooth cylinder D′.

Rigidly fixed to the shaft *c²* are two series of cams *c⁵* and *c⁶* alternating with each other and projecting in this instance 180° apart. The brackets C and these arms are so placed and proportioned that each of said cams is directly under one of the levers *f* so that under operating conditions one arm of each lever may be engaged and lifted by its particular cam, in alternating succession.

A gear wheel D², driven by a chain D³ from a pinion *e* on a shaft E, causes the cylinder D′ to rotate, and this shaft E in turn receives power from the main shaft A through spur gears *e′* and *e²*, bevel gears *e³* and *e⁴*, shaft *e⁵*, and bevel gears *e⁶* and *e⁷*.

The vertical bars B serve as supports for a transverse rod F on which are mounted levers *f* of a number depending on the number of ends in the fabric to be woven. These levers are each recessed at *f′* so as to be free to rock on the rod F, and said recesses are so formed as to permit the removal of any lever or levers from said rod without disturbing any of the others.

The levers mounted in this manner may be bodily raised or lowered by the vertical movement of the bars B, or they may be rocked upon the bar F as a pivot. The forwardly projecting arms of the levers *f* are provided with holes *f²* arranged at different distances from the bar F, for the purpose of effecting the size of the shed to be formed as set forth hereinafter, while the rearwardly projecting arms or ends of the levers *f* are usually though not necessarily vertically

slotted at f^3 for the reception of pivotally mounted pendent pins g having skirt weights g' whereby they are normally maintained in an upright position. In order to reduce the friction between adjacent levers f, I preferably provide each of them with projecting bosses or collars g^2 as shown in Fig. 8.

Mounted above the mechanism so far described is a carriage H having wheels h resting on a substantially horizontal track h', supported in any desired manner above the weaving mechanism. This carriage H has mounted upon its under face a plate K and also has fixed to it semi-cylindrical nuts h^2 threaded so as to engage with threaded shafts h^3, whereby the carriage H may be caused to move along its track. The plate K constitutes one form of my design-supporting surface and on it may be fastened in any desired manner fretwork patterns K', which in this instance consist of wooden or metallic motives or forms constituting the design of the fabric to be woven.

Tied to the levers f through the holes f^2 are the heddle threads R for operating the warp threads in the usual manner, and these heddle threads, after leaving the levers f, pass between pins m on a board M whereby they are delivered to the levers f in a perpendicular alinement. Between the heddles and the board M is placed the usual comber board P.

Referring to Fig. 1, it will be noted that the wheels h are each carried on an arm of a bell crank lever h^4. Said levers are rigidly fixed to spindles h^5 extending across the carriage, there being four such levers, one on each end of each spindle.

On one side of the carriage is mounted a downwardly extending operating lever made in two pivotally connected sections J and J', of which the upper is pivoted to the carriage at j. The lower end of the section J' is provided with a hand lever j' to one arm of which is attached a flexible connection j^2 such as a chain or cable. Said connection is guided around a pulley j^3 from whence it passes up along the sections J' and J, dividing near the upper end of the latter into two branches h^6, respectively passing over guide pulleys h^7 and finally connected to the second arms of the bell crank levers h^4. The lever section J' is guided by a suitably formed frame J^2 projecting downwardly from the tracks h'.

The toothed cylinder D' is preferably constructed as shown in Figs. 9 and 10, and consists of a metallic or hardwood shell having longitudinal grooves, of any desired number, of which there are two in the case illustrated. These grooves are provided for the reception of comb sections d which are held in place by longitudinally extending wedges d' in turn held to the cylinder body by screws d^2.

For the purpose of indicating to the operator at just what part or pick of a pattern or motive the machine is operating and to afford the greatest facility for adjusting the pattern plate in various desired positions, I provide the device illustrated in Fig. 17; this mechanism being also valuable in case it is desired to repeat or eliminate or in other ways modify any part of the design or pattern to produce various changes in the woven fabric. In said figure h^8 indicates a cam fixed to the carriage H and designed to operate on a roller carried by a vertically slidable rod or bar l, having at its lower end a rack l'. A spring l^2 tends to maintain the upper end of this rod in engagement with the surface of the cam h^8

Suspended from one of the tracks h' is a frame N, on which is mounted a plate n having a circular scale graduated in units corresponding to the length of one of the patterns employed in the machine. Upon a spindle n' mounted in the plate n is carried a hand or pointer n^2 whose end passes adjacent to the circular scale and there is also carried on said spindle a pinion n^3 meshing with the teeth of the rack l'. Also mounted upon the plate n adjacent to the scale or dial n^4, above referred to, is placed a miniature sketch or reproduction n^5 of the pattern or design to be woven in any particular case and this has one of its sides graduated as indicated at n^6 in divisions corresponding to the units on the circular scale.

