No. 720,181. PATENTED FEB. 10, 1903.

L. E. SALISBURY.

MULTIPLE SHUTTLE LOOM.

APPLICATION FILED JUNE 19, 1901.

NO MODEL. 13 SHEETS—SHEET 1.

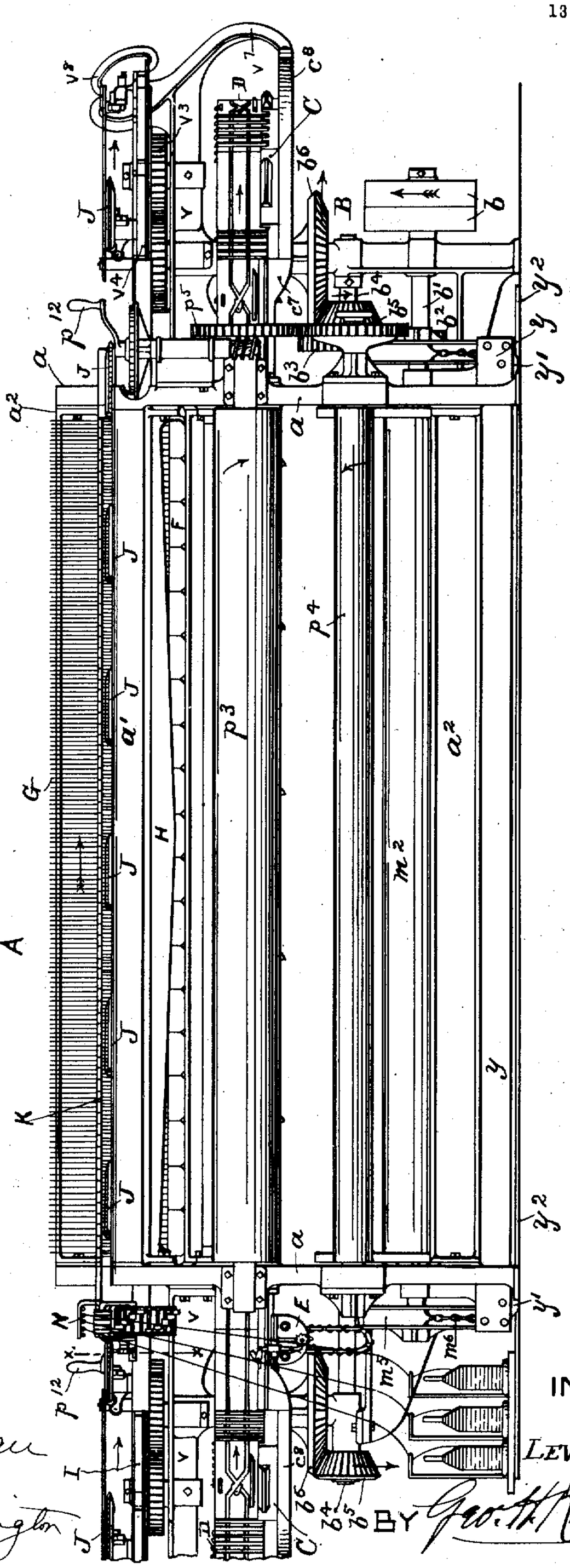

FIG. 1.

WITNESSES:

Harry J. Garceau

Chas. C. Remington

INVENTOR:

LEVI E. SALISBURY.

BY Geo. H. Remington & Co

ATTYS

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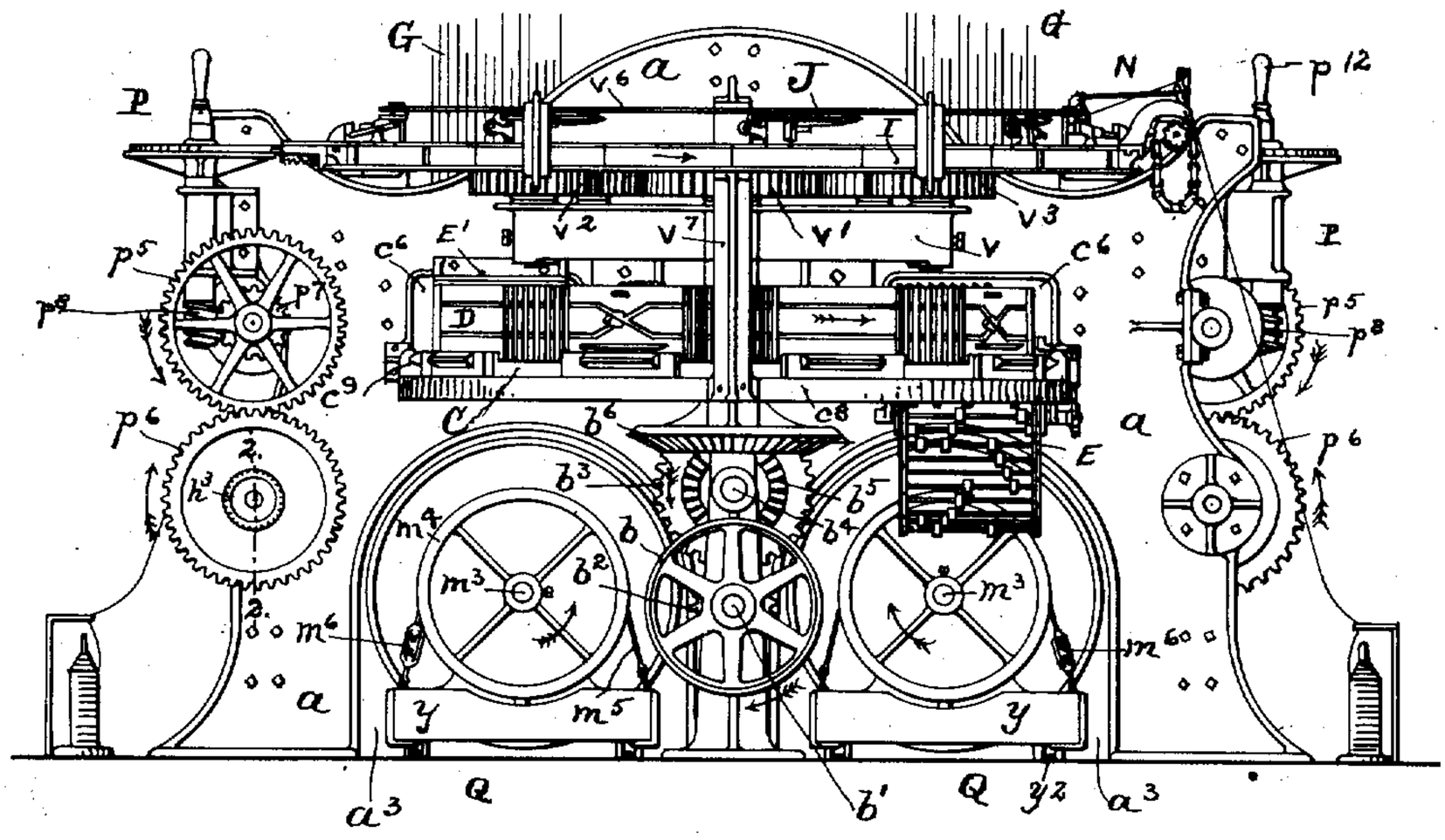

FIG. 2.

WITNESSES:

Harry J. Gaucan

Chas. C. Remington

INVENTOR:

LEVI E. SALISBURY.

BY Geo. A. Remington & Co.

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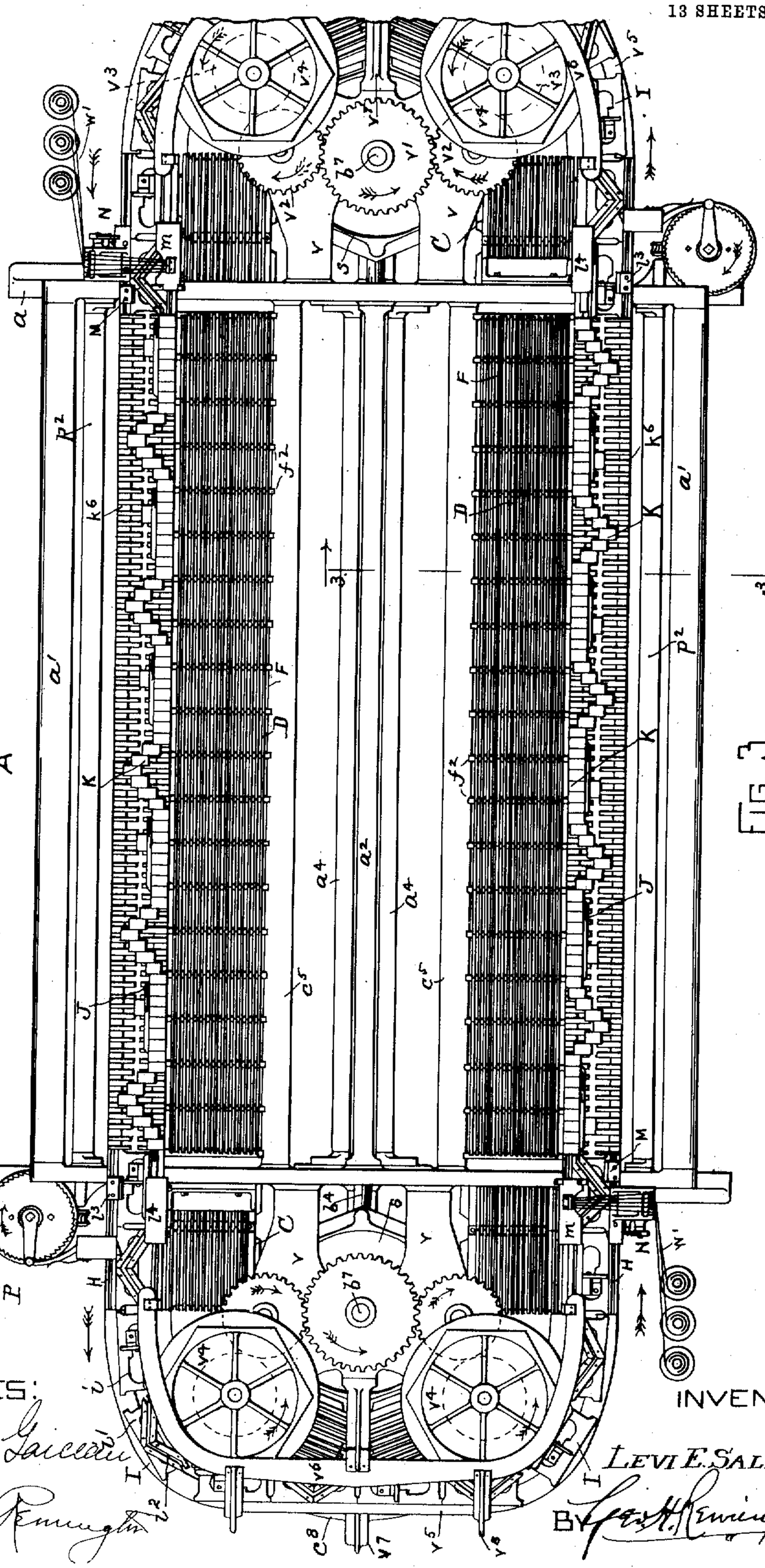

FIG. 3.

WITNESSES:

Harry J. Gaccon

Chas. E. Remington

INVENTOR:

LEVI E. SALISBURY.

BY Geo. H. Remington & Co

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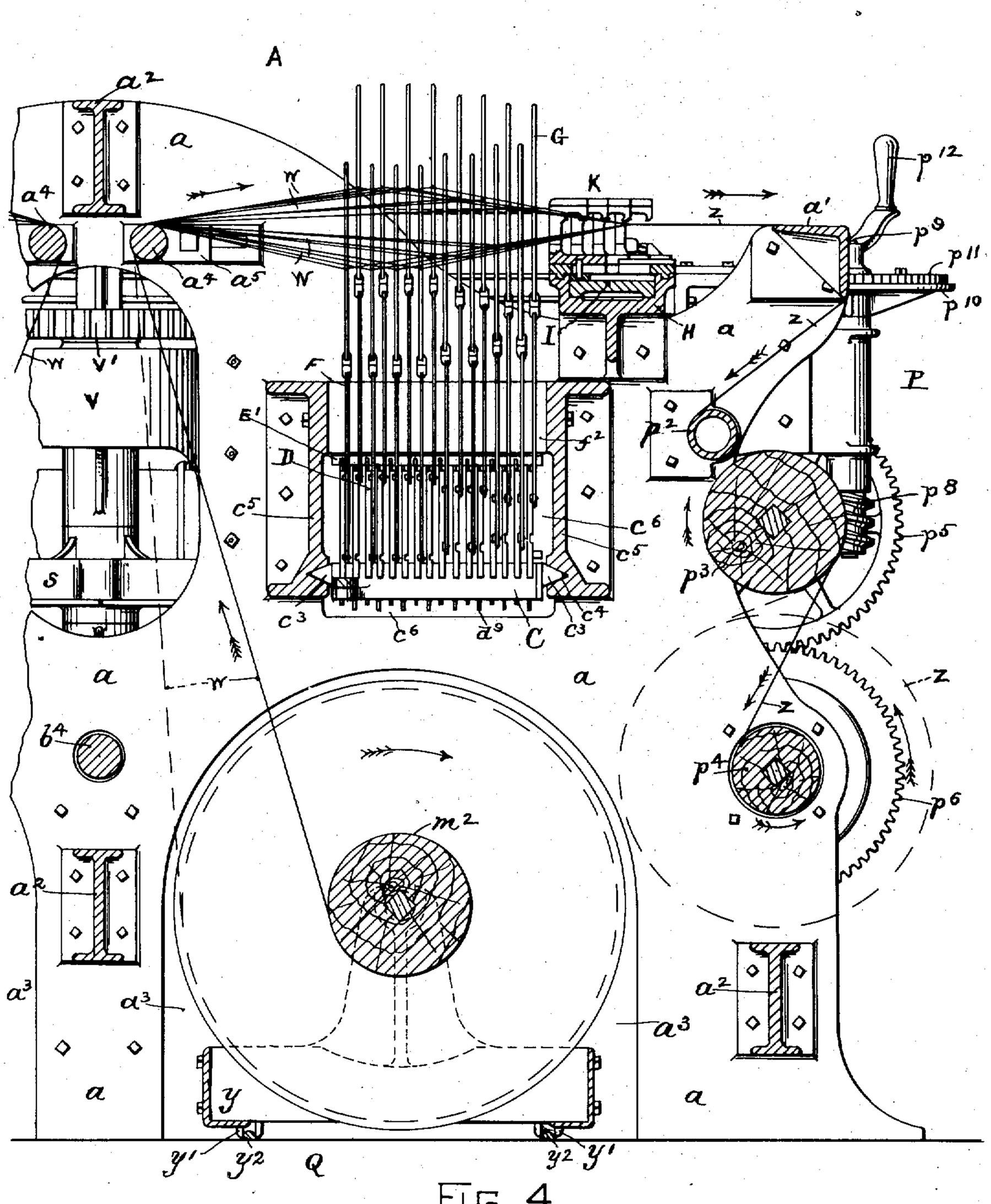

FIG. 4.

WITNESSES:

Harry J. Garceau

Chas. C. Remington

INVENTOR:

LEVI E. SALISBURY.

BY Geo. H. Remington & Co.

ATTYS

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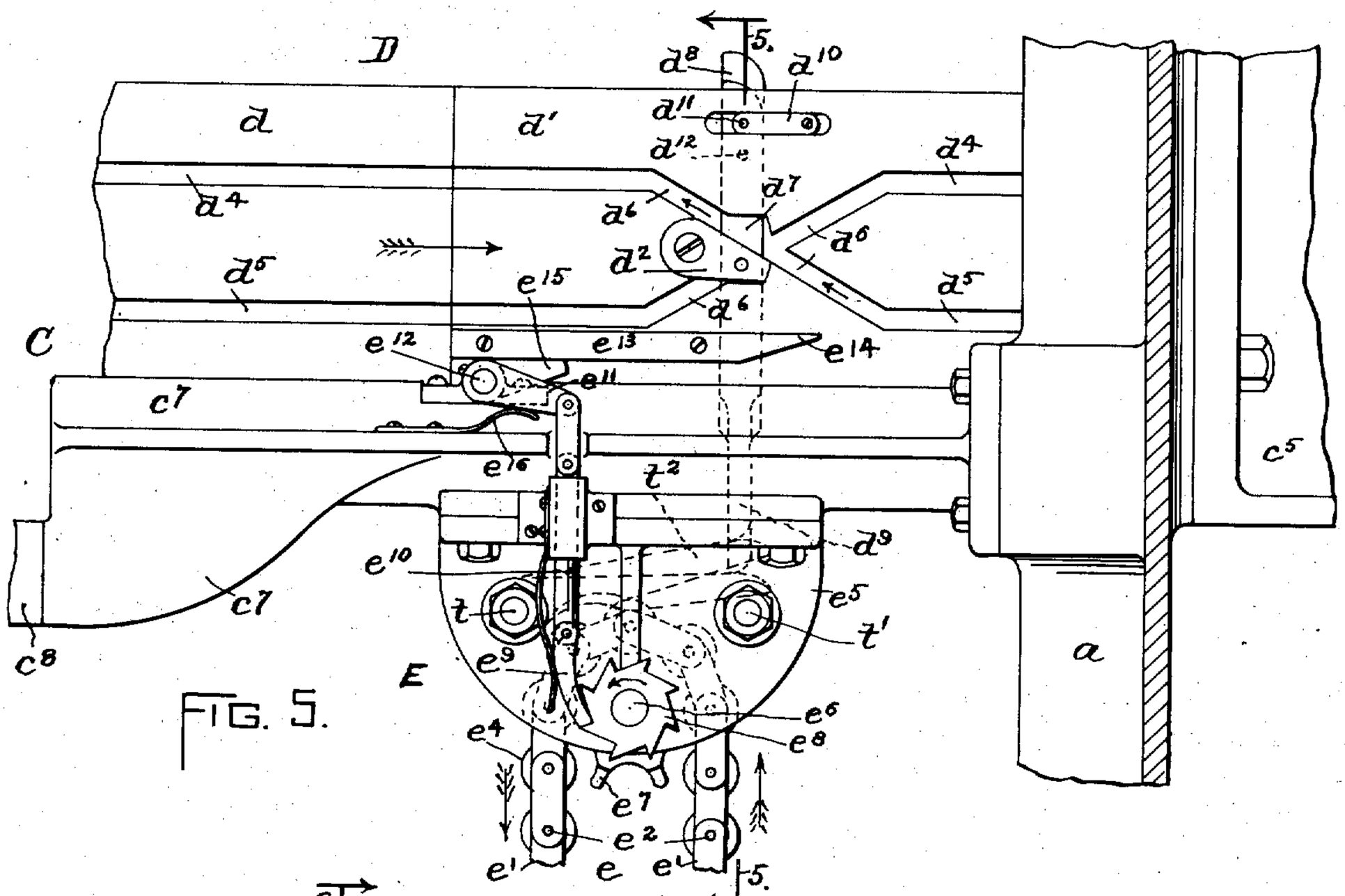

FIG. 5.

