

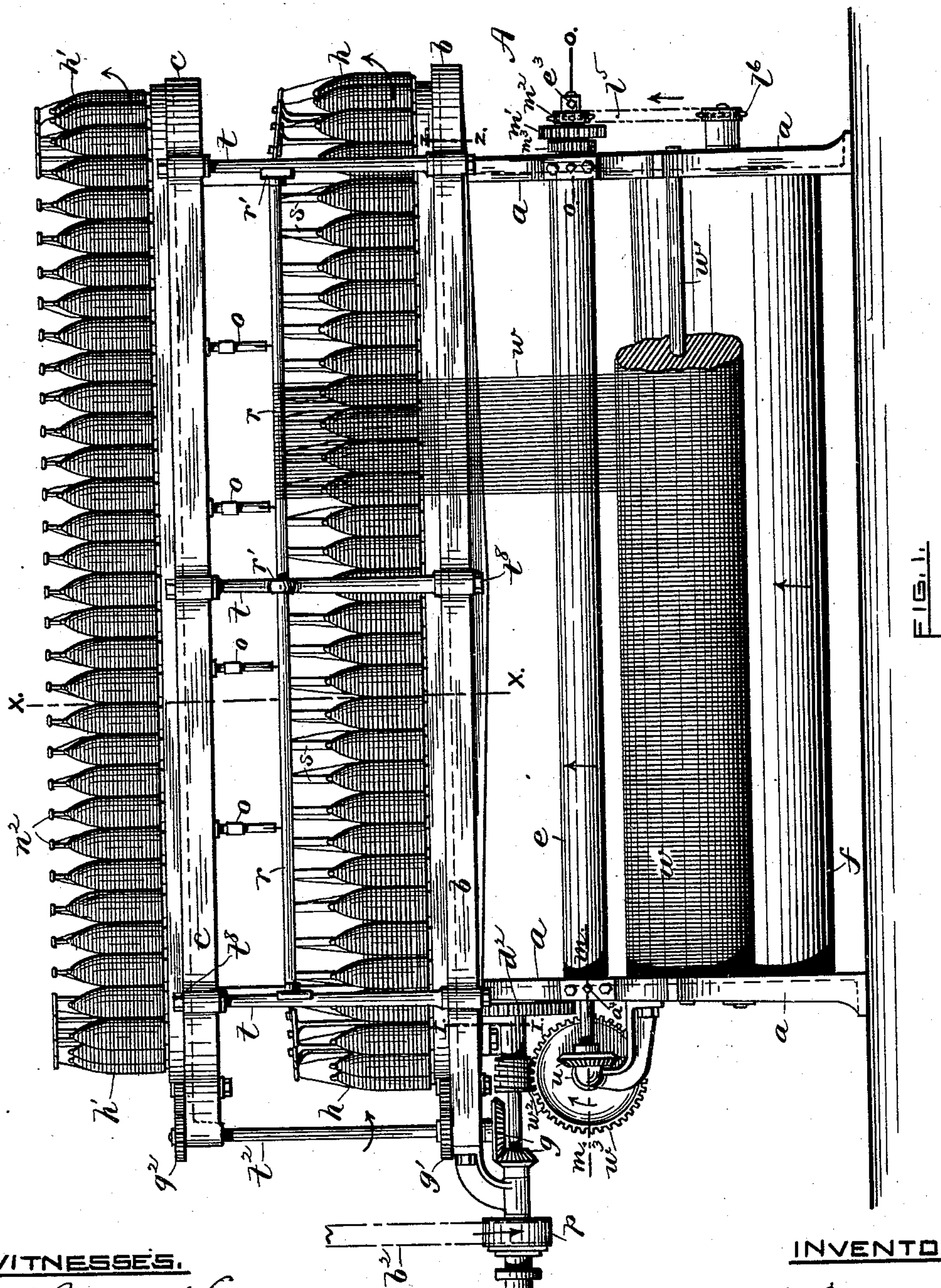
(No Model.)