With the above described arrangement of parts the main shaft A is turned from any suitable source of power, as are also the threaded shafts h^3. These latter cause movement of the carriage H over its tracks at a predetermined rate and also effects the revolution of the comb tooth cylinder D' and the spindle c^2. At every revolution of the main shaft A, the cams a thereon move the bars or rods B vertically upward, and consequently move bodily upward the transversely extending bar F with its levers f. Before the pattern on the carriage has come in position to be acted upon by the pendent pins g, the shedding operation is performed by means of the operation of the cams c^5 and c^6; the various gearing being so proportioned that the spindle carrying these latter turns at half the rate of the shaft A, making, therefore, one revolution to each two picks or two shots of the shuttle. This arrangement therefore, results in all of the levers being raised with their bar F, after which every other lever, as shown in Fig. 16, is rocked on said bar F by the cams c^5, thereby causing alternate ones of the heddle threads to be raised. On the next revolution of the shafts A and c^2 the remainder of the levers f are lifted by the cam c^6, thereby rocking them on their bar F and raising the remainder of the heddles, it being understood that the levers f, as soon as they are released by their cams, are returned to their normal positions

by reason of their weight and because of the lingoes on the ends of their heddle threads.

It is to be noted at this point that the weaving operation so far as described is not necessary in every case, though it serves as a simple and convenient means for providing regular shedding when necessary, prior to the commencement of the weaving of a design.

If, now, the carriage H has been moved sufficiently by the revolution of the threaded shafts h^3 to bring the pattern plate K, with its pattern K′, over the pendent pins g carried by the levers f, then each time the rods B are moved upwardly by the cams a on the shaft A, the bar F, as before, bodily raises all of the levers f, but after they have been moved upward a predetermined distance, certain of them are rocked on said bar F by reason of the fact that their particular pins g strike, as shown in Fig. 4, against the raised portion of the fretwork pattern K, thus causing that particular lever or levers to assume the position shown in Fig. 5, by the time the bars C have moved to the extreme upward end of their stroke. As is obvious, this results in a lifting of certain of the heddle threads as desired. On the other hand, certain others of the pins g, as illustrated in Fig. 6, are opposite openings or depressed portions in the fret-work pattern and consequently, even though the bars B are moved upwardly to their full extent, said pins are in no wise effected and the levers f to which they are attached are similarly unaffected. There is consequently no lifting of the heddle threads attached to these levers. It is, therefore, obvious that owing to the combined action of the levers f affected by the pattern and those unaffected by it, there is formed a definite shed as desired. As before noted, the continued revolution of the shaft c^2 causes the raising of alternate levers f at each revolution of the shaft A, and thereby forms a uniform shed in order to provide a plain weave serving as a foundation between the motives of the design being woven, as indicated in Fig. 16, above referred to.

When any of the levers f are in their elevated positions, as shown in Fig. 5, under the action of the pins g, it is to be understood that they will not be affected by the cams c^5 and c^6, since these will merely pass under them, owing to the fact that said levers are above their range of movement.

In order to provide for the tying down of the long floats otherwise formed in the motive portions X, Y, etc., of the design, I provide means whereby at intervals the levers f are permitted to remain in their lower positions instead of being raised, even though their pins g are opposite the raised portions or motives of said design. The comb tooth cylinder shown in Figs. 9 and 10 is employed for this purpose, and in the present instance is so driven that it makes one revolution to every eight shots of the shuttle. The comb teeth are so arranged on the cylinder D′ that a tooth in one set is opposite a space in the other set and as a consequence, the skirt g' of any given pin g is only acted upon once in every revolution of the comb tooth cylinder. It will be understood that the action of the teeth of the comb upon these skirts g' is such that the pins g otherwise striking a raised portion of the pattern and hence causing their levers f to raise the heddle threads, are turned on their pivots into the positions shown in Fig. 7, so that all of the levers whose ends are so arranged remain unelevated for one stroke and consequently permit a shot of filling to be placed over them to tie them down. A half revolution of the toothed cylinder D′ brings its other set of teeth into position to act on the skirts of the pins of the remainder of the levers f.