FIG. 6.

WITNESSES:

Harry J. Gaccain

Chas. C. Remington

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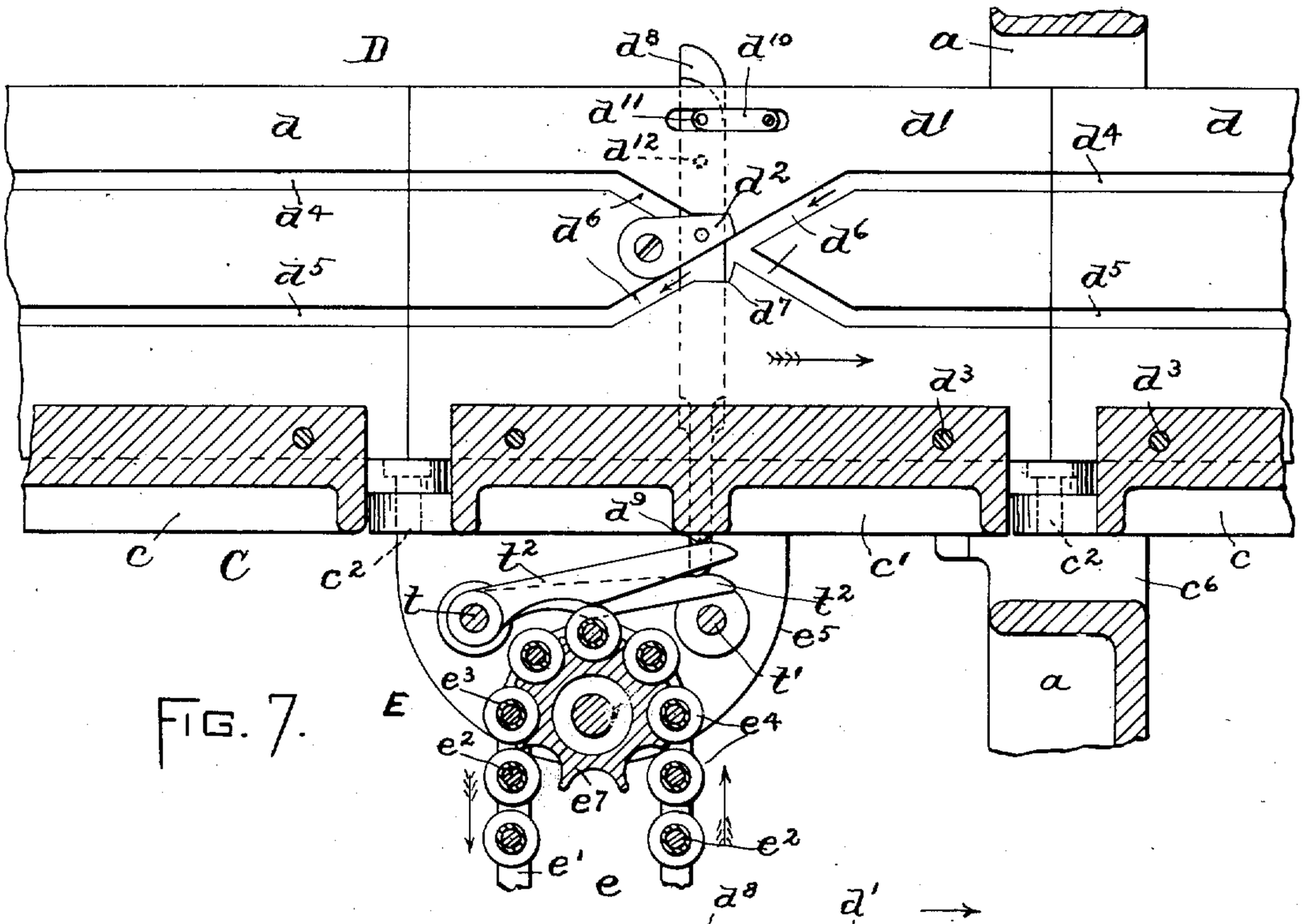

FIG. 7.

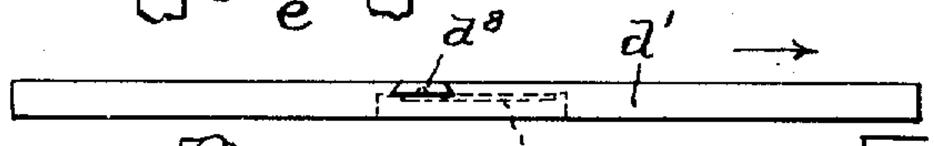

FIG. 8.

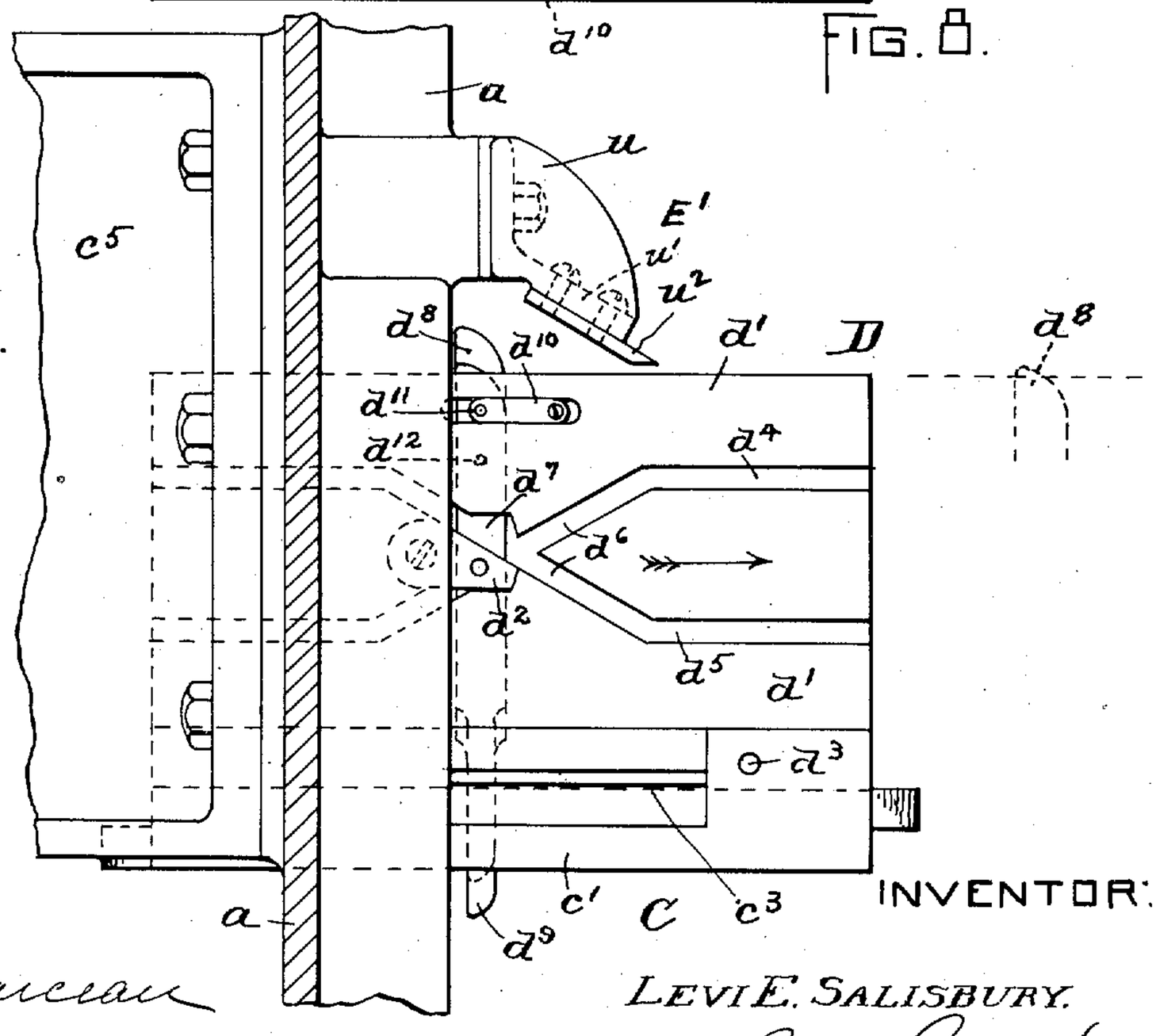

FIG. 9.

WITNESSES:

Harry J. Garceau

Chas. E. Remington

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BY Geo. H. Remington & Co

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NO MODEL. 13 SHEETS—SHEET 7.

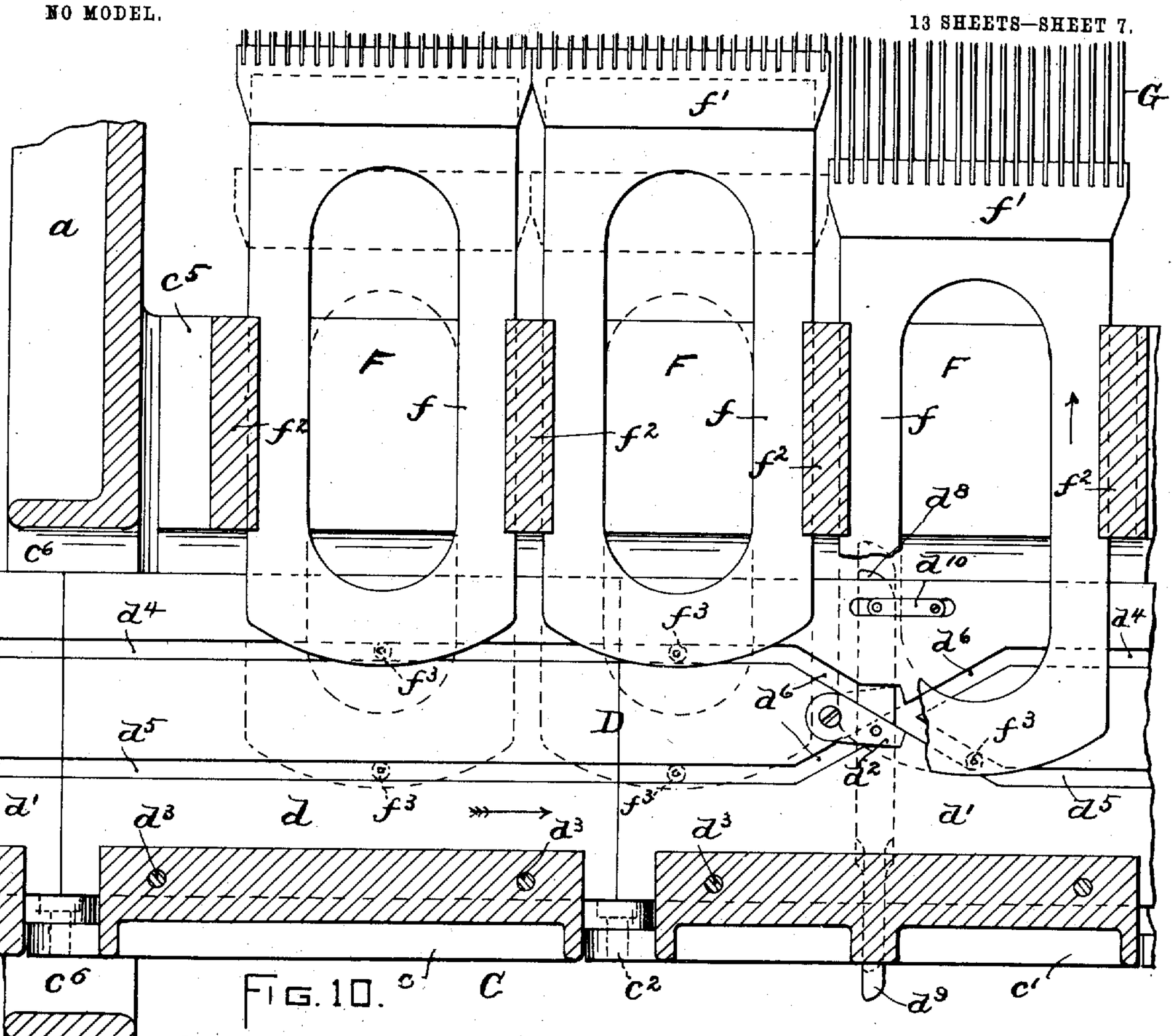

FIG. 10.

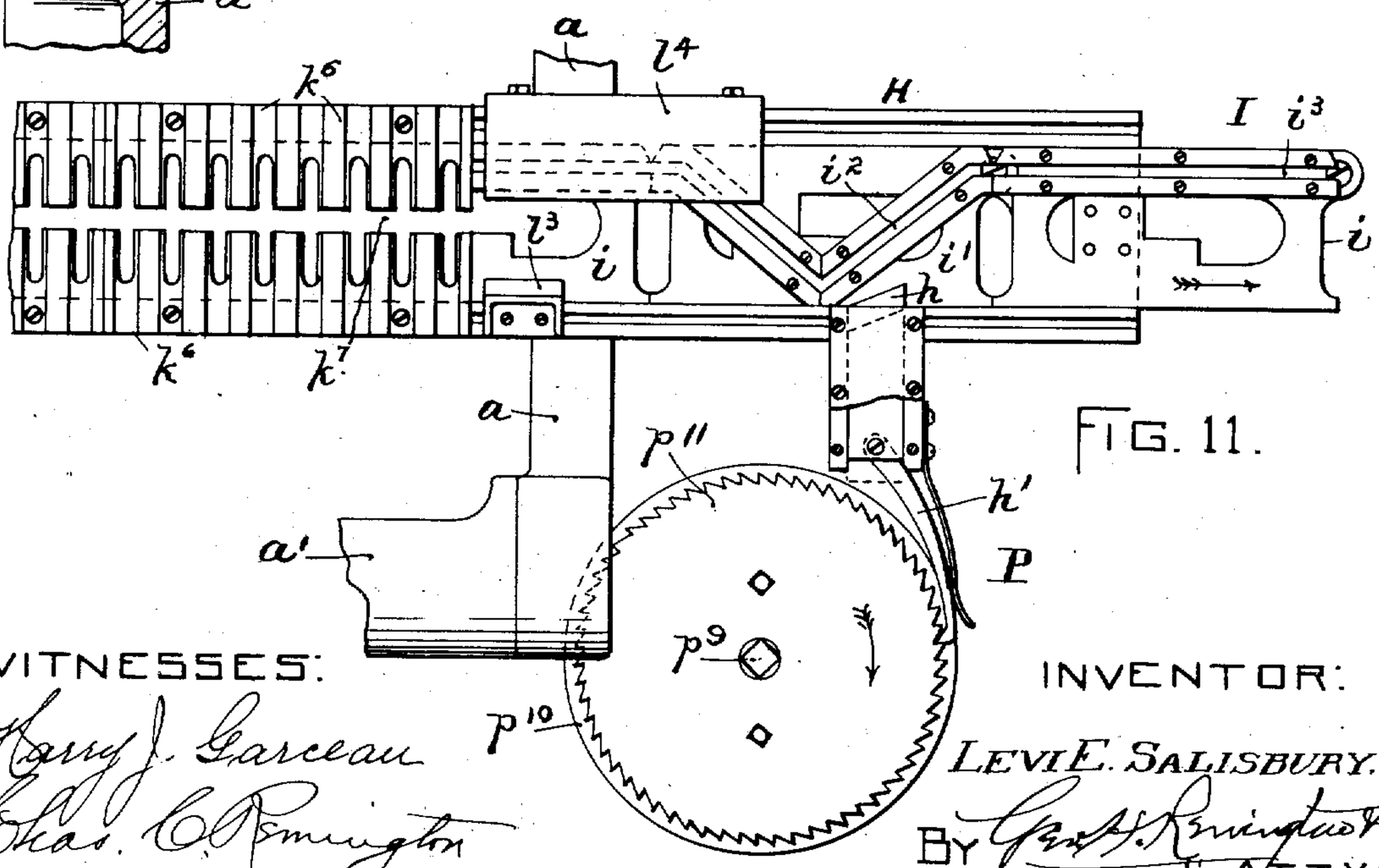

FIG. 11.

WITNESSES:

Harry J. Garceau

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MULTIPLE SHUTTLE LOOM.

APPLICATION FILED JUNE 19, 1901.