5 Sheets—Sheet 1.

L. E. SALISBURY.
KNITTING MACHINE.

No. 455,464.

Patented July 7, 1891.



WITNESSES.

Charles Hannigan

Emile Maertens

INVENTOR.

Levi E. Salisbury

by *Remington T. Henshorn*

Atty.

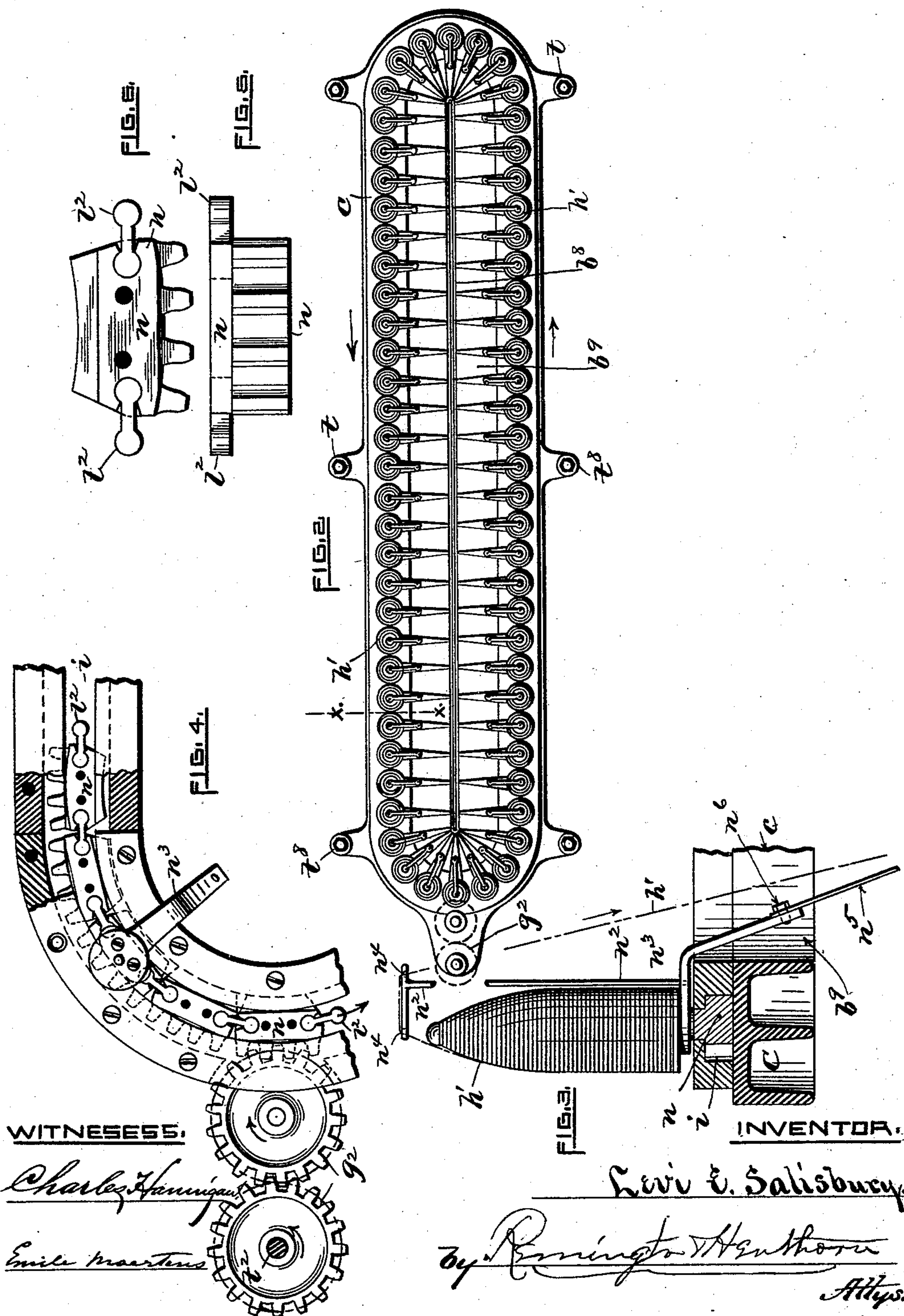
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5 Sheets—Sheet 2.