While I have illustrated two longitudinally extending series of comb teeth, it is obvious that these may be arranged in more than two rows and may also be placed upon their cylinder in any irregular or other desired positions so as to cause any desired tying down of the warp threads.

In order to prevent the possibility of the heddle thread being partially raised, as by one of the pins g striking one of the raised portions of the pattern and then slipping off after the lever f has been partly rocked on its bar F, I provide means whereby when once a heddle thread has been raised a predetermined distance, it will be forced to move its full distance in case of the failure of its lever to perform this function. For this purpose I provide on each of the supporting structures B′ a small bracket c^8 and to each bracket I pivot a lever c^9, one end of which is loosely connected to the arm c' of the part C fixed to the bar B. Said bracket c^8 also has pivoted to it a comb c^{10} loosely connected to the opposite ends of said levers c^9 and is so placed that the heddle threads R respectively pass between its teeth when said comb is in its raised position. Each of the heddle threads is provided with a knot as indicated at r which, when the thread is down, is just below and out of the line of the teeth of the comb c^{10}. As the heddle thread is raised, as by the rocking of the lever f, its knot passes above the ends of the teeth of the comb, which immediately follow it, owing to the continued upward movement of the bracket C transmitted through the levers c^9. As a consequence, even should any of the heddle threads be permitted to drop, after having once started to rise, their knots r would be caught by the teeth of the comb c^{10} and moved upward to their full extent in spite of the possible failure of one or more of the levers f to properly operate. It is obvious that when the bars B next move to their

lower positions the knots r slip off of the teeth of the comb c^{10}, which ordinarily does not engage them.

If it be desired to form a plain weave without employing the cams c^5 and c^6, I may replace the carriage H by a transverse bar Q, as shown in Fig. 11 and 12; this being rigidly held to the tracks of the machine by bolts q immediately over the line of pins g. Naturally, if a bar with a plane face were employed by itself all of the levers would be raised at the same time, but in order to effect a proper shed, I employ the comb tooth cylinder D′, which in such a case, would be caused to make one half revolution for each two shots of the shuttle so that only one-half of the levers f would be raised at each revolution of the shaft A; the other half remaining down owing to the action of the teeth on said cylinder D′.

If it be desired to dispense with the comb teeth cylinder D′, I may provide the device illustrated in Fig. 14, in which a toothed bar Q′ is employed so supported as to be capable of longitudinal oscillation transversely of the machine. In its simplest form the teeth of this bar are of the same widths as the spaces between them and by means of any suitable mechanism, such as a lever q', actuated at each revolution of the main shaft A, said toothed bar Q′ is so moved that at one upward movement of the bar F with its levers f, half the pins strike the projecting teeth q^2 of said bar, while the remaining pins enter between the teeth and their levers are consequently not affected. On the next stroke the longitudinal movement of the bar Q to a distance equal to the width of one tooth causes the levers previously unaffected to be raised by reason of the engagement of their pins g with the teeth. This device may be employed for the formation of the various forms of weaves, such as twills, by varying the relative widths of the teeth and their intervening spaces, and providing various transverse movements for the bar Q.

In many cases, it may be desirable to employ in place of the flat or plane pattern plate with its raised motives, such a device as that illustrated in Fig. 13. In this figure A represents a framework mounted at each side of the machine and providing bearings for a transverse shaft a^9 driven by a gear a^8, or other suitable means. Upon said shaft is mounted a cylinder S, on the surface of which are removably fixed the raised motives X′, Y′, constituting the pattern, which it is desired to reproduce on the fabric to be woven. The lower surface of the cylinder in this instance bears the same relation to the pins g of the levers f as does the plane fretwork pattern of the carriage H. This latter form of supporting device may, in many instances, be preferable to that shown in the previous figures, inasmuch as by its use the pattern can be repeated or modified in some ways with greater ease and relatively simpler mechanism.