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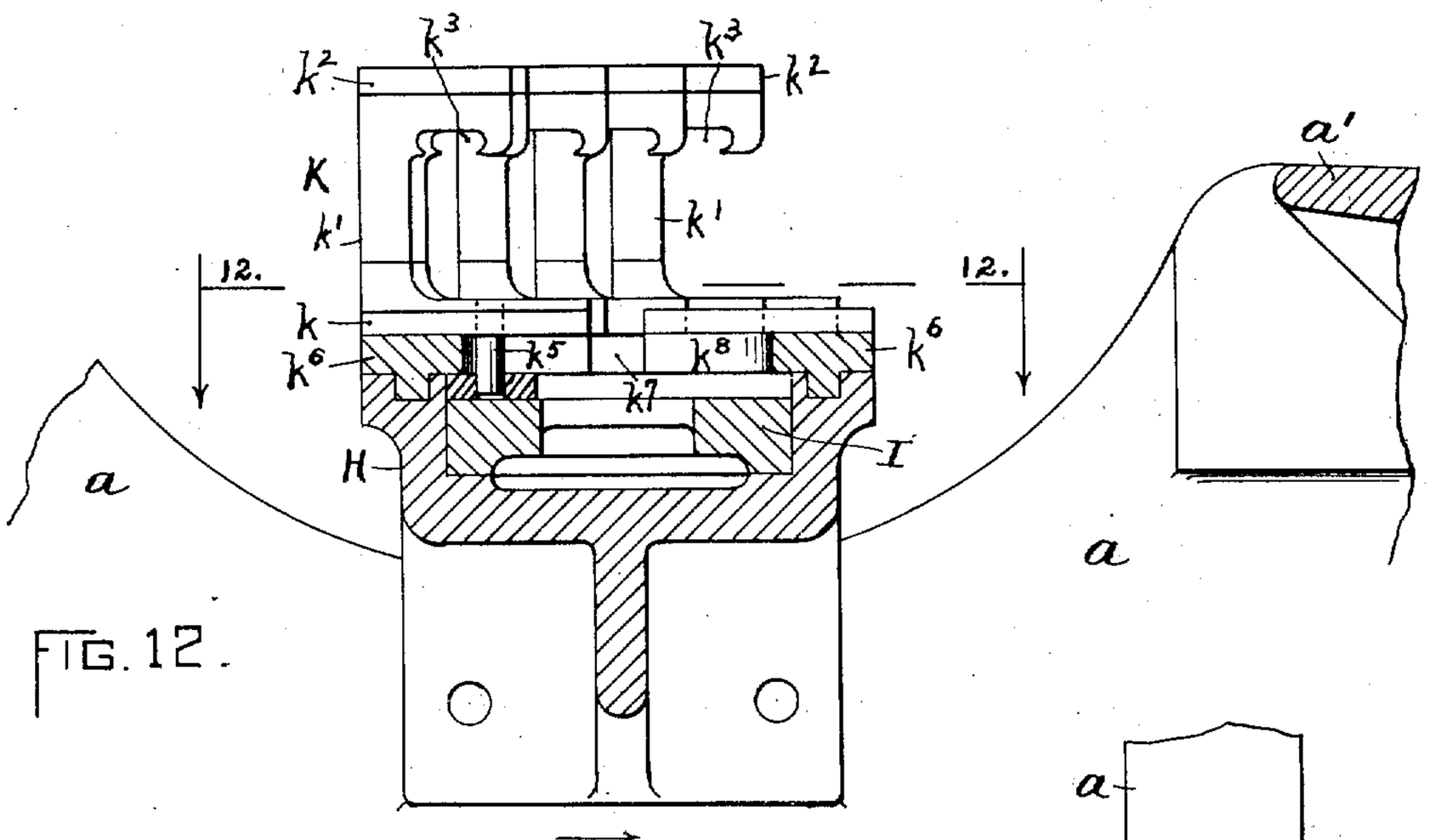

FIG. 12.

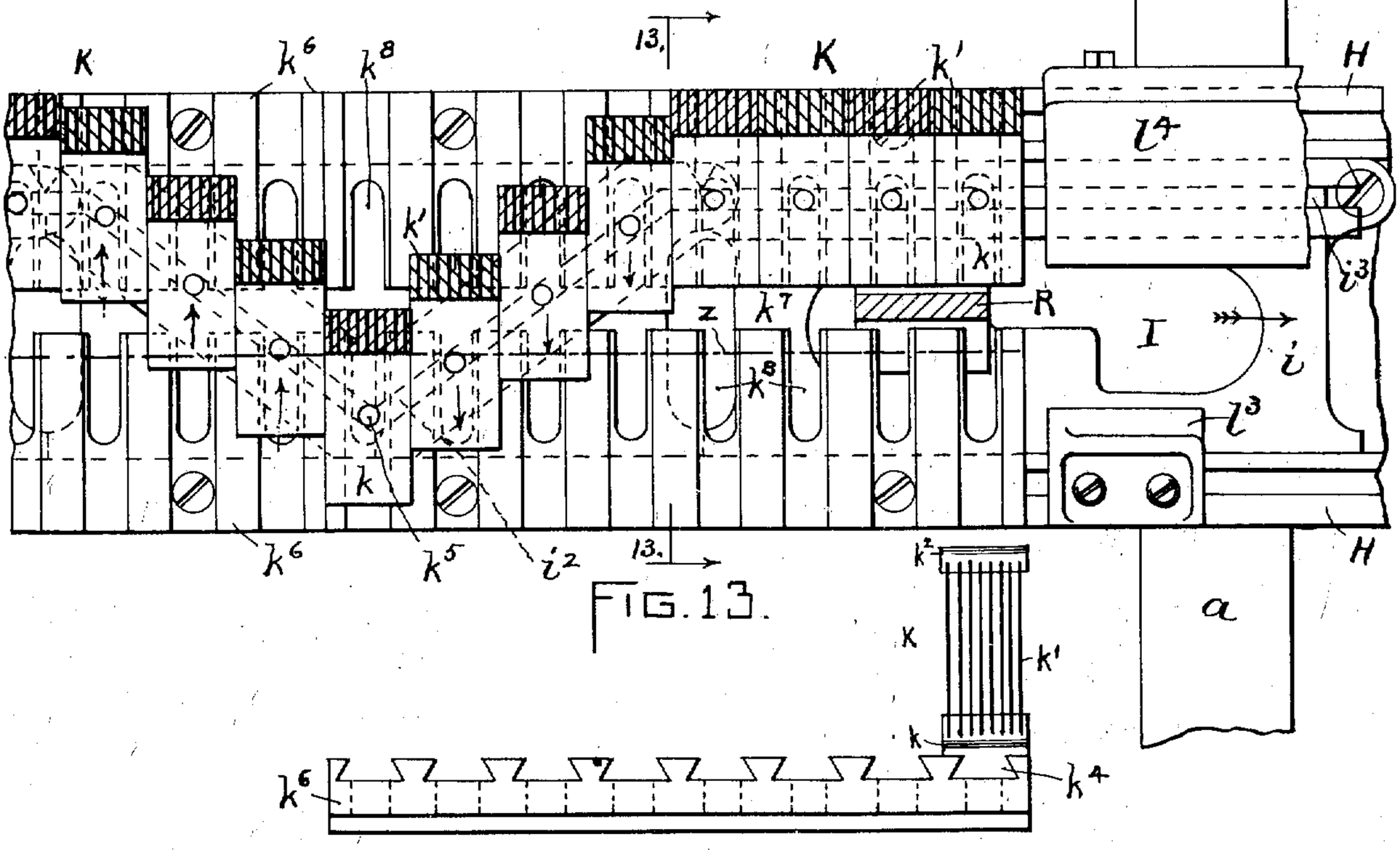

FIG. 13.

FIG. 14.

WITNESSES:

Harry J. Garceau

Chas. C. Remington

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NO MODEL. 13 SHEETS—SHEET 9.

FIG. 15.

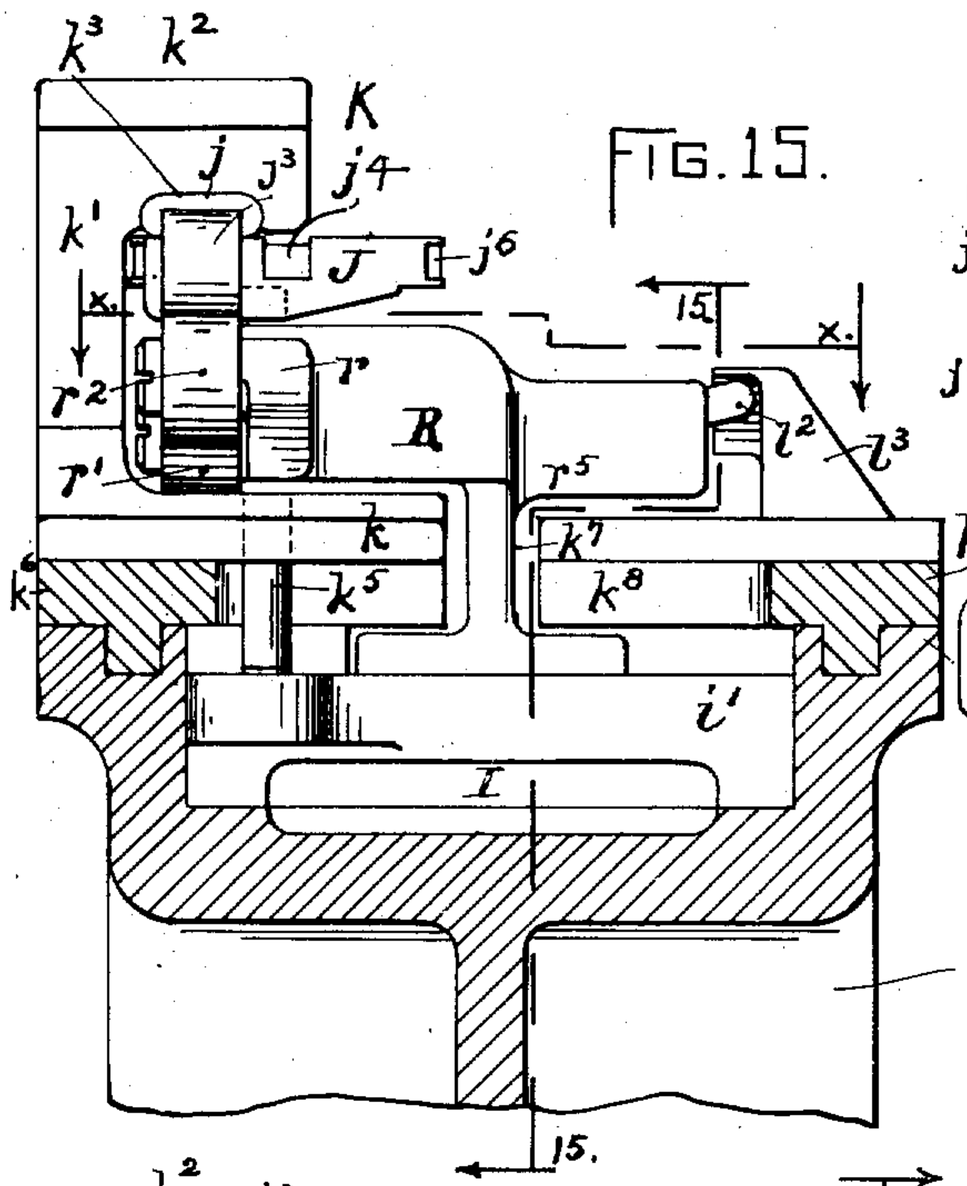


FIG. 16.

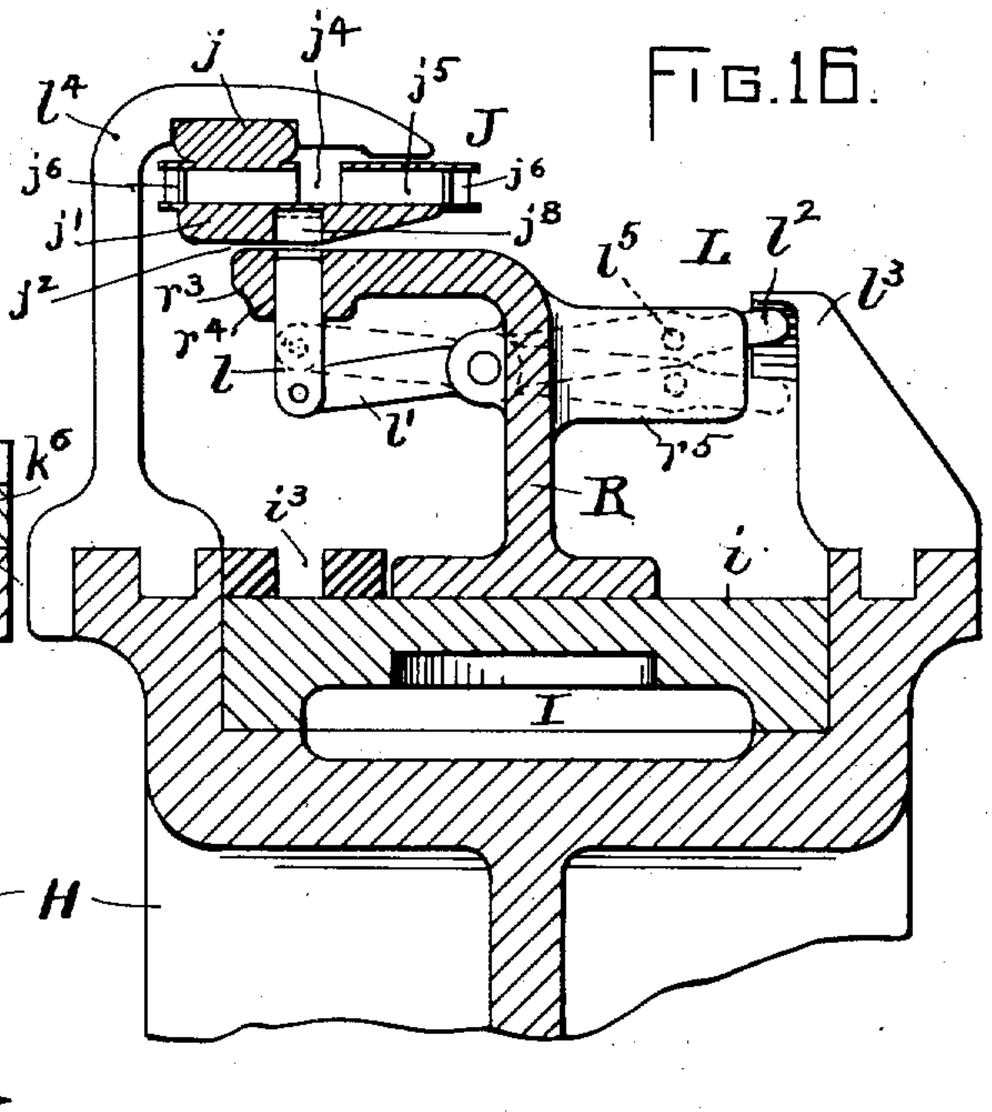
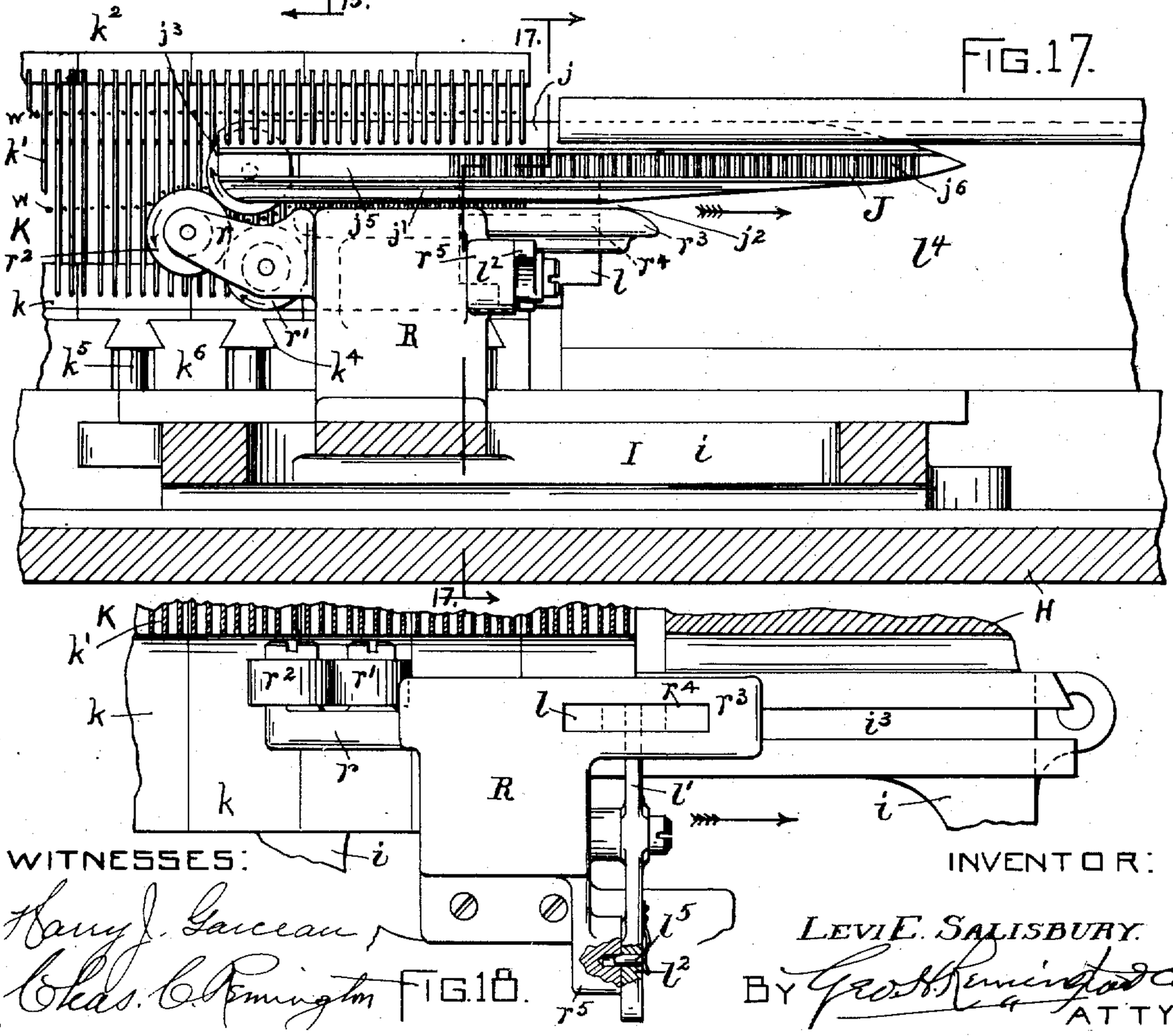


FIG. 17.