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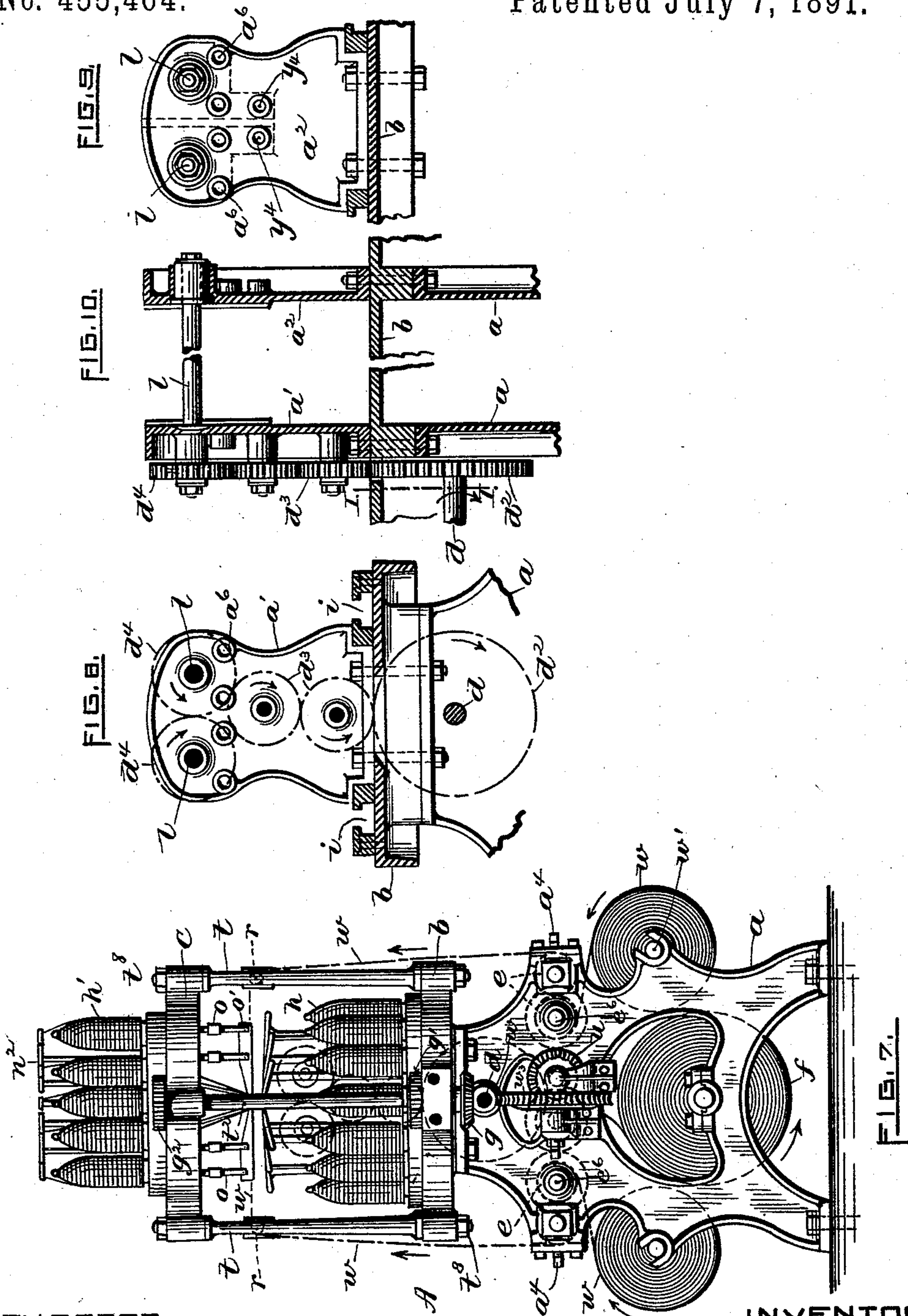
(No Model.)