From the above description, it will be understood that patterns may be applied to the pattern plate, or to the cylinder, as the case may be, with great ease, in an infinite variety, and at little cost, either according to or regardless of scale, so that not only may ornamental figures or patterns be woven with utmost facility, but figuring or letters may be easily repeated or reproduced or modified, transposed, eliminated reversed, distorted or transmuted, merely by modifying the usual operation of the machine after the pattern has been attached to the cylinder or pattern plate.

It is obvious that special units for selvage heddles and for regulating the shuttle colors can be conveniently placed on the sides of the fret pattern plate without departing from my invention.

It is obvious that in carrying out my invention I may provide fonts of type, units of design, or figures of any desired form, so arranged as to be immediately introduced into my machine as patterns, so that such objects as signs, placards, inscriptions, etc., may be woven in a fabric with the utmost ease rapidity and economy; these various modifications being in addition to such well known figure designs as are commonly employed in fabrics at present. It will be further noted that my invention lends itself particularly to the origination and inexpensive preparation of new patterns, and by the modification of a single original pattern, has practically indefinite possibilities for the production of a multiplicity of designs and weaves. In other words, one pattern unit may be moved at varying rates of speed through the machine and its position therein may be changed at the will of the operator, so there is practically no limitation to the mutations possible with a single pattern. It is also to be noted that the machine has but relatively few parts, particularly when employed for such specific weaves as twills, satins, etc., and the action of these is positive, while their arrangement is such that there is a minimum of lost motion with but little likelihood of any of the parts getting out of repair. Moreover weaves of any pattern may be made with the greatest facility without change of mounting or tie-up; *i. e.* without regard to the number of warps or picks per inch.

It is conceivable that in some instances a plurality of heddle threads may be controlled by each of the levers f and this will be understood to be contemplated by my invention and to be covered by the claims thereof.

I claim:

1. Shed forming mechanism consisting of

a fretwork pattern having a rigid supporting structure, a series of heddle threads and levers connected to said heddle threads, with a single structure mounted on each lever so as to be capable of directly operating on the pattern to form a shed, substantially as described.

2. Shedding mechanism consisting of a pattern having its parts rigidly positioned, a series of heddle threads, a series of levers each having one arm connected to one of the threads, the second arm of each lever being provided with means whereby it may be actuated from the pattern, and means for periodically moving the levers, substantially as described.

3. Shedding mechanism consisting of a series of heddle threads, a series of levers each having one of its arms connected to a heddle thread, means for periodically moving the levers, and a pattern having its parts rigidly positioned, and constructed to coöperate with the levers to prevent their movement from raising definite ones of the heddle threads, substantially as described.

4. Shedding mechanism consisting of a series of heddle threads, a series of levers, each of which has one of its arms connected to a heddle thread, means for periodically moving the levers, and a pattern having its parts rigidly positioned, and constructed to coöperate with one of the arms of each lever to cause movement of each lever to result in a raising of its heddle thread at predetermined times, substantially as described.

5. Shedding mechanism consisting of a series of heddle threads, a series of levers each having an arm connected to one of said threads, with two devices placed to operate on said levers to periodically cause definite ones of said threads to be raised while the others remain down, substantially as described.

6. Shedding mechanism having a series of levers, a pattern having portions operative on one arm of each lever at predetermined times, a device in addition to said pattern capable of operating on the second arm of each lever, and a series of heddle threads respectively connected to said levers, substantially as described.

7. Shedding mechanism including a series of levers, a pattern having parts rigidly positioned relatively to each other and operative on one arm of each lever at predetermined times, a series of heddle threads respectively connected to said levers, with means for periodically moving the levers to cause certain of them to raise their heddle threads, substantially as described.

8. The combination of a series of heddle threads, a series of levers, means for bodily moving said levers, connections between one arm of each lever and a heddle thread, a pattern having its parts rigidly positioned relatively to each other, and a device carried by each lever capable of engaging the pattern under predetermined conditions when the levers are raised, substantially as described.