WITNESSES:

Harry J. Gaucean,

Chas. C. Remington

FIG. 18.

INVENTOR:

LEVI E. SALISBURY.

BY Geo. B. Remington & Co.

ATTYS

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MULTIPLE SHUTTLE LOOM.

APPLICATION FILED JUNE 19, 1901.

NO MODEL. 13 SHEETS—SHEET 10.

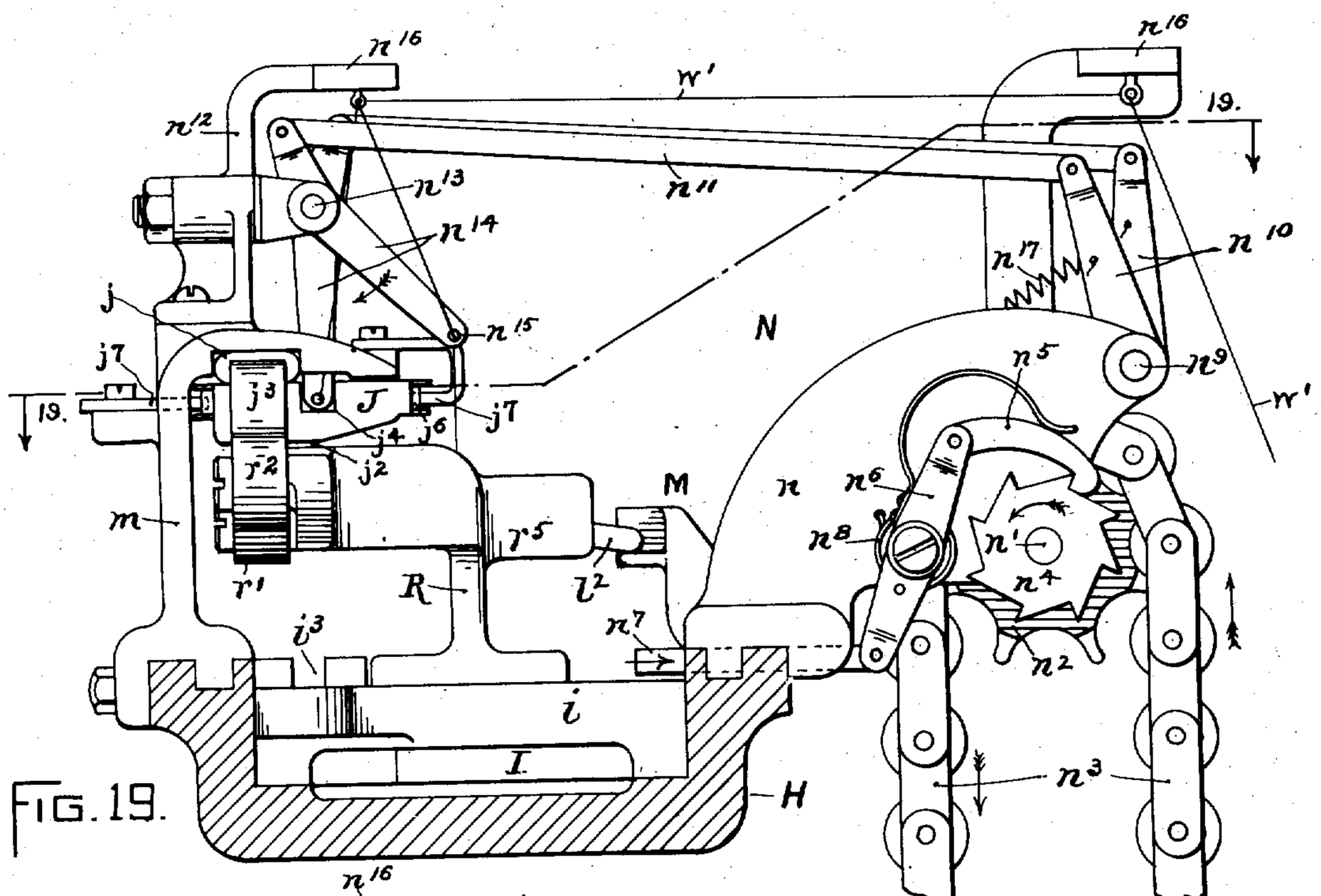

FIG. 19.

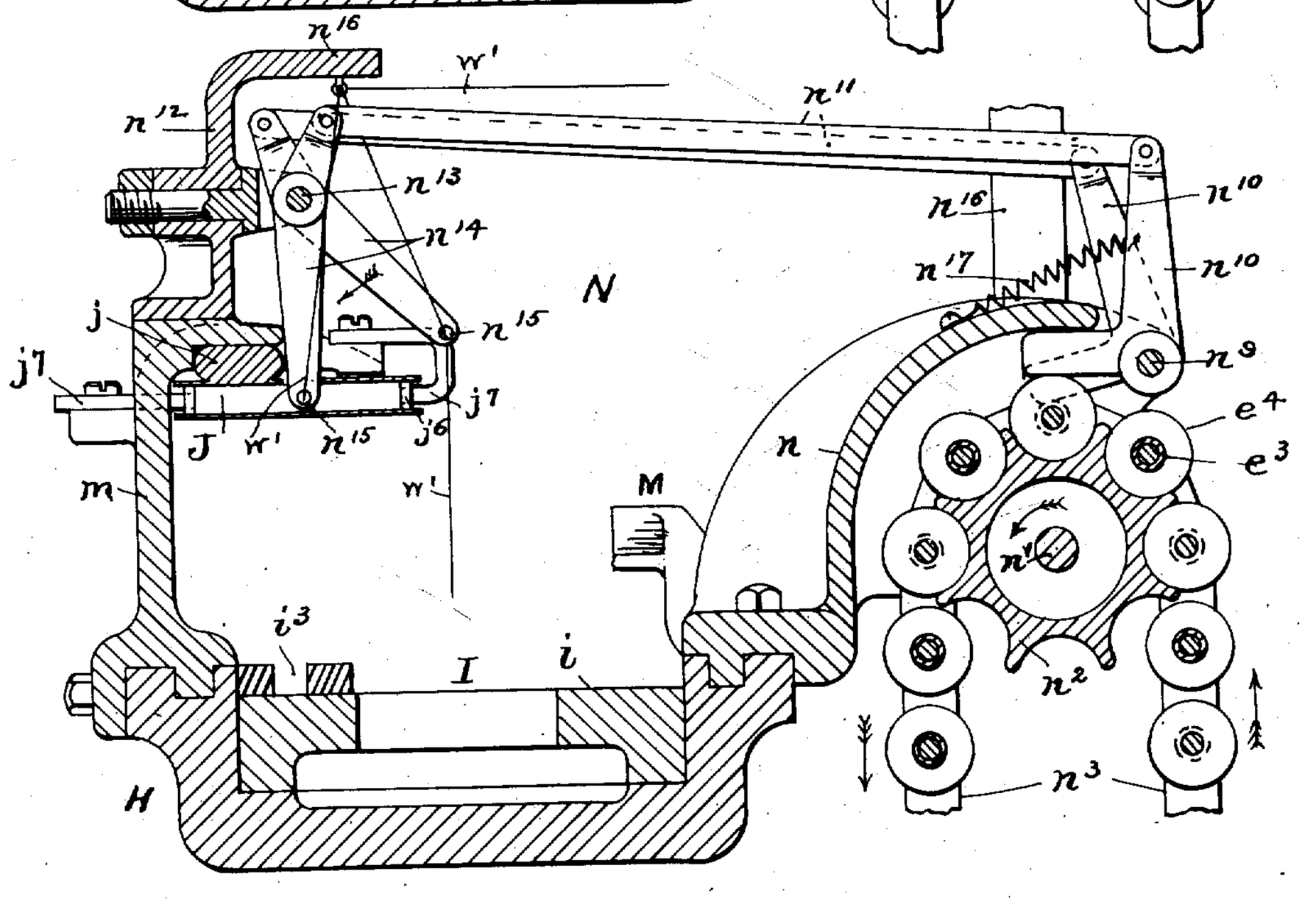

FIG. 20.

WITNESSES.

Harry J. Garceau

Chas. C. Remington

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NO. MODEL. 13 SHEETS—SHEET 11.

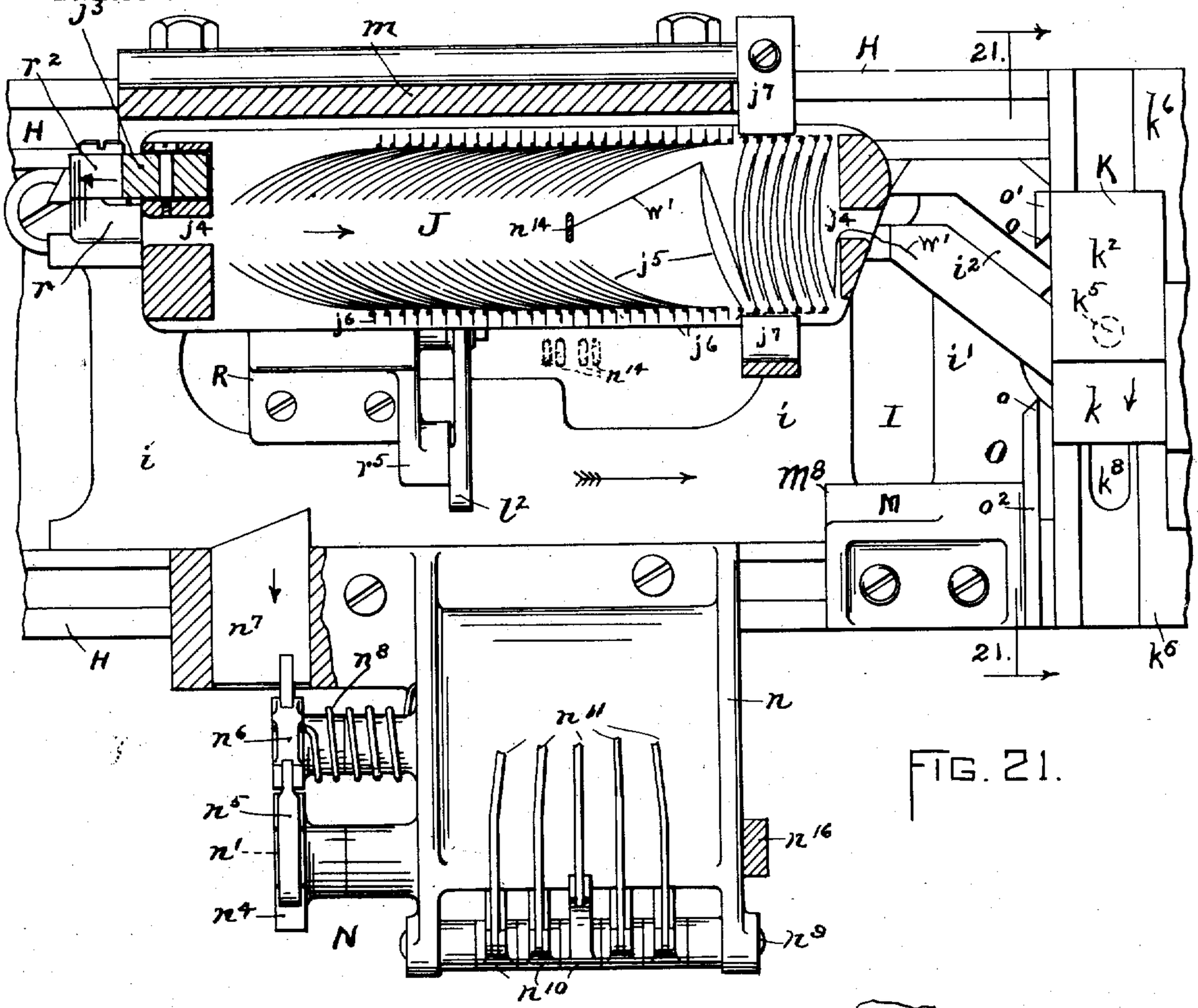

FIG. 21.

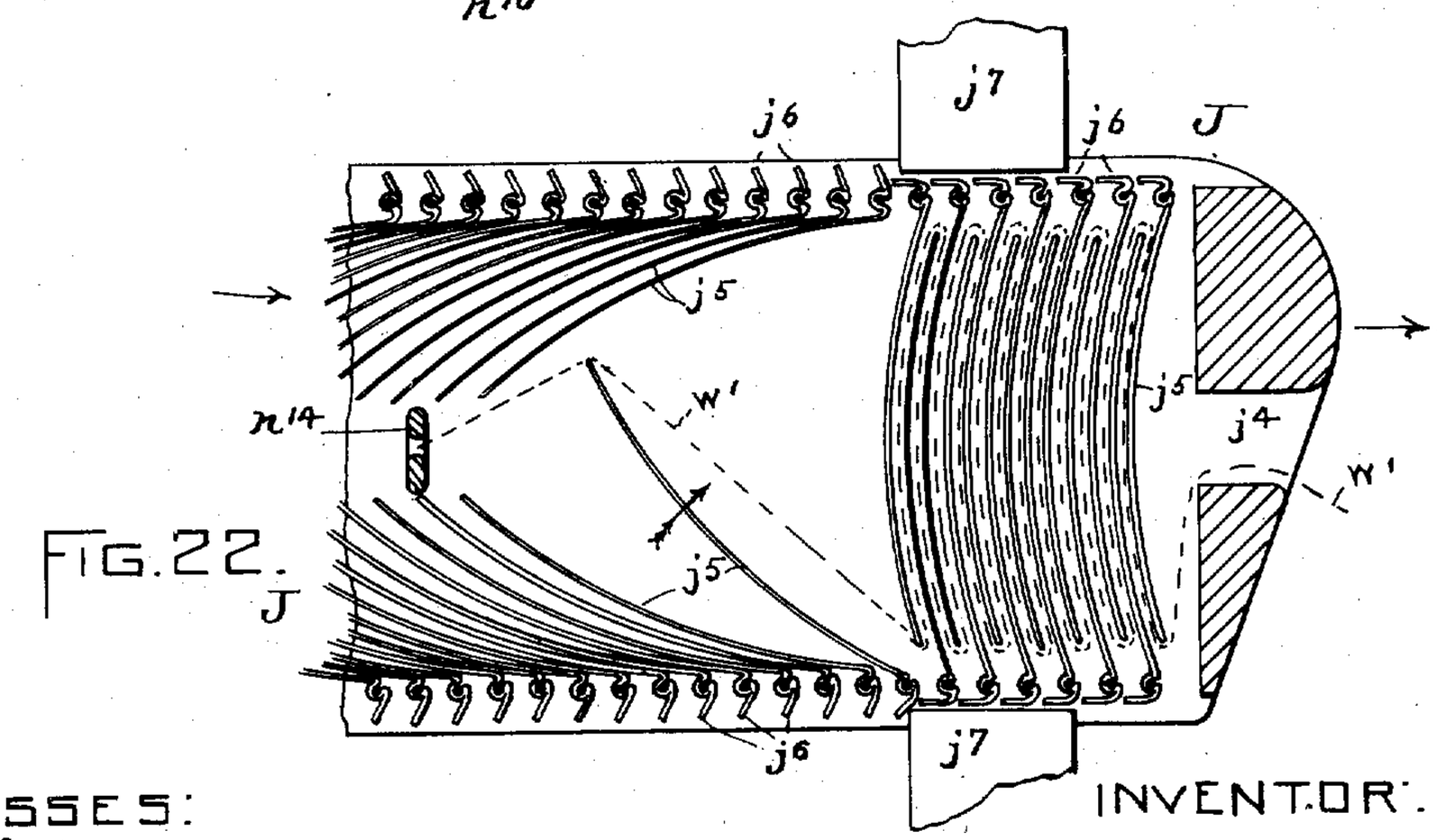

FIG. 22.

WITNESSES:

Harry J. Garceau

Chas. C. Remington

INVENTOR:

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MULTIPLE SHUTTLE LOOM.