5 Sheets—Sheet 3.

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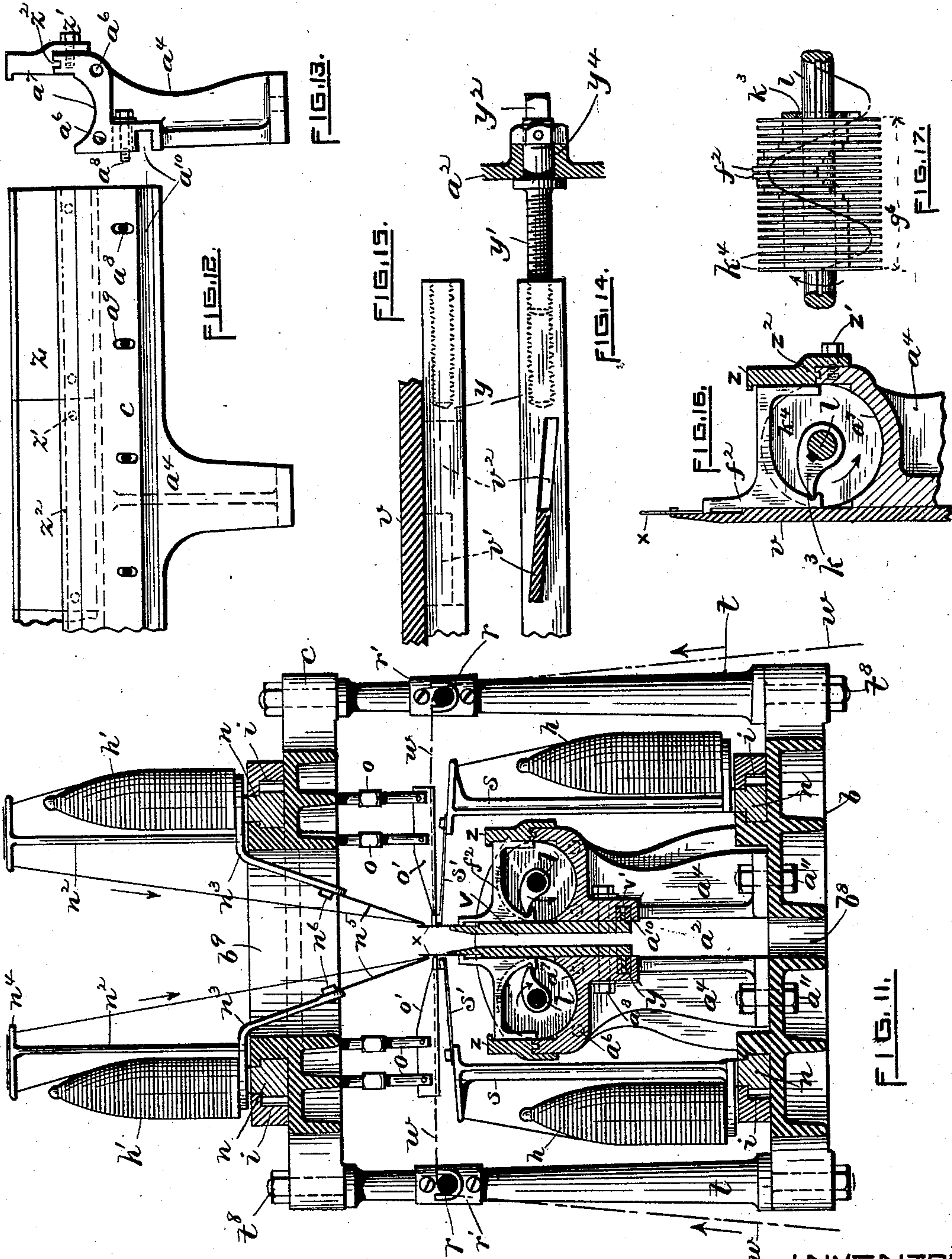
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5 Sheets—Sheet 4.