9. The combination of a series of heddle threads, a vertically movable structure, a series of levers carried thereby, each having one arm connected to one of the threads, a movable pattern having recesses and elevations of predetermined arrangement mounted upon a rigid structure, and means carried by each lever constructed to engage the raised portions of the patterns as said levers are raised so as to cause raising of the heddle thread connected to them, substantially as described.

10. Shedding mechanism consisting of a series of substantially parallel levers, bodily movable structures carrying said levers, means for periodically moving said structures, a series of heddle threads respectively connected to the levers, a movable pattern having portions of its surface at different elevations, a series of devices respectively carried by the levers and placed to coöperate with the pattern as the levers are raised, with means independent of the pattern to cause the levers to raise their heddle threads at predetermined times, substantially as described.

11. The combination in a shedding mechanism, of a pattern, a series of levers, with means for moving the levers to cause them to be turned on their pivots by the pattern, heddle threads connected to the levers, and means operatively independent of the pattern for periodically turning the levers on their pivots to raise definite ones of the heddle threads, substantially as described.

12. The combination in a shedding mechanism of a pattern, a series of levers, means for moving the levers to cause them to be turned on their pivots by the pattern, heddle threads connected to the levers, with a series of cams placed to actuate the respective levers to raise the heddle threads at predetermined times independently of the pattern, substantially as described.

13. Shedding mechanism consisting of a pattern, a series of heddle threads, a series of movable levers respectively connected to the heddle threads, means for moving the levers to cause certain of them to coöperate with the pattern to raise their heddle threads, and means for periodically rendering a lever or levers inoperative when it would otherwise coöperate with the pattern to raise a heddle thread or threads, substantially as described.

14. The combination in a shedding mechanism, of a pattern, a series of heddle threads, a series of levers respectively connected to the heddle threads, a device carried by each lever for engaging the raised portions of the patterns when its lever is moved, with mechanism periodically operative on said devices

carried by the levers to move them into positions where they are incapable of cooperation with the pattern when their levers are raised, substantially as described.

15. The combination in a shedding mechanism, of a pattern, a series of levers, a supporting structure therefor, means for periodically moving said structure with the levers toward the pattern, a pivotally supported pin carried by one arm of each lever and arranged to engage the raised portion of the pattern when its lever is moved toward the pattern, and a series of heddle threads respectively connected to the second arms of said series of levers, substantially as described.

16. The combination in a shedding mechanism, of a pattern, a series of levers, a supporting structure therefor, means for periodically moving said structure with the levers toward the pattern, a pivotally mounted pin carried by one arm of each lever and arranged to engage the raised portion of the pattern when its lever is moved toward the pattern, a series of heddle threads respectively connected to the second arm of said series of levers, with means independent of the pattern for turning the levers on their supporting structure to raise the heddle thread or threads, substantially as described.

17. The combination in a shedding mechanism, of a pattern, a series of levers, a supporting structure therefor, means for periodically moving said structure with the levers toward the pattern, a movable pin carried by one arm of each lever and arranged to engage the raised portion of the pattern when its lever is moved toward the pattern, a series of heddle threads respectively connected to the second arm of said series of levers, with means periodically operative on certain of the pins to prevent those otherwise engaging the pattern from being engaged thereby when their levers are raised, substantially as described.

18. The combination in a shedding mechanism, of a pattern, a series of levers, means for periodically moving said levers bodily toward the pattern, a pivotally mounted pin carried by one arm of each lever and arranged to engage a raised portion of the pattern when said lever is moved toward the same, a series of heddle threads, respectively connected to the levers, a toothed cylinder, and means for operating said cylinder to cause its teeth to periodically engage certain of said pins to turn the same on their pivots, substantially as described.

19. The combination in a shedding mechanism, of a pattern, a series of levers, means for periodically moving said levers bodily toward the pattern, a series of heddle threads respectively connected to said levers and a pin pivotally carried by each lever, with a device for normally maintaining said pins in such position that they are capable of engaging the raised portion of the pattern when the levers are moved toward the same, substantially as described.

20. The combination in a shedding mechanism, of a pattern, a series of levers, means for periodically moving said levers bodily toward the pattern, a series of heddle threads respectively connected to said levers, and a pin pivotally carried by each lever, each pin having a weight attached to its lower portion whereby it is normally maintained in such position as to be capable of engaging the raised portion of a pattern when its lever is moved toward the same, substantially as described.