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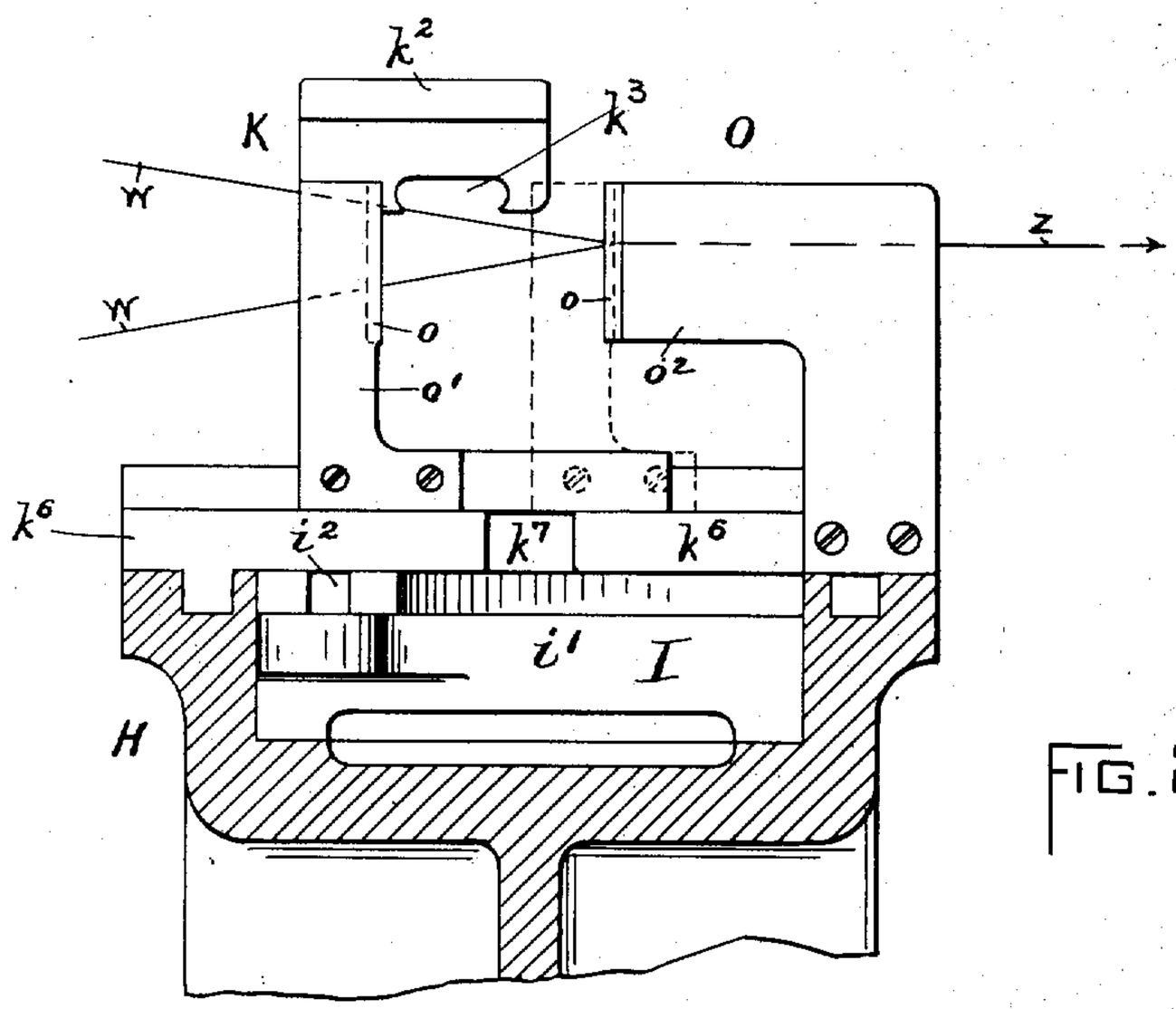

FIG. 23.

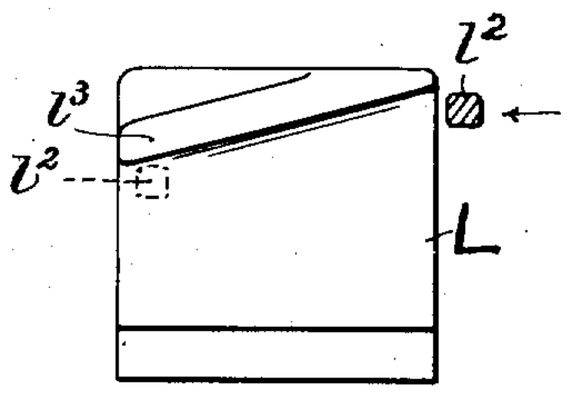

FIG. 24.

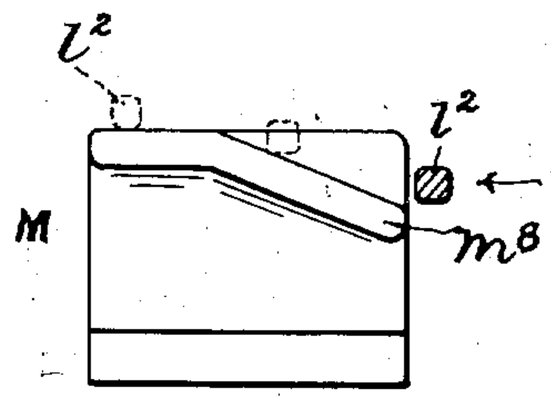

FIG. 25.

WITNESSES:

Harry J. Gareau

Chas. C. Remington

INVENTOR:

LEVI E. SALISBURY.

BY Geo. H. Remington & Co.

" ATTYS

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L. E. SALISBURY.

MULTIPLE SHUTTLE LOOM.

APPLICATION FILED JUNE 19, 1901.

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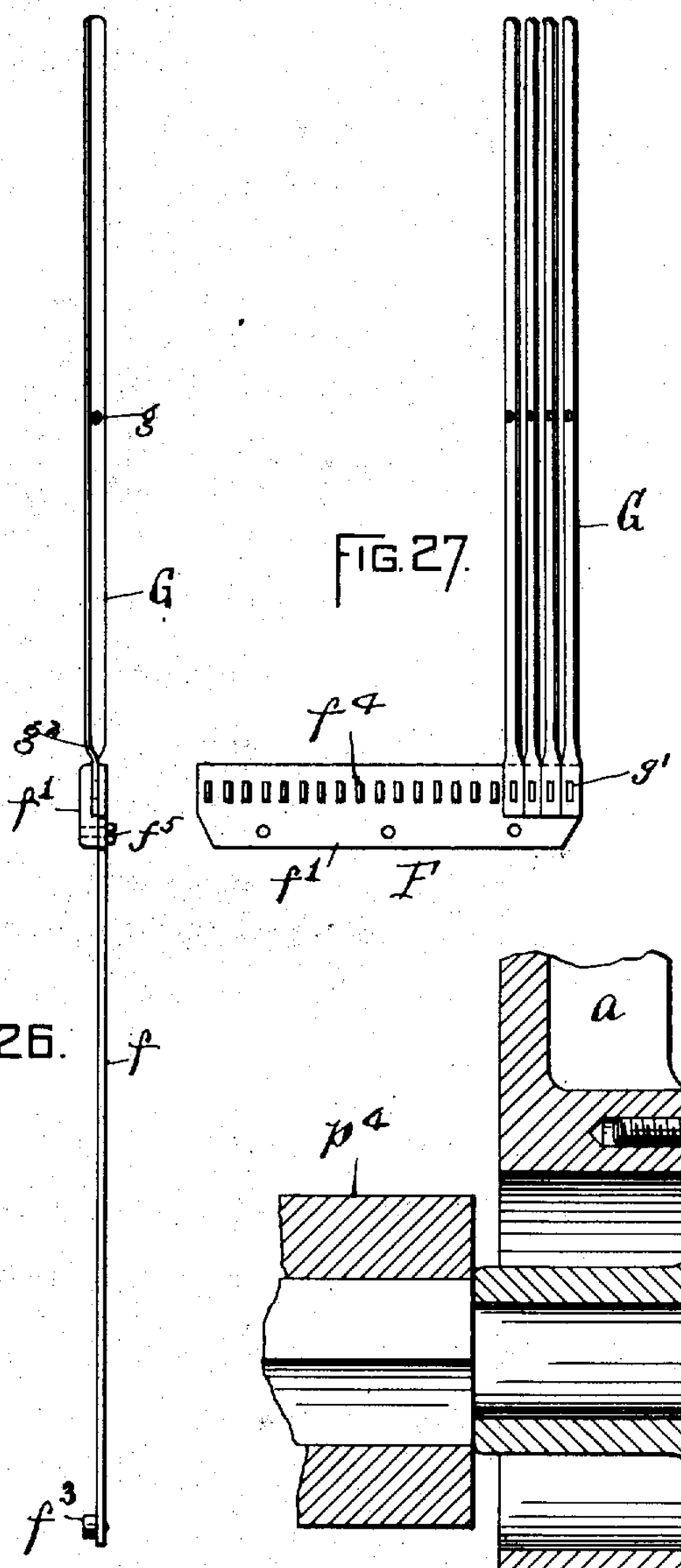

FIG. 27.

FIG. 26.

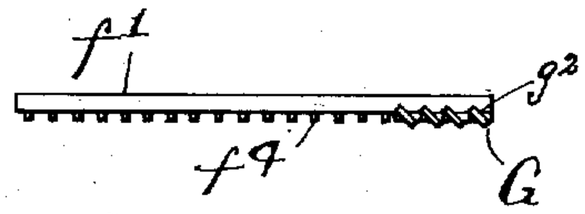

FIG. 28.

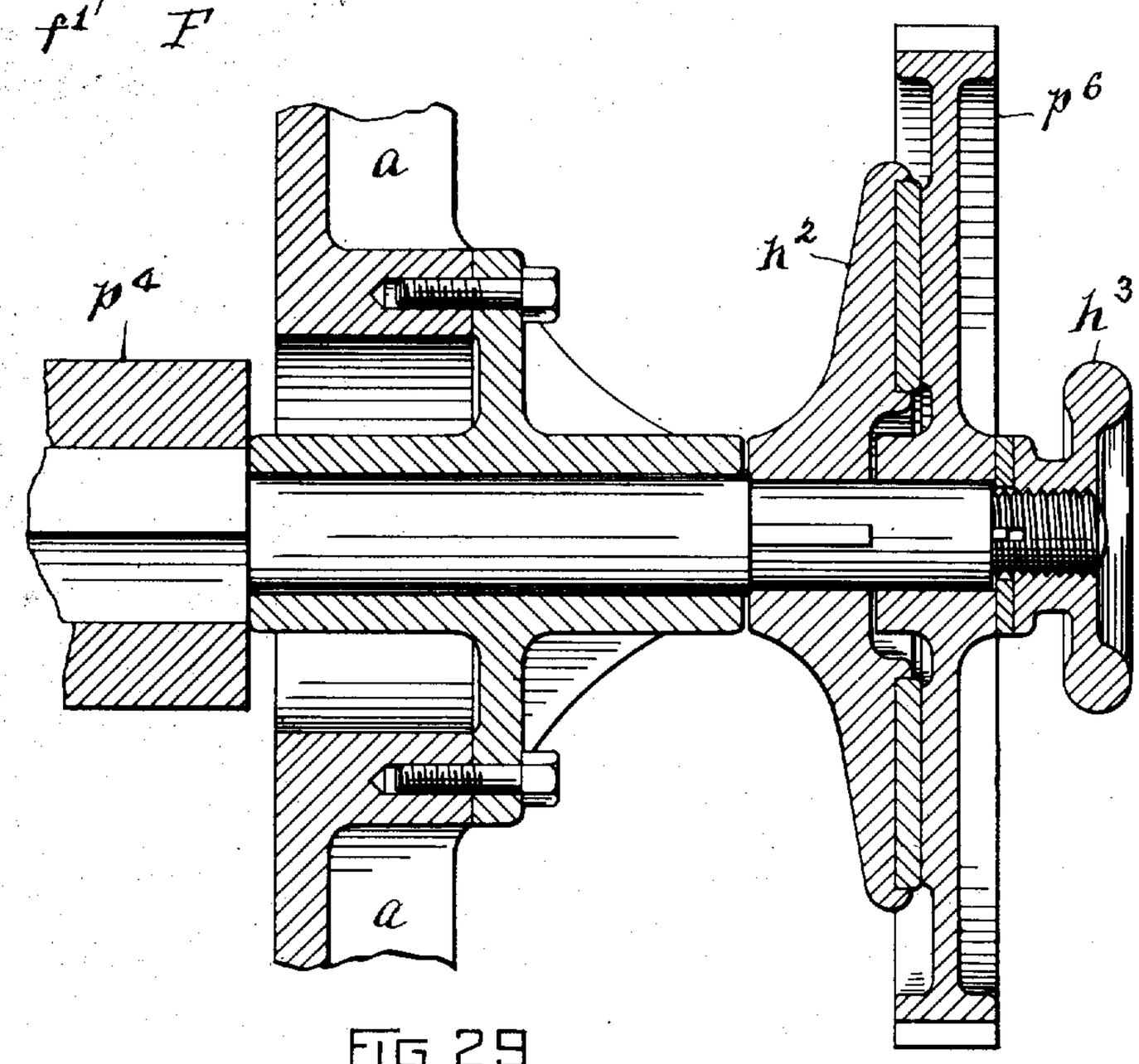

FIG. 29.

WITNESSES:

Harry J. Gareau

Chas. E. Remington

INVENTOR:

LEVI E. SALISBURY.

BY Geo. H. Remington & Co.

ATTYS

UNITED STATES PATENT OFFICE.

LEVI E. SALISBURY, OF PROVIDENCE, RHODE ISLAND.

MULTIPLE-SHUTTLE LOOM.

SPECIFICATION forming part of Letters Patent No. 720,181, dated February 10, 1903.

Application filed June 19, 1901. Serial No. 65,108. (No model.)

To all whom it may concern:

Be it known that I, LEVI E. SALISBURY, a citizen of the United States of America, and a resident of Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Multiple-Shuttle Looms, of which the following is a specification.

My invention relates to new and novel improvements in looms for weaving textile fabrics—such, for example, as woolen dress goods, suitings, plain and twilled, &c.—the loom, in fact, being adapted to weave any style or pattern of goods that may be produced on any of the well-known woolen looms.

My improved loom, which may be termed an "automatic non-reciprocating multiple-shuttle loom," is adapted to simultaneously produce two distinct webs of cloth (one at each side of the loom) from two independently-mounted beams carrying the warp-yarns, which pass through two corresponding sets or series of independently-actuated harnesses, heddles, and reeds and a series of continuously-traveling shuttles arranged each to successively and automatically select and charge itself with a length of weft yarn or thread (from large fixed spools or bobbins) to produce a single pick and deliver or feed the same to the respective webs while the shuttle is being propelled through or between the corresponding warp-yarns—that is to say, in my improved loom the continuously-traveling (but non-reciprocating) shuttles follow one another at comparatively short intervals, so that, say, in the production of double-width goods there may be five or six of them simultaneously and continuously traveling across and delivering weft-threads into the web being produced, the construction and arrangement of the various mechanisms being such that the several heddle-carrying harnesses (each divided longitudinally into short independent sections) are automatically and successively set or adjusted just in advance of the next succeeding shuttle and its weft-thread or pick. At substantially the same instant that the harnesses are being set, as just stated, the corresponding portion of the reed, also divided into short independent sections, is being actuated to beat up into the web the weft-thread or pick delivered by the immediately-preceding shuttle. Thus it will be seen that there are, say, six continuously-traveling shuttles successively feeding the weft to each web, while at the same time a corresponding number of harness and reed sections are being suitably actuated with respect to the shuttles, the result being that the production of cloth may be one hundred or more per cent. greater than the product of the usual broad loom, while at the same time the shuttle speed of the former per second may be less than one-half that of the latter.

In carrying out my invention I provide the loom with two positively and continuously driven endless belts or chains traveling in unison in one direction in different horizontal planes and at exactly the same rate of speed. The lower chain has a series, say, of sixteen cams repeated at regular intervals throughout the chain, arranged and adapted to engage with and actuate the harnesses, (sixteen in number,) each being divided longitudinally into short sections. Each series of cams is automatically tripped as they pass out of or from the harnesses of one side of the loom and are again mechanically readjusted or reset by a suitably arranged and actuated pattern-chain before the cams engage the other set of harnesses to operate the heddles of the opposite side of the loom. The other or upper of said continuously-traveling chains carries a series of independent shuttles arranged with respect to the said harness-operating cams. These shuttles are each successively and automatically charged with a weft-yarn selected from any one of a series, say, of five colors located in the path of the shuttles, which is fed into the web and between the warp-yarns, which latter are opened or shed immediately in advance of its shuttle. The chain traveling continuously in one direction, as before stated, carries the shuttles as they emerge empty from one side of the loom around the end of the machine, the shuttles meanwhile being successively charged with the weft-yarn prior to entering the other side of the loom.

I would state that my improved loom is capable of producing color goods having exactly the same style, pattern, or design as can be produced on a common or drop-box loom employing a corresponding number of harnesses

and colors and having reciprocating shuttles. Among other advantages possessed by my improved loom is this: that while the production or output greatly exceeds that of the common loom the power required for operating it is less. This result is due to the fact that practically all the movements of the parts are continuous and non-reciprocating. The shuttles are small and light and are positively driven or propelled continuously in one direction only. Therefore the loom is adapted to produce cloth at almost any rate of shuttle speed less than a maximum—that is to say, in looms in which the shuttles are shot or propelled alternately back and forth the shuttle must arrive at a state of rest at each end of the throw or movement before it can be reciprocated back again, even though the shuttle be positively driven. Moreover, the force of the blow or impact must be sufficient to carry the shuttle the entire length of the raceway. Thus it is apparent that any reduction of speed below the normal is liable to be attended with serious results. In my improved loom, however, the speed of the shuttles is constant throughout, the rate of travel corresponding with the speed of the main driving mechanism. The weft-yarns may be fed and properly interwoven into the fabric even though the loom be running slowly or at an irregular rate of speed, a feature not possible in looms in which the shuttles are reciprocated to and fro in the raceway.