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(No Model.)

5 Sheets—Sheet 5.

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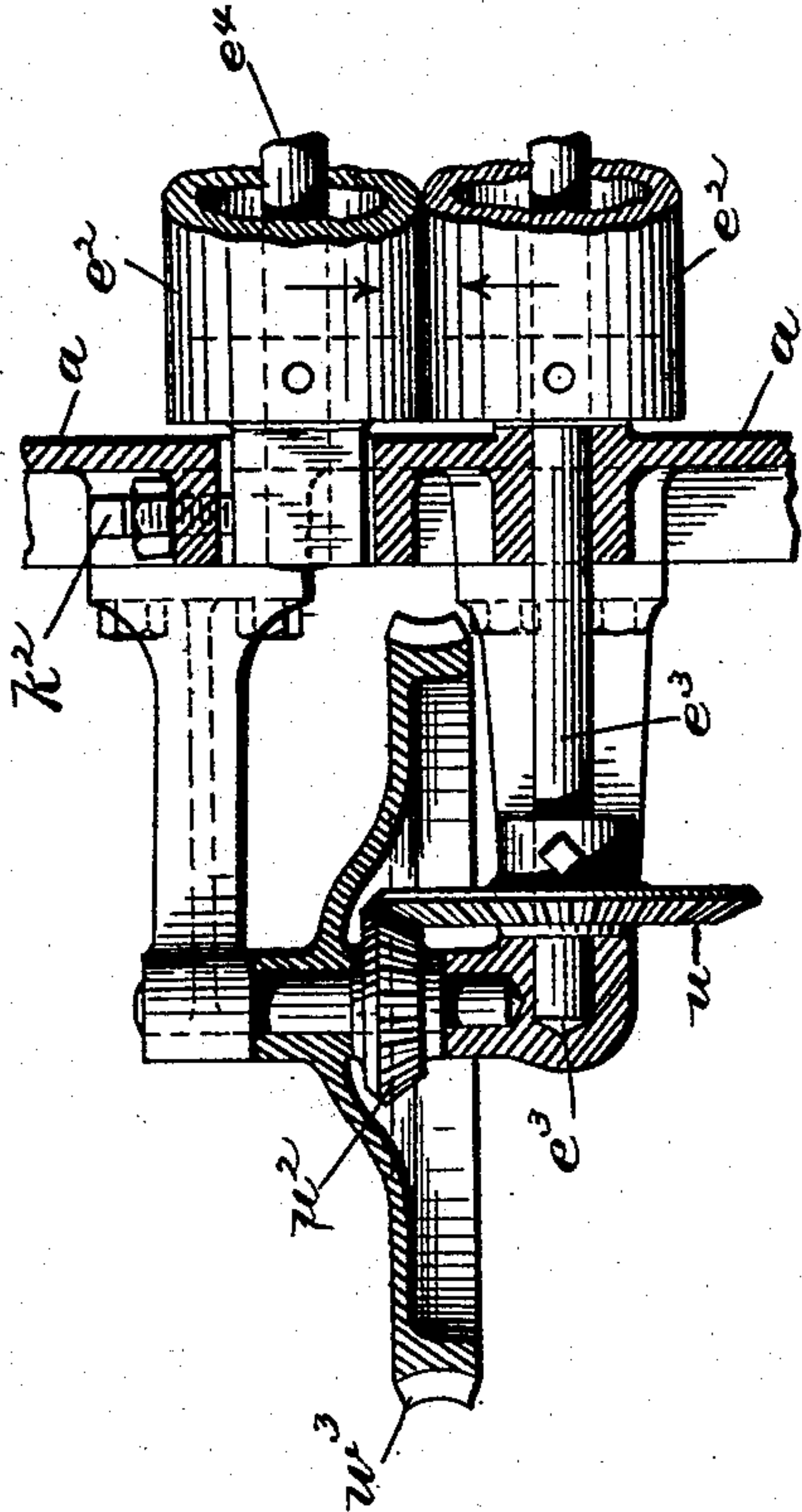


FIG. 18.