21. The combination in a shedding mechanism, of a pattern, a series of levers, means for periodically moving said levers bodily toward the pattern, a series of heddle threads respectively connected to said levers, devices carried by each lever capable of engaging the pattern when such lever is moved toward the same, with means for moving the pattern to bring new portions in position to be engaged by the devices of the levers, substantially as described.

22. The combination in a shedding mechanism, of a rotatable pattern having portions of its surface at different levels, a series of structures bodily movable toward the pattern and capable of being individually actuated thereby, means for periodically moving said structures, and heddle threads respectively connected to the structures so as to be raised thereby under predetermined conditions, substantially as described.

23. The combination of a cylinder, means for turning the same, a pattern structure mounted on the cylinder, a series of levers, means for moving said levers relatively to the pattern structure, with a series of heddle threads respectively connected to the levers, and a device carried by each lever capable of engaging the pattern structure when its lever is properly actuated, substantially as described.

24. The combination of a cylinder, means for turning the same, a pattern structure mounted on the cylinder, a series of levers, means for moving said levers relatively to the pattern structure, a series of heddle threads respectively connected to the levers, a device carried by each lever capable of engaging the pattern structure when its lever is properly actuated, with means for preventing said devices engaging the pattern structure even though their respective levers are actuated, substantially as described.

25. The combination of a pattern, a series of levers, means for operating said levers to cause them to be actuated by the pattern, a series of heddle threads respectively connected to the levers, and means for insuring each heddle thread being completely raised

after its lever has moved it through a predetermined distance, substantially as described.

26. The combination of a pattern having portions of its surface raised, a series of levers placed to be actuated by said raised portions, a series of heddle threads respectively connected to the levers and arranged to be raised when the levers are actuated, and a device capable of operating on the threads and including means for lifting them to their full extent after they have been moved a predetermined distance by their levers, substantially as described.

27. The combination of a pattern, a series of heddle threads, a series of levers respectively connected to said heddle threads, means for moving the levers to cause them to be actuated to raise their heddle threads when they are acted on by the pattern, a projection on each heddle thread, a structure supported adjacent to the threads, and provided with teeth spaced to permit passage of the threads while retaining said projections, and means for causing said toothed structure to follow said projections on the threads after they have been raised a predetermined distance by their levers, substantially as described.

28. The combination in a shedding mechanism, of a pattern, a series of structures actuated by said pattern, heddle threads connected to said structures so as to be raised thereby when the corresponding structures are acted on by the pattern, with a device for indicating the portion of the pattern operative upon the structures, substantially as described.

29. The combination of a movable pattern, a series of levers, a series of heddle threads respectively connected to the levers, means for bodily moving the levers toward the pattern, a device carried by each lever and capable of engaging the pattern when its lever is moved toward the same, a cam on the pattern, a scale divided into units corresponding to the pattern, and an indicator actuated from the cam and operative over the scale to show the portion of the pattern operating on the devices carried by the levers at any given time, substantially as described.

30. The combination in a shed forming mechanism, of a series of levers, a series of heddle threads respectively connected thereto, and a series of cams rotatably mounted on a single shaft respectively operative on said levers, with means for actuating said cams, substantially as described.

31. The combination in a shedding mechanism, of a series of levers, a series of heddle threads respectively connected to the levers, and a plurality of series of cams rotatably mounted on a single shaft placed to periodically operate on the levers in order to raise the heddle threads, substantially as described.

32. The combination in a shed forming mechanism, of a series of levers, a series of heddle threads respectively connected to said levers, a plurality of series of rotatably supported cams having a single supporting shaft, with means for turning said cams so as to cause them to periodically actuate the levers, substantially as described.

33. The combination in a shedding mechanism, of a pattern, a series of structures actuated by said pattern, heddle threads connected to said structures so as to be raised thereby when the corresponding structures are acted on by the pattern, an indicator actuated from the main pattern, a scale therefor, and a miniature pattern mounted adjacent to said indicator having a scale corresponding to the scale of the indicator, substantially as described.

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

WALTER W. HUBBARD.

Witnesses:
WALTER CHISM,
JOS. H. KLEIN.