In my improved loom the harnesses are actuated by a series of cams or other analogous means adapted to travel continuously in one direction, the latter being, in fact, the same as that of the shuttles and at exactly the same rate of speed. These cams are automatically adjusted for each pick (if need be) by means of a mechanically-actuated pattern-chain, which is set up or arranged by the pattern-designer before the loom is set in motion, the result being that the coöperation of the shuttle and harness mechanisms reproduces the pattern or design in the fabric at fixed intervals throughout the web or bolt.

I may add that in a general way the operative relations of the shuttles, harnesses, and pattern-chains to one another are substantially the same as in the usual multicolor or fancy loom, in which the shuttles are reciprocated back and forth in laying the weft-yarns, so that the style, quality, and appearance of the goods or fabrics produced on both types of looms are exactly the same.

In the accompanying thirteen sheets of drawings illustrating my improved loom, Figure 1 is a side elevation of the loom complete as in use. Fig. 2 is an end elevation viewed from the driving end of the loom. Fig. 3 is a plan view corresponding with Fig. 1. Fig. 4 is a partial transverse section, enlarged, taken on line 3 3 of Fig. 3. Fig. 5 is a side view, enlarged, of a portion of the harness or heddle operating chain and also showing the harness-shedding mechanism. Fig. 6 is a transverse section taken on line 5 5 of Fig. 5, the chain as drawn having a series of sixteen cams adapted to control and actuate a corresponding number of harnesses. Fig. 7 is a sectional view taken on line 6 6 of Fig. 6. Fig. 8 is a plan view of one of the harness-cams detached from the chain. Fig. 9 is a side elevation of the harness-cams and also showing the device for automatically tripping the switches or dogs. Fig. 10 is a partial longitudinal section taken through the harness-actuating chain, frame, and harness-guides, showing the relation of the harness-sections to the harness-cams, &c. Fig. 11 is a plan view showing a portion of the shuttle carrying or propelling chain, the take-up mechanism, &c. Fig. 12 is a transverse section of the shuttle-carrying chain, its guide, reeds, &c., taken on line 13 13 of Fig. 13. Fig. 13 is a horizontal sectional or plan view taken on line 12 12 of Fig. 12, showing the manner of operating the reed-sections, &c. Fig. 14 is a side view of one of the reed guides or ways. Fig. 15 is a transverse section of the shuttle-carrying chain guide or track and showing an end view of the shuttle and its carriage, the reed, &c. Fig. 16 is a transverse sectional view taken on line 17 17 of Fig. 17. Fig. 17 is a combined elevation and longitudinal section taken on line 15 15 of Fig. 15. Fig. 18 is a combined horizontal section and plan view taken on line $x\,x$ of Fig. 15, the shuttle being omitted. Fig. 19 is an end view, enlarged, of the weft-changing and shuttle-charging mechanisms, the cross-section of the shuttle-chain track being taken at the line $x\,x$ of Fig. 1. Fig. 20 is a central sectional view of the mechanisms represented in Fig. 19, the shuttle-carriage being omitted. Fig. 21 is a horizontal sectional view in partial elevation, taken on line 19 19 of Fig. 19. Fig. 22 is a still further enlarged horizontal sectional view of the forward portion of the shuttle, corresponding with Fig. 21. Fig. 23 is a transverse section taken on line 21 21 of Fig. 21, showing the weft-cutting device. Fig. 24 is a side view of the cam for locking the shuttle to the carriage. Fig. 25 is a similar view of the unlocking-cam. Fig. 26 is an end elevation of one of the harness-sections, including its heddles. Fig. 27 is a corresponding side elevation, the harness-blade and some of the heddles being omitted. Fig. 28 is a plan view of the harness-section; and Fig. 29 is an enlarged longitudinal sectional view showing a portion of the take-up device, taken on line 2 2 of Fig. 2.

I may state in passing that while the construction and manner of operation of some of the devices or instrumentalities employed in my improved loom are to a certain extent unlike the mechanisms employed in the usual type of loom for analogous results I deem it desirable in the following description or specification to use terms or names which have a well-known meaning in the textile-manufacturing arts. For example, a shuttle is usually arranged and adapted to carry a spool or

cop of weft yarn or thread and is reciprocated to and fro alternately in the shuttle-box or lay, the shuttle being wholly clear from the warps before the harness-shed can take place. Consequently in such cases a single shuttle can only be in service at the same time or instant.

I am aware that looms have been devised in which two or more shuttles are passed successively through the shed or warps at the same time. In such former arrangement, however, the shuttles are provided with cops, bobbins, or spools of weft-yarn.

My weft-carrier, which I term a "shuttle," does not reciprocate, nor does it carry a spool or cop of yarn, but simply a length of yarn to produce a single pick. The usual harness is a single or integral member extending entirely across the loom longitudinally; so, also, is the reed member, as is well known. Therefore whenever they perform their functions the entire harness and reed must be actuated. I would state, however, that looms have been devised in which the harnesses and reeds are divided into a number of short sections.

In my improved loom the harnesses and reeds are each divided into several short independent sections, forming a number of series corresponding to the number of shuttles being propelled across the loom simultaneously. I term each section of the harness a "harness-section" and each section of the reed a "reed-section." Each harness-section carries a series of vertically-extending flat wires, each having a hole therethrough to receive a warp-yarn. These wires, which I term "heddles," are employed in lieu of the usual heddles.

The following letters of reference designate in a general way the devices or instrumentalities constituting my improved loom, to wit:

A is the loom as a whole; B, the main driving mechanism; C, the continuously-traveling harness-actuating chain; D, the harness-actuating cams, secured to and carried by said chain C; E, the pattern-chain and its mechanism, adapted to automatically actuate the switches in the traveling harness-actuating cams D, so as to shed the corresponding harness in advance of the next succeeding shuttle; E′, the device for tripping or returning the switches to the normal position; F, the vertically-guided harness-sections, the same being in engagement with and actuated by the said harness-actuating cams; G, the heddles, secured to the upper end of the harness-sections; H, the shuttle-carrying-chain track or support; I, the shuttle-carrying chain, adapted to travel in said track H; R, the shuttle-carriage and its connections; J, the shuttle itself; K, the reed-sections, arranged to be actuated by cams on the shuttle-carrying chain I; L, the device for locking the shuttles to the carriages secured to said chain I; M, the means for unlocking the shuttles from the carriages; N, the pattern-chain and its mechanism for automatically and successively selecting and delivering the proper weft-yarns to the shuttles; O, the device for automatically severing the weft-yarn from the stationary supply spool or bobbin; P, the "take-up" mechanism, adapted to be actuated pick by pick, if desired, and Q the warp-beam and its track complete, adapted to be readily run in and out longitudinally of the loom and below the harness-chains.

The loom A as a whole is double—that is to say, it is provided with two independent sets or series of warps, harnesses, heddles, reeds, &c., adapted to simultaneously produce two independent webs of similar or dissimilar fabrics, as desired. The weft-yarns are automatically selected and fed into the series of shuttles one at a time, the shuttles being carried or propelled by a continuously-traveling endless chain. The latter is also adapted to successively actuate the reed-sections to beat up the picks into the fabric. A similar chain is employed for actuating the several harness-sections. The two chains are located in different horizontal planes and are driven in one direction only, but at exactly the same rate of speed. In order that the chains may be actuated with greater ease and uniformity, they are mounted on positively-driven sprocket-wheels located at each end of the loom, said wheels being simultaneously rotated by means of gearing which receives its motion from a shaft extending longitudinally through the center of the loom.

The following is a detailed description of the several devices before referred to and taken in the order named.

The main driving mechanism B, (shown more clearly in Figs. 1 and 2,) through which the loom is actuated, is provided with the usual fast and loose belt-driven pulleys b or clutch-pulley, if desired. The first or short driving-shaft b', on which said pulleys are mounted, revolves in suitable bearings. It carries a spur-gear b^2, meshing into a larger gear b^3, secured to the shaft b^4, extending longitudinally through the center of the loom. At each end of this shaft is secured a bevel-pinion b^5, each in turn meshing into a larger bevel-gear b^6, secured to upright shafts b^7, Fig. 3, which latter carry the horizontally-arranged sprocket-wheels s for actuating the harness-chain C. Thus it will be seen that the two upright shafts b^7 and any gearing connected therewith are adapted to be rotated in exact unison.

The harness-actuating chain C consists of a series of connected alternating plain and cam links c c', respectively, Figs. 5, 6, 7, 9, 10, &c. The links are jointed together at the inner side or edge by means of pins c^2, passing through ears integral with the links. A plain link and a cam-link constitute one of the said series. The chain is endless and is mounted on and actuated by the driving or sprocket wheels s, before described. The two opposite sides or edges of the links are,

as drawn, provided with V-shaped projections or lugs c^3, Figs. 4 and 6, adapted to travel in correspondingly-shaped grooves or tracks c^4, formed in the lower adjacent faces of the stationary girders or ties c^5, the latter being secured to and uniting the two end frames a of the loom, as clearly shown. Each of said frames has two openings c^6 therein, through which the chain and its cams freely pass. The said tracks c^4 are continued at each end of the loom by means of the short brackets c^7, which also serve to properly guide the chain to and from the chain-wheels s. In order to form a support for the outer portions of the chain while it is passing around the ends of the loom, I provide a substantially semicircular flat track member c^8, secured to the ends of said brackets c^7. (See Figs. 1 and 2.)

The harness-actuating cams D are constructed and arranged as follows: The upper side or face of each of the links of said chain C is provided with a series of, as drawn, sixteen laterally-separated longitudinally-extending grooves, into which the cams are inserted and secured in a vertical position by the two transverse bolts or pins d^3. These cams, which are practically flat steel plates, are arranged in series—that is, the plain plates or cams d are mounted in the said plain links c and alternate with the plates d', in which the cams proper are formed, the latter plates being secured to the links c'. In the vertical or working face of each plate or cam $d\,d'$ are cut longitudinally-extending upper and lower grooves $d^4\,d^5$, respectively, adapted to receive and actuate the harness-sections, soon to be described. At or near the center of the cam-plates d' the said grooves $d^4\,d^5$ are deflected, so as to cross each other, the inclined grooves being indicated at d^6. (See Figs. 5, 7, 9, and 10.) At the point of intersection of these grooves d^6 the stock is cut away, so as to form an enlarged space d^7. In this space is located a short pivotally-mounted switch or arm d^2, its sides being adapted to form a continuation of the said inclined grooves. When the switch is in the position represented in Fig. 5, the action of the traveling chain would be to elevate the harness-sections. Conversely, the position of the switch represented in Fig. 7 would be to depress the harness. Thus it will be seen that the shed of the harness and its warps is effected automatically in either direction, according to the respective positions of the switches d^2. The switches are actuated by means of flat vertically-slidable bars d^8, connected therewith and dovetailed into the backs of the cam-plates d'. The upper end of these bars is well rounded and adapted to engage a tripping device E', soon to be described. The lower portion d^9 of the bars extends downwardly through the chain-links c' to be actuated automatically by the pattern-chain mechanism. Each of the switch-bars is maintained in position, either up or down, by means of a spring member d^{10}, (let into the face of the cam-plate d',) having a pin d^{11}, arranged to spring into one or the other of two well-rounded holes d^{12}, formed in the bar. These holes are separated vertically by a distance equal to the movement of the bar in swinging the switch from one position to the other.

The mechanism E for actuating the switches d^2 of the cam-plates d', whereby the harnesses are automatically set or adjusted with respect to each pick introduced into the fabric, consists of a pattern-chain, &c., adapted to be intermittingly operated by the cam-plates of the traveling chain C. This device (one at each end of the loom) is located just in front of the end frame a and, as drawn, is secured to one of the said chain-supporting guides or brackets c^7, as shown in Figs. 5, 6, &c. As thus arranged the several switch-bars of each successive chain-link c' as they pass the pattern-chain mechanism are suitably set just prior to entering that portion of the loom in which the harnesses are mounted, whereby the latter cause the warp-yarns carried by the heddles thereof to be correspondingly elevated or depressed, or "shedded," as it is termed. In this device, as drawn, the endless pattern-chain e consists of connected end links e', united transversely by small rods or pins e^2, on each of which are removably mounted small and larger rolls $e^3\,e^4$, respectively, sometimes called "sinkers" and "risers." The length of this chain as well as the number and relative position of the rolls employed are calculated and arranged by the designer in accordance with the style or pattern to be produced in the fabric, substantially as usual in fancy or pattern looms. To the under side of said brackets c^7 are secured two small side frames e^5, in which the chain-wheel shaft e^6 is revolubly mounted. The said chain or sprocket wheel e^7 supports and actuates the chain e. To the front or outer end of shaft e^6 is secured a ratchet-wheel e^8, adapted to be rotated by the spring-pressed push-pawl e^9, in turn jointed to and vertically reciprocated by the guided bar e^{10}, jointed to an arm e^{11} of the rocker-shaft e^{12}. To each front or outer cam-plate d' is secured a steel dog e^{13}, having a beveled end e^{14}, adapted to engage a short arm e^{15}, located in the path of the dog and secured to said rocker-shaft e^{12}, all as clearly shown in Figs. 5 and 6. The said frames e^5 are secured together by means of the two tie-rods $t\,t'$. On the former rod are loosely mounted swinging switch-levers t^2, the outer or free ends of which are adapted to be in intermittent engagement with the lower ends d^9 of the corresponding switch-bars, the arrangement being such that when one of the large rolls e^4 of the moving pattern-chain e contacts with its lever the latter will be quickly lifted, thereby elevating the corresponding switch-bar. In case, however, one of the small rolls e^3 be present the lever will remain in its lowest or normal position, as clearly shown in Fig. 7. I may add that after the dog e^{13} has passed beyond the arm e^{15} the latter, together with

the pawl e^9 and its connections, will swing upwardly by means of the spring e^{16}, Fig. 5, so as to be again actuated by the next-succeeding dog, the operation being repeated upon the passage of each cam-plate d'. It will be seen that the construction and arrangement are such that the entire series of sixteen switch-levers f^2 are or may be actuated simultaneously by the single series of dogs and the intermediate connections.

The device E′ for automatically and successively tripping or forcing all the switch-bars d^8 downwardly to the normal position after the cam-plates d' of the harness-actuating chain C have for the time being completed their work and before again engaging the harnesses of the other side of the loom is represented in Fig. 9. To the outer face of the frame a and extending across the top and in front of the frame-opening c^6 is secured a suitable bracket u, having its under side u' beveled and carrying an adjustably-secured steel tripping-plate or thin flat bar u^2, its lower edge being slightly beveled or rounded and lying contiguous to the top edge of the cam-plates $d\ d'$ of the chain C. By means of this device all the elevated switch-bars upon engaging with said tripping-plates u^2 will be quickly forced downwardly and uniformly to the normal position (see dotted lines) preparatory to being reset by the other pattern-chain mechanism E before the cams again reëngage the harnesses.

In my improved loom I may use the same number of harnesses as are employed in other fancy looms; but in lieu of making each harness integral throughout or across the length of the loom I divide each one into a series of comparatively short independent sections F. In the accompanying drawings I have represented sixteen harnesses, each divided into short sections, as just stated. Each section F consists of a thin flat steel blade f, Figs. 4 and 10, and a head portion f', in which the heddles G are suitably secured. These blades are arranged in a vertical manner and are adapted to slide in grooves formed in the transverse guides f^2, in turn secured to the ties c^5, before described. To the lower central part of each blade is mounted a pin or small laterally-projecting roll f^3, in continuous engagement with one or the other of said cam-grooves. Obviously while they are in the horizontal grooves of the plain cam-plates d no movement whatever of the harness-sections can take place; but upon entering the inclined grooves d^6 of the plates d' the sections will be deflected upwardly or downwardly, as the case may be, until the roll f^3 engages the exposed or open side of the switch d^2, at which instant the latter, according to its position, will cause the section to continue and complete its original movement or else deflect it back again to the horizontal groove, in which latter event only a partial shedding action will then take place.

The heddles G are preferably mounted in and secured to the head portion of the harness-sections, substantially as shown in Figs. 26, 27, and 28. As thus drawn, the face of the head member f' is provided with a series of short lugs f^4, corresponding with the number of heddles to be secured to the section. Fig. 27 shows a front view of the head with the blade f and some of the heddles omitted. The heddles may be made of flat steel wire cut to the desired length and having well-rounded edges. The lower end of the heddle has an opening g' therein adapted to receive a lug f^4. After the heddles of each section are mounted therein the members $f\ f'$, with the interposed heddles, are clamped together by means of short screws f^5 or other suitable device. The heddles are comparatively short and are or may be all alike throughout the loom. In order to more readily permit the passage of the warp-yarns through the heddle-eyes g, the body of the heddle contiguous to the head of the harness-section is twisted axially about thirty degrees, substantially as indicated at g^2 in Fig. 28. The heddles, as shown in the drawings, extend vertically from the harness frame or head f' and are unsupported at the top. As an advantage resulting from this arrangement the "drawing-in" operation may be somewhat facilitated.

At the upper part of the loom are secured two parallel laterally-separated longitudinally-extending channeled bars or members H, forming a continuous straight track or guide for the traveling shuttle-carrying chain I, soon to be described. These bars H further serve to tie the end frames a together. They also form supports for other mechanisms adapted to coöperate with the shuttles.

The shuttle-carrying endless chain I is composed of a series of alternate plain and cam links $i\ i'$, respectively. The chain is flat and fitted to slide in the recessed portion of said track H. The links are jointed together at the inner edge or side substantially the same as the harness-actuating chain C, the latter chain, however, being much larger and heavier than the chain I. The length of the links from center to center of the joint-pins is exactly the same in both chains, and since they travel in unison it follows that the relative arrangement of the links of one chain remains constant with respect to those of the other chain. The links i, which I term "plain" links, are adapted to carry each a shuttle, the alternate links i' being provided with a V-shaped cam-groove i^2, adapted to successively actuate the reed-sections K to beat up the fabric. The links i have a straight groove i^3 therein adapted to maintain a true guide for the reed-sections while the traveling shuttles are being supported by them. I may add that the said grooves $i^2\ i^3$ form a practically-continuous track for the reed-sections, the latter remaining stationary except when actuated by said cam portion i^2.