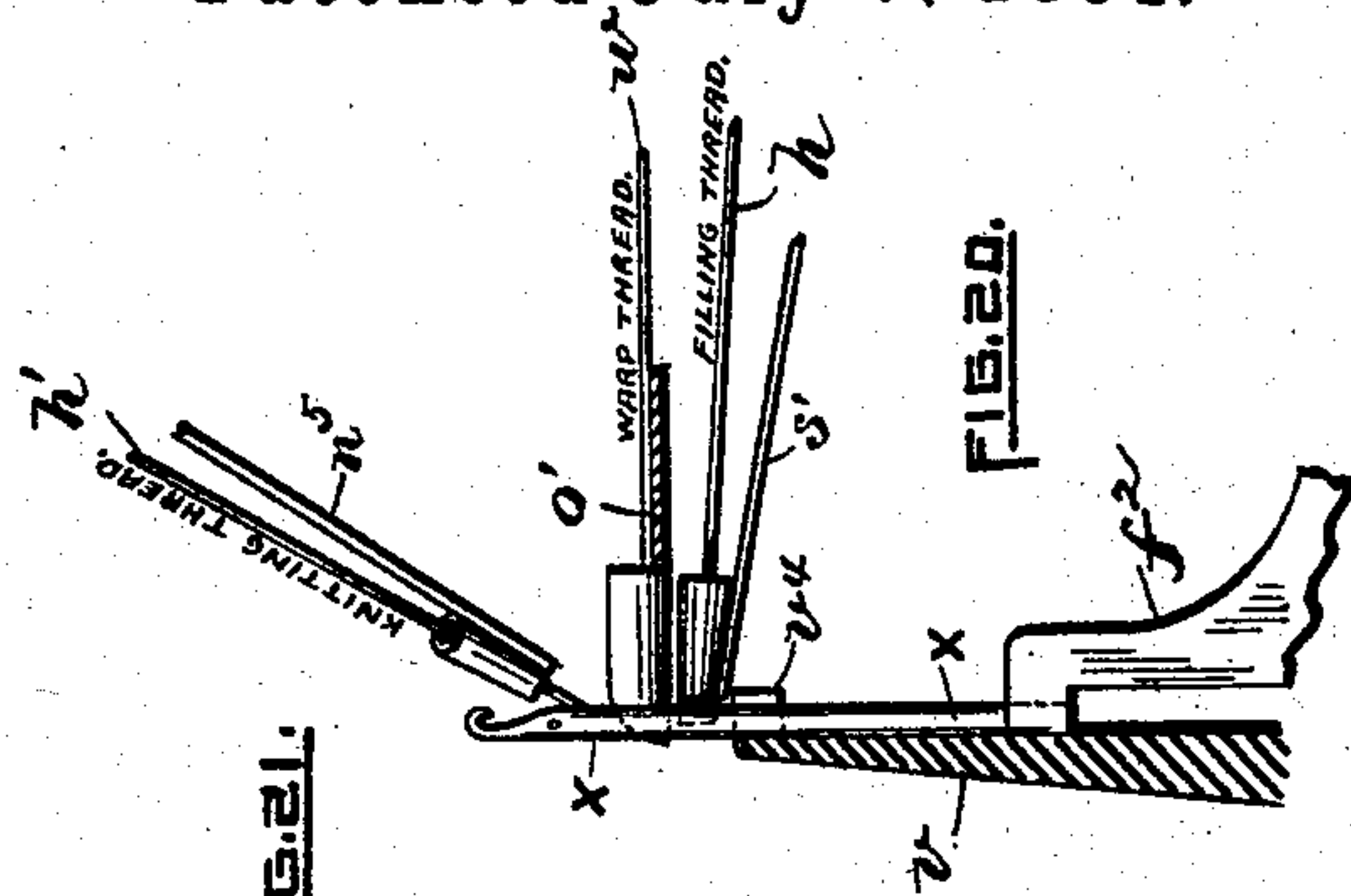


FIG. 20.