The following describes the mechanism for

driving the chain I: At each end of the loom is secured to the frame *a a* a large outwardly-extending bracket *v*, (see Figs. 1, 2, 3, &c.,) each forming a bearing for said upright shaft b^7, the latter being surmounted by a spur-gear v', Fig. 3, meshing into the two intermediate or stud gears v^2, in turn driving the two gears v^3, (indicated by dotted lines,) the latter turning on short vertical shafts fixed in said bracket. Mounted above and secured to each of said gears v^3 is located a sprocket or chain wheel v^4, carrying the chain I. The proportion of the several gears, as well as the timing of them, is such that they are adapted to revolve in one direction with the chain C, so that both chains travel at exactly the same rate of speed, as before stated.

In order to provide an auxiliary support for the chain I while the latter is passing around the ends of the loom, I may employ a suitably-bent thin flat track v^5, its ends being secured to those of the said straight track-guides H. A similar but smaller track v^6 is located just above the shuttles to prevent them from becoming accidentally detached from the chain or carriage. An **S**-shaped end bracket v^7, Fig. 1, secured to the said bracket *v* and also to the several track members v^8, v^5, and v^6, serves to support the latter, smaller intermediate brackets v^8 being used to maintain a uniform distance between the members v^5 v^6 vertically. The said shuttle driving or carrying chain I is provided with a series of carriages R, adapted to support a corresponding number of shuttles. These carriages are secured to the plain links *i* of the chain (see Figs. 15 to 19, inclusive) and have each a rearward extension *r*, carrying two freely-turning truck-rolls r' r^2, in frictional engagement with each other. The rolls may be made of rawhide or other suitable material. The lower roll r' is adapted to bear upon the base of the reed-sections K, the arrangement being such that the traveling chain causes the roll to revolve in the arrow direction, Fig. 17, which in turn revolves the other roll r^2 in a contrary direction. The upper surface of the carriage is made slightly curved and smooth and forms a traveling support for the lower shed of warp-yarns, as clearly shown. The forward portion of the carriage is extended at r^3 and has an opening r^4 therethrough, in which a vertically-movable locking member *l* is fitted.

The two reeds K are divided longitudinally of the loom into short independently-movable sections, each section being, say, one inch long. As drawn, the sections consist each of the elongated base *k*, into which the "dents" k' are inserted and soldered, and the top member k^2, uniting the upper ends of the dents comprising the section. The dents are or may be made of thin sheet metal, the form being clearly shown in Figs. 12 and 15. The dents are separated laterally for the passage between them of the warp-yarns, substantially as usual, the number of dents per inch of reed being governed by the size or number of the yarn used, also as common. The head portion of the dent is cut away on its under side to form, with the other dents of the reed, a continuous open groove k^3, having inturned ends, the dents being extended or projecting in front for the purpose. This groove forms a supporting guide and track in which the shuttles are suspended and adapted to freely travel therein. The base *k* of each reed-section is provided on its under side with a dove-tail-shaped tongue k^4, from which extends a stud or pin k^5, its lower portion being adapted to work in the said continuous cam-grooves i^2 i^3 of the chain I. (See Figs. 12, 13, 14, &c.)

The upper face of the shuttle-track member H is provided longitudinally on each side with a connected series of fixed guides k^6, adapted to form supports for the reed-sections to travel forth and back in. The guide members are dovetailed to receive the corresponding portion k^4 of the reed-base. (See Fig. 14.) The inner ends of the adjacent guides are separated, so as to form an open space k^7 along the center of the track H for the passage of the shuttle-carriages. (See Figs. 13, 15, &c.) The guides are also provided with end openings k^8, in which the base-pins k^5 of the reed freely travel. By means of the construction thus described it will be clear that while the chain I is passing along the two reeds K the forward end or side of the traveling cams i^2 will be gradually forcing the corresponding reed-sections outwardly to beat up into the fabric the weft-yarn or pick deposited by the immediately-preceding shuttle, the opposite side of the cam at the same time retracting or returning the previously-advanced sections to the normal position. (See arrows, &c., in Fig. 13.) Thus it will appear that the reed-sections are adapted to be operated in series at several continuously-changing points simultaneously, as clearly shown in Fig. 3. It is to be understood that a corresponding series of harness-sections are being shed or actuated concurrently with said series of reed-sections.

As drawn, there are five shuttles feeding the weft-yarns to the fabric continuously at each side of the loom. Therefore if it be assumed that the chains C and I are driven at the low rate, say, of three feet per second and that the harnesses and reeds are six feet long it follows that the production or output of fabric (on both webs) will be at the rate of five picks per second or three hundred per minute. It is obvious that the rate of production may be maintained irrespective of the width of the loom.

The shuttles J are made of thin metal, as steel, and polished. They are substantially rectangular cross-sectionally and hollow, the forward end being flat-pointed, so as to readily enter between the warps. The upper side of the shuttle has a flat longitudinally-extending bar *j* secured thereto, having well-rounded edges (see Figs. 15 and 16) adapted to enter and slide in the said open groove k^3 of the

reed-dents, the form of the groove being such that it supports the weight of the shuttle and prevents it from moving out of its true or normal position either vertically or laterally. The under side of the shuttle is provided with a suitably-beveled rib j', arranged when in use to deflect the lower warps, a narrow clear space j^2 being formed between the adjacent surfaces of said rib and the top of the carriage R, as shown in Figs. 16, 17, &c. At the rear end of the shuttle is mounted a freely-turning friction-roll j^3, similar to the said rolls r' r^2 of the carriage, its center being above and somewhat in advance of the roll r^2, whereby the latter is adapted to rotate the shuttle-roll, the shuttle at the same time being propelled ahead by the combined movement of the carriage and its revolving rolls, as clearly indicated in Fig. 17. It will be seen that the lower warp-yarns are deflected by the shuttle-roll and pass between the adjacent faces of said rolls j^3 and r^2. A longitudinally-extending opening j^4 is formed in the top wall of the shuttle for the free passage of the lower end of the weft-yarn guides or levers n^{14}, which deliver the weft to the shuttle-charging mechanism. This latter consists of a series of light pivotally-mounted arms or fingers j^5, arranged along and near the outer longitudinal edges of the shuttle-frame, the fingers on one side alternating with those of the other side and adapted (when the shuttle is being charged) to swing inwardly one after the other in a zigzag manner, as clearly shown in Figs. 21 and 22. The outer portion of each of the fingers j^5 beyond the fulcrum or pivot-pins is arranged at substantially right angles therewith and consists of a short arm j^6. These do not extend beyond the shuttle-frame. Therefore they are protected and cannot engage the face of the reed-sections while the shuttles are passing through them.

The shuttles are charged with the weft-yarn w' as follows: Just before each shuttle enters the warp-yarns w, the several fingers j^5 then being swung rearwardly and empty, the traveling shuttle passes between two oppositely-arranged stationary dogs j^7, located in the path of the short arms j^6, which latter engage the said dogs and cause the fingers to be quickly and successively swung inwardly or downwardly, thereby at the same time instantly enfolding the weft-yarn between and upon the fingers in a zigzag manner, the proper weft-guide n^{14} having previously been brought into position to deliver the desired length of weft-yarn to the fingers. After the shuttle has entered between the warps a proper distance the yarn trailing from the slot j^4 at the rear end of the shuttle is mechanically severed from the main spool or supply. This device will be described later. After the weft-yarn w' has been delivered by the shuttle into the web or fabric (the shuttle having of course been unlocked from the carriage before entering the warp in order to allow the latter to pass between the shuttle and carriage) the shuttle is again locked to the carriage, so that it may be carried around the end of the loom. The means L for thus locking the parts together are as follows: To the front end of the carriage R is pivoted a lever l', having the vertical locking-bar l jointed thereto, the latter extending upwardly in an opening r^4, formed in the extension r^3 of the carriage and adapted to enter a corresponding opening j^8 registering therewith, formed in the under side of the shuttle. The other or outer end l^2 of the lever is arranged to engage a stationary cam l^3, having a beveled surface, thereby forcing downwardly the outer end of the lever and elevating the opposite end, the result being to introduce the upper end of the bar l into the opening or socket j^8 of the shuttle. (See Figs. 16, 24, &c.) While the traveling shuttle is thus being locked, it is maintained in position by means of the fixed guide-bracket l^4, secured to the rear side of the track member H. (See Fig. 16, &c.) The lever l^2 is held in either position by means of a spring pin or catch l^5, mounted in an extension or lug r^5 of the carriage. The shuttle as thus locked is now carried around the end of the loom by means of the chain I, mounted on the two gear-driven chain-wheels v^4, and is automatically unlocked from the carriage just before it reënters the warps and after being again recharged with the weft-yarn. The means for unlocking or detaching the shuttle from the carriage are as follows: In fact, it is simply a reversal of the locking operation and consists of a fixed cam M, also secured to but at the opposite end of a track member H, the arrangement being such that the end l^2 of the lever l' is elevated by its engagement with the cam projection m^8 of the cam M, and thus withdraws the bar l from the shuttle, the latter meanwhile fairly entering the reed-sections to deliver a new pick or length of weft-yarn into the corresponding web or fabric. Figs. 24 and 25 show the said locking and unlocking cams and the relative positions of the lever to them.

The pattern-chain and mechanism connected therewith for automatically and successively selecting and introducing the proper weft-yarns w' to the shuttles J are indicated at N, Figs. 19, 20, and 21. I prefer to locate the same contiguous to the front end of the reed and at each outer end of the loom. (See Fig. 3.)

The following is a detailed description of the device and the manner of its operation: To the front side of the track member H is secured a curved overhanging bracket n, in which is mounted a revoluble short shaft n', carrying a sprocket-wheel n^2, which in turn actuates the endless pattern-chain n^3. This chain is composed of links and small and larger rolls, substantially as hereinbefore described with respect to the pattern-chain e, employed for automatically setting the switches mounted in the harness-actuating cams. In fact, the several rolls are alike and

interchangeable. In the drawings I have represented the chain n^3, &c., as capable of being used with five weft-yarns, each, if need be, having a different color. In Figs. 1 and 3 I have shown but three spools or bobbins at each end of the loom for supplying the weft-yarns. The rolls are arranged on the chain so as to present the desired yarn for each pick in succession, the design or pattern being repeated in the fabric at longer or shorter intervals, as determined by the length of the chain. The manner of setting up or arranging the rolls of the pattern-chain is, however, practically the same as in other multiple-color or fancy looms. To one end of the shaft n' is secured a ratchet-wheel n^4, arranged to be intermittently rotated in the proper direction by a spring-pressed hook-pawl n^5, in turn jointed to the swinging two-arm lever n^6, the latter having at its lower end a guided endwise-movable pusher-bar n^7, attached thereto. (See Figs. 19 and 21.) The said bar extends horizontally through the adjacent side of the casting H and has a beveled end normally located in the path of the said cams i^2 of the shuttle-carrying chain I. As thus arranged the outer side or wall of the cam in traveling along the guide H engages the bar n^7 and forces the latter endwise or outwardly, thereby vibrating the lever n^6 and through the medium of said pawl rotating the chain-wheel, say, one-eighth of a revolution or one tooth, being the length of the chain-link, and thus placing the next succeeding roll in position, thereby also at the same time swinging the corresponding yarn-guide n^{14} in position. After the chain-cam has passed a spring n^8 serves to return the pusher, &c., to the normal position, (shown in Fig. 19,) to be again actuated upon by the next succeeding cam. To the rear side of the track member H and opposite the said chain-carrying bracket n is secured a combined bracket and shuttle-guide m. (See Figs. 19, 20.) To the top of the member m is fixed a stand n^{12}, in which is mounted a short shaft or stud n^{13}, carrying a series of five independently-swinging weft-yarn guides n^{14}, the lower end of each having a small well-rounded eye n^{15} therein, through which the yarn is guided and introduced into the shuttle. These guides as arranged are adapted to be swung singly to a substantially vertical position, so as to register with and enter the said longitudinal opening or slot j^4, formed in the upper side of the shuttle. After the shuttle has passed the guide is returned to its normal position, the guide carrying the next-desired weft-yarn meanwhile being swung downwardly to deliver its yarn to the succeeding shuttle, this operation being repeated for each pick or shuttle charge. The means for effecting such action or movement of the yarn-guides n^{14} consists of a corresponding series of bell-crank levers n^{10}, loosely mounted on a rod n^9, secured in the said bracket or chain-supporting frame n and connected with the guides by links n^{11}. The short or horizontal arms of the levers n^{10} extend rearwardly and lie in the paths of the several rows of chain-rolls—that is to say, when the yarn-guides are in the normal position, as before stated, the levers n^{10} are in engagement with the smaller rolls of the pattern-chain n^3, (see dotted lines, Fig. 20,) springs n^{17} being employed to automatically maintain them in said position. Now whenever the chain in its movement causes one of the larger rolls thereof to engage a lever n^{10} the latter will then be swung upwardly on its axis, thereby imparting a counter movement to its connected guide n^{14} and swinging it downwardly in the path of the shuttle, where it remains until the next movement of the chain. In order to conduct the several weft-yarns w' from the large supply-bobbins (shown in Figs. 1, 2, and 3) to the guides n^{14}, the ends are passed through suitably-arranged individual eyes secured to arms or holders n^{16}. (See Fig. 19.) After the shuttle has been charged with the weft-yarn the latter has to be severed from the supply-bobbin, thereby permitting the free end of the yarn (still threaded through the eye of its guide n^{14}) to be presented, if need be, to the action of the next succeeding shuttle. A means for effecting such severance of the yarn is indicated at O, Figs. 21 and 23, wherein a thin plate o^2 is represented as secured to the front end of the outer row of the reed-guides k^6. The said plate extends toward the center of the track and has a beveled cutting edge o. At the opposite side a vertically-extending fellow member o', also having a cutting edge o, is secured to the end section of the reed, the arrangement being such that upon quickly advancing the said reed-section the cutter o' in passing the member o^2 will instantly sever the strand of yarn then between them, the corresponding shuttle end of the yarn being next beat up into the fabric by the action of said reed-section, the succeeding sections continuing and completing the beating up of the pick in unison with the rate of its discharge from the shuttle.

The take-up mechanism P (see Fig. 4, &c.) in my improved loom may be described as follows: The two webs of cloth z as produced pass each over the usual "breast-beam" a', then downwardly and around a hollow friction-roll p^2, and over a rough-surfaced "feed-roll" p^3 to the winding-beam p^4, also as usual. The diameters of the rolls p^3 and p^4 may be alike, the circumference being, say, eighteen inches, or one-half a yard. Therefore each revolution of the feed-roll p^3 would represent the production of eighteen inches of cloth. The two rolls p^3 p^4 are adapted to revolve in opposite directions by means of the two intermeshing spur-gears p^5 p^6, respectively. The said rolls have the same normal rate of movement; but as the amount of cloth is increased on the roll p^4 the relative movement is automatically changed, the latter roll then decreasing in its rate correspondingly. To the feed-roll shaft is secured

a worm-wheel p^7, having, say, eighteen teeth, or one tooth per circumferential inch of the roll p^8. The said wheel or gear p^7 is rotated by a worm or screw p^8, secured to the lower end of a suitably-mounted upright shaft p^9, the latter having at its opposite end a driving head or disk p^{10}, fastened thereon. To the face of the driving-head a fine-toothed ratchet-wheel p^{11} is removably secured, the number of teeth in this wheel being, say, equal to the number of "picks" or weft-yarns per inch of fabric being produced. By employing a suitable series of interchangeable ratchet-wheels having the number of teeth corresponding with the required picks per inch it is a comparatively easy and simple matter to set or adjust the take-up.

By referring to the plan view Fig. 11 it will be seen that a device is employed for operating the mechanism last described which is similar to that represented in Fig. 21, &c., for actuating the pattern-chain of the weft-changing mechanism—that is, a suitably-mounted slidable push-bar h, adapted to be forced endwise by the wall of the reed-actuating cams i^2 of the shuttle-carrying chain I, has a spring-pressed push-pawl h' jointed to its outer end and being in continuous engagement with the teeth of the ratchet-wheel p^{11}. Now as each cam i^2 corresponds with one shuttle or pick it follows that the pawl will be reciprocated once. Thus it is clear that the device is capable of rotating the take-up rolls a correspondingly small degree or extent. As the web or bolt of cloth increases in diameter on its roll p^4 the rate of rotation must be decreased, as before stated. In order to provide for this contingency, the corresponding gear p^6 is capable of turning independently of its shaft—that is, a friction-disk h^2 is rigidly secured to said shaft, against which disk bears the rear face of the gear, a nut h^3, mounted on the screw-threaded end of the shaft, being employed to maintain any yielding degree of pressure desired in a well-known manner. (See Fig. 29.) By means of the crank-handle p^{12} the take-up rolls may be operated independently of the driving mechanism.

The warp-beams and the manner of mounting them are indicated by Q. The beam proper, m^2, including the flanged ends and shaft m^3, is made substantially as usual. Each end portion of the beam is provided with a grooved wheel m^4, carrying a friction strap or band m^5, its ends being secured to the beam-truck. One end of said band is provided with a "turnbuckle" m^6 for readily controlling the degree of pressure or tension upon the warps. The beam-truck y is made of light angle-iron, &c., its length being sufficient to properly support the beam therein. It is provided with a series of four small rolls y', adapted to run on the track-rails y^2, extending longitudinally of the loom, as clearly shown. The said tracks extend slightly above the floor, so that when the loaded beam-trucks are run thereon the entire weight is supported directly by them. The tracks not only serve to lessen the friction, but also form guides for the trucks, whereby the latter always maintain the proper relation to the loom. If desired, they may be clamped or otherwise secured in position.

It will be seen, referring to Figs. 2 and 4, that the end frames a of the loom are provided with two laterally-separated enlarged openings a^3 a^3, adapted to freely receive the said truck and its beam. When the latter are in position, they are directly below the harness-actuating mechanism or chain C. The warp-yarns w lead directly from the under side of the beams upwardly to the respective warp-rolls or stationary guides a^4, Fig. 4. The dotted lines indicate the warps when the beam is filled. Similar lines indicate the maximum diameter of the bolt or cut of cloth z on its roll p^4. Since the main driving-shaft b^4 extends along the center of the loom, (see Figs. 2 and 4,) it is apparent that the beams and trucks can be freely run in and out without touching any of the parts or members of the loom. The same is true as to the other or driving end of the loom, with the exception of the pulleys b. In this case they would have to be removed temporarily or made smaller in diameter. The said warp rolls or guides a^4 are capable of adjustment laterally by means of the sliding bearings a^5 and the securing-bolts. This construction permits the angle of the warp-shed to be changed or varied substantially as usual, according to the number of harnesses employed.

In view of the fact that the shuttles used are very thin and narrow the amount of shedding movement is practically reduced to a minimum, this being especially true as to the harnesses contiguous to the reeds. In order to maintain an approximately uniform angle to all the warps passing through the reeds, I prefer when, say, sixteen harnesses are employed, as shown in the drawings, to construct the harness-actuating cams so as to consist of three groups, each varying in the amount of vertical movement or "throw" to be imparted to the harness-sections, as indicated in Figs. 4 and 6. In the latter figure the first group of four sections, 1, (being the front sections nearest the reeds, the latter not shown,) has the least cam throw, the next or intermediate group of four sections, 2, has an increased throw, while the last or rear group, 3, consisting of eight sections, has a still greater throw.

I would further add that a loom embodying my improvements is equally well adapted to produce wide or narrow fabrics. The loom can also be easily arranged to make cloth having a few inches less width than the maximum width—that is, assuming the loom to be constructed to weave goods, say, eighty inches wide, with the shuttles each having a corresponding capacity, or, in other words, having the number of its arms j^5 sufficient to infold

between them at least eighty inches of weft-yarn. If now it be desired to weave seventy-inch cloth, the shuttle capacity may be correspondingly reduced by simply removing from the rear portion of the shuttle a proportional number of the arms used in the former case. Obviously the shuttle may be readily adapted to carry charges of weft-yarn varying in length by simply increasing or diminishing the number of its swinging arms or fingers j^5.

It is of course essential that the arms on one side of the shuttle be arranged to overlap those on the other or opposite side in an alternate manner. The amount of such overlapping for each pair of arms forms a unit of measurement for determining the number of pairs required to take up the desired length of yarn to form a single pick. One or more of the last pairs of arms of the series mounted in the shuttle may be shortened, if desired, thereby readily adapting them to take up a fraction of said unit of measurement.

It will be apparent, considering the producing capacity of my improved multiple-shuttle loom, that its weight is relatively less than that of the usual broad loom. There is practically no interior mechanism, except the harness-sections, and these are accessible from above and below. The loom is strong and is tied together longitudinally by the braces a^2, as well as by the members a', c^5, and H.

The manner of operation of my improved loom A is substantially as follows, assuming, first, however, that the several parts or instrumentalities have been properly adjusted or set to produce the desired pattern and that the warp-beams are in position, with the warp-yarns w drawn through the several heddle-eyes and both reeds K. Now upon rotating the main shaft b^4 of the driving mechanism B the harness-actuating and shuttle-carrying chains C I, respectively, will be continuously driven ahead simultaneously and in unison in one direction (see arrows) by means of the respective sprocket-wheels and intermediate gearing. Just before the harness-cams D enter the portion of the loom containing the reeds K, feed-rolls, &c., the several switches d^2, mounted in said cams, are automatically set or adjusted, either up or down, by means of the device E, so that upon engaging the harness-sections F of the sixteen harnesses the sections are successively and correspondingly actuated to properly shed the warp-yarns while the cams are traveling across the loom. The upper or shuttle-carrying chain I is so arranged and timed that the relation of the shuttles thereof to said switch-carrying cams alternate with one another, whereby the corresponding harness-sections and their heddles are actuated to continuously shed the warps in advance of the next succeeding shuttle. The traveling shuttles J are automatically charged singly and successively with the desired length of the proper weft-yarn w' by means of the device N, the shuttle being automatically unlocked from its carriage by the device M just before it enters between the warps, followed immediately thereafter by the action of the weft-cutting device O, which severs the yarn uniting the shuttle and the corresponding guide n^{14} and leading from one of the stationary supply-bobbins. The sections of the reed are successively actuated by the cams i^2 of the chain I to beat up into the fabric each pick deposited by the immediately-preceding shuttle, the corresponding warp-shedding action taking place practically concurrently therewith. As the harness-actuating cam-sections D after having completed their work emerge successively from the opposite end of the loom, all the switches in each section are automatically forced downwardly to the normal position by means of the tripping device E'. The thus-tripped sections are then carried around the end of the loom and again reset by another device E before entering the harness-sections of that side of the loom. The shuttles while supported by the reeds are propelled through the warps, the latter being open or shed just in advance of each shuttle, so that the upper shed passes over it, while the lower shed warp-yarns pass between the shuttle and its carriage and the adjacent faces of the corresponding friction-rolls j^3 and r^2 at the rear. When the shuttles pass outwardly from the reeds, they are successively locked to the respective carriages by means of the locking device L. As thus locked the shuttles are carried around the end of the loom and again recharged with the proper weft-yarn by another charging device N before entering the reed and warps of that side of the loom, a device M, as before, being employed to successively unlock the shuttles from the carriages at substantially the same instant.

While the foregoing operations are taking place the take-up device P is being intermittently actuated by the traveling chain I, as before stated.

I am well aware that circular looms have been devised prior to my invention, such looms, however, being more particularly adapted to produce woven fire-hose, tubular seamless bagging, &c. Looms of this type could not be successfully employed to produce the pattern goods which may be made on my improved loom. Moreover, the latter is not adapted to produce tubular fabrics or goods. I am also aware that straight reciprocating looms have been devised wherein the weft-yarn is introduced by a "weft-carrier," so called, instead of by a shuttle, such weft-carrier leaving a single thread of filling instead of two threads, as common in so-called "needle-looms." In such former looms each pick or filling is selected and drawn entirely across the loom by the weft-carrier before another thread can be introduced and before

the reed and lay are moved forward to beat up the filling-thread. I disclaim such former construction.

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

1. In a multiple-shuttle double loom, adapted to simultaneously produce two webs of cloth (one at each front or working side of the loom), the combination of harnesses and reeds divided into short independently-movable sections; instrumentalities or devices arranged and adapted to actuate said harness-sections consecutively or in a prearranged order, whereby the warp-yarns are properly shed; a series of shuttles traveling continuously in one direction and separated from one another at fixed intervals and adapted to be supported by said reeds while in the act of delivering the weft-yarn or pick therefrom, each shuttle being provided with a series of swinging arms or fingers arranged to overlap one another alternately to infold a length of weft-yarn between them in a zigzag manner; means for selecting the proper weft-yarn, introducing it to and charging the shuttle therewith; means for severing the length of weft-yarn in the shuttle from the supply; means for beating up each weft-yarn or pick into the web or fabric in advance of the next succeeding shuttle, and a take-up device for maintaining a proper degree of tension upon the cloth as it is produced, substantially as hereinbefore described.

2. In a loom, a traveling shuttle capable of being charged with a predetermined length of weft-yarn and deliver the same into the web while passing between the shedded warp-yarns, and means coacting with the shuttle for introducing the weft-yarn into the shuttle and charging it with the same.

3. In a loom, provided with mechanically-actuated harnesses and reeds having the warp-yarns passing therethrough, a non-reciprocating continuously-traveling shuttle capable of being charged, while in motion, with a predetermined length of weft-yarn from a supply-bobbin, and means coacting with the shuttle for introducing and charging it with said length of weft-yarn before the shuttle passes between the shedded warp-yarns.

4. As a new article of manufacture, a straight double loom having mechanically-actuated harnesses and reeds, each divided longitudinally into short independently-movable sections, a series of self-charging independent weft-carrying shuttles, and means consisting of suitably mounted and driven endless flexible connections or chains, traveling in unison, for actuating the reeds and harnesses and for propelling the shuttles successively and continuously in one direction through or between the previously-shedded warp-yarns.

5. A multiple-shuttle loom having its harnesses and reeds divided longitudinally into short independent movable sections, a continuously-traveling endless driving-chain by which the harness-sections are actuated at the proper time, mechanically-charged weft-carrying shuttles for placing the weft-yarn in position between the warps, and an endless chain, traveling in unison with the said harness-actuating chain, provided with carriages adapted to carry the shuttles and arranged to successively actuate the reed-sections, substantially as described.

6. In a loom for weaving textile fabrics, provided with reeds and harnesses divided longitudinally into short independently-movable sections and other necessary instrumentalities arranged to coöperate with one another in weaving the fabric, a continuously-driven endless chain and a series of mechanically-charged weft-carrying shuttles supported and propelled by said chain, substantially as described.

7. As a new article of manufacture, a shuttle arranged to receive a comparatively short length of weft-yarn, said shuttle having a series of light swinging levers or fingers arranged longitudinally thereof along each edge, the center or pivotal points of one series alternating with those of the other series, and arranged whereby upon closing the fingers successively from one side to the other the weft-yarn is folded alternately in a zigzag manner between them, substantially as described.

8. In a loom, a traveling shuttle having a dual series of suitably-arranged pivotally-mounted levers or fingers, in combination with fixed dogs or means adapted to engage with and actuate said levers to infold the weft-yarn between them in a zigzag manner, substantially as described.

9. In a loom for weaving textile fabrics, a continuously-traveling non-reciprocating shuttle having suitably-arranged swinging levers or fingers mounted therein and provided each with a short outer extension, fixed cams or dogs, and means for automatically introducing the weft-yarn to the shuttle and arranged whereby said extensions are brought successively into engagement with said dogs so as to close the levers and infold a length of weft-yarn between them in a zigzag manner, substantially as described.

10. The shuttle herein described, having a series of swinging arms or levers mounted longitudinally on each side thereof, and a longitudinally-extending groove or space formed in the upper side of the shuttle adapted to receive the weft-yarn guide, substantially as described.

11. The shuttle herein described, having swinging arms or levers mounted on opposite sides thereof adapted to be swung inwardly or toward the center of the shuttle, one after the other successively and alternately, whereby a length of weft yarn or thread to produce a single pick is infolded by and between them in a zigzag manner.

12. In a loom for weaving textile fabrics,

the combination with the reed divided longitudinally into short independent sections, means for successively actuating the sections to and fro, and a carriage adapted to travel continuously in one direction, of the slidably-supported weft-carrying shuttle, and freely-turning friction-rolls mounted in the shuttle and carriage, substantially as hereinbefore described and for the purpose set forth.

13. In a loom for weaving textile fabrics, the combination with the carriage adapted to travel continuously in one direction, and a pair of friction-rolls mounted thereon capable of being rotated by engagement with a plane surface, of a weft-carrying shuttle adapted to be supported and propelled by said carriage, a friction-roll mounted in the rear end of the shuttle arranged to engage with and be rotated by the carriage-rolls, and means for automatically locking the shuttle to and unlocking it from the traveling carriage, substantially as described.

14. In a multiple-shuttle loom, the combination of a suitably-mounted chain arranged to travel continuously in one direction, a series of carriages or carriers secured to and traveling in unison with said chain, a corresponding series of weft-carrying shuttles mounted in and propelled by said carriers, fixed guides arranged above and longitudinally of the chain and having an open space between them for the passage of the shuttle-carrier, a series of short independently-movable reed-sections mounted in said guides, and cams connected with said chain and in engagement with the reed-sections, whereby the latter are adapted to be successively reciprocated forth and back in said guides to beat up the weft, substantially as described.

15. In a straight multiple-shuttle loom, the combination of a suitably-mounted endless chain adapted to travel continuously in one direction provided with a series of shuttle-carriers alternating with a corresponding series of cams, and a reed consisting of a series of short independent sections in engagement with said cams, adapted to be successively actuated by the latter after the passage of the corresponding shuttle-carrier, substantially as described.

16. In a multiple-shuttle loom, the combination of a series of mounted shuttles arranged to be continuously driven in one direction, means for independently and successively charging the shuttles with the weft-yarns from suitably-arranged bobbins or other source of supply, and means for severing the weft-yarn connecting the bobbin and shuttle after the latter has entered the warps and in advance of the next succeeding shuttle, substantially as described.

17. In a multiple-shuttle loom, the combination of a series of shuttles, mechanism for propelling them continuously in one direction, a series of suitably-mounted independent weft-yarn guides adapted to receive a corresponding number of weft-yarns leading from conveniently-located bobbins or spools, and mechanism embodying a pattern-chain or other analogous means for placing said weft-yarn guides in position, one at a time, in the path of the traveling shuttles, whereby the latter are adapted to successively seize the free ends of the weft-yarns as presented by the respective guides and draw off the proper length of yarn or thread and at the same time infold it therein, preparatory to being introduced into and form an integral part of the fabric or web, substantially as described.

18. In a multiple-shuttle loom, the combination with an intermittingly-actuated pattern-chain and a series of levers n^{10} operatively connected therewith, of continuously-traveling shuttles adapted to be charged with the weft-yarn, and a series of independently-movable guides n^{13} connected with and actuated by said levers and carrying the weft-yarn and having their lower ends adapted to be swung into the path of the shuttles, substantially as described and for the purpose set forth.

19. In a multiple-shuttle loom, the combination of a series of continuously-traveling shuttles, a series of weft-yarn guides adapted to be moved into the path of the shuttles, and an intermittently-operated pattern-chain for actuating said guides singly, one at a time, and arranged whereby a guide is adapted to be swung into position in advance of the corresponding shuttle so that the latter may draw from the guide a length of yarn to produce a single pick, substantially as described.

20. In a multiple-shuttle loom, a harness or warp-shedding device, consisting of a series of short independently-movable vertically-reciprocating sections carrying heddles through which the warp-yarns pass, an endless chain adapted to travel continuously in one direction, and cams secured to said chain having the harness-sections operatively connected therewith, substantially as described.

21. In a multiple-shuttle loom, the combination of a series of short independently-movable heddle-carrying harness-sections, an endless chain adapted to travel continuously in one direction, a connected series of vertically-arranged laterally-separated cam-carrying plates secured to said chain having the harness-sections operatively connected therewith, dogs or switches mounted in the cams, and means for automatically setting the switches before the latter engage the harness-sections, substantially as described.

22. In a multiple-shuttle loom, the combination of vertically-movable independent harness-sections, a continuously-traveling chain, adjustable cams mounted in said chain for actuating said sections at prearranged intervals, means for tripping the cams after the latter have passed the harness-sections, and a mechanically-actuated pattern-chain adapt-

ed to readjust or reset said cams before they are again brought into engagement with the harness, substantially as described.

23. In a multiple-shuttle loom, a series of suitably-guided independently-movable harness-sections, each consisting of a flat guide or blade, a head member secured thereto and a series of heddles removably secured to said head and blade members, the axes of the heddle-eyes being at an angle with the face of said blade, substantially as described.

24. In a multiple-shuttle loom, the combination of a continuously-traveling chain, a series of cams secured thereto, a corresponding series of independently-movable heddle-carrying harness-sections operatively connected with said cams, a traveling dog or switch located in the path of each of the cams, means for automatically setting the switch, whereby the warp-shed is correspondingly opened or closed, and a spring-stop for holding the switch in the operating position, substantially as described.

25. In a multiple-shuttle loom, a series of traveling cams D, each having formed in its face oppositely-inclined grooves crossing each other, a swinging dog or switch d^2 located directly in an enlarged space d^7 formed at said intersection of the grooves, a vertically-movable bar for changing the position of the switch so as to close one or the other of the cam-grooves, and a spring-stop for maintaining the switch in position, substantially as described.

26. In a multiple-shuttle loom, the combination of a pair of laterally-separated horizontal bars c^5 extending longitudinally of the loom and secured to the end frames thereof, a series of grooved cross-ties f^2 uniting said bars at fixed intervals, and vertically-movable harness-sections mounted in the grooved portion of said cross-ties, substantially as described.

27. In a multiple-shuttle loom, the combination with a series of vertically-movable warp-shedding harness-sections and a continuously-traveling chain provided with cams for actuating said sections, of switch members mounted in the cams and extending below the chain, a series of independently-movable arms or fingers arranged to be engaged by said switches, a pattern-chain having suitably-arranged rolls or members thereon adapted to engage with and actuate said fingers, mechanism for intermittingly operating the pattern-chain, whereby the switches are suitably set or adjusted before engaging the harness, and other mechanism adapted to trip or release said switches after the latter have been disengaged from the harness-sections and prior to being again readjusted by said pattern-chain, substantially as described.

28. In a multiple-shuttle loom, the combination with the harnesses and reeds, each consisting of short independently-movable sections, of an endless chain provided with cams or devices arranged to actuate said harnesses, an endless chain provided with shuttles carrying the weft-yarn and arranged to actuate said reed, and suitable driving-wheels, located at each end of the loom, having said chains mounted thereon, whereby both chains are adapted to be driven continuously in one direction and at the same rate of speed, substantially as described.

Signed at Providence, Rhode Island, this 15th day of June, 1901.

LEVI E. SALISBURY.

Witnesses:
GEO. H. REMINGTON,
S. C. HARRIS.