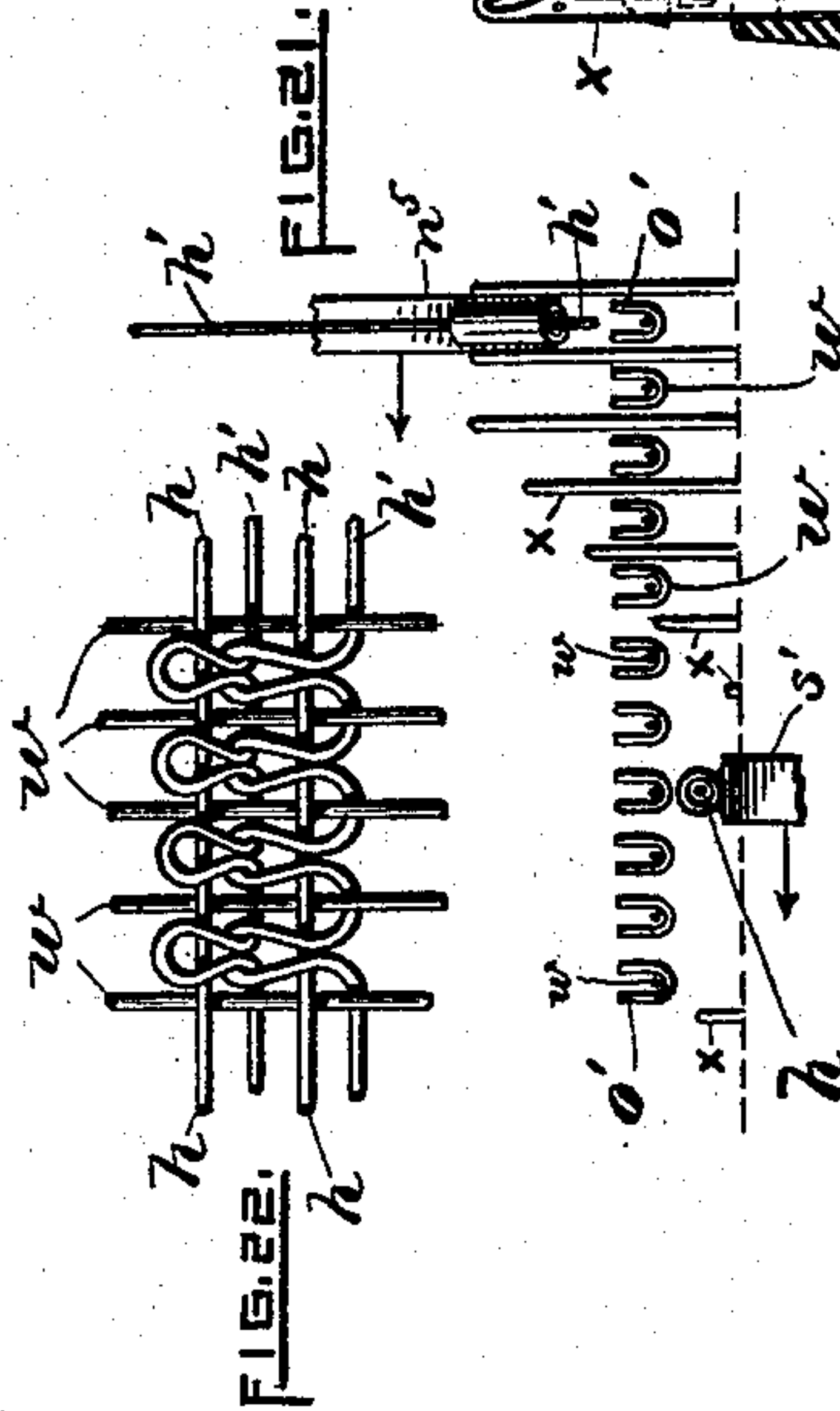


FIG. 21.

FIG. 22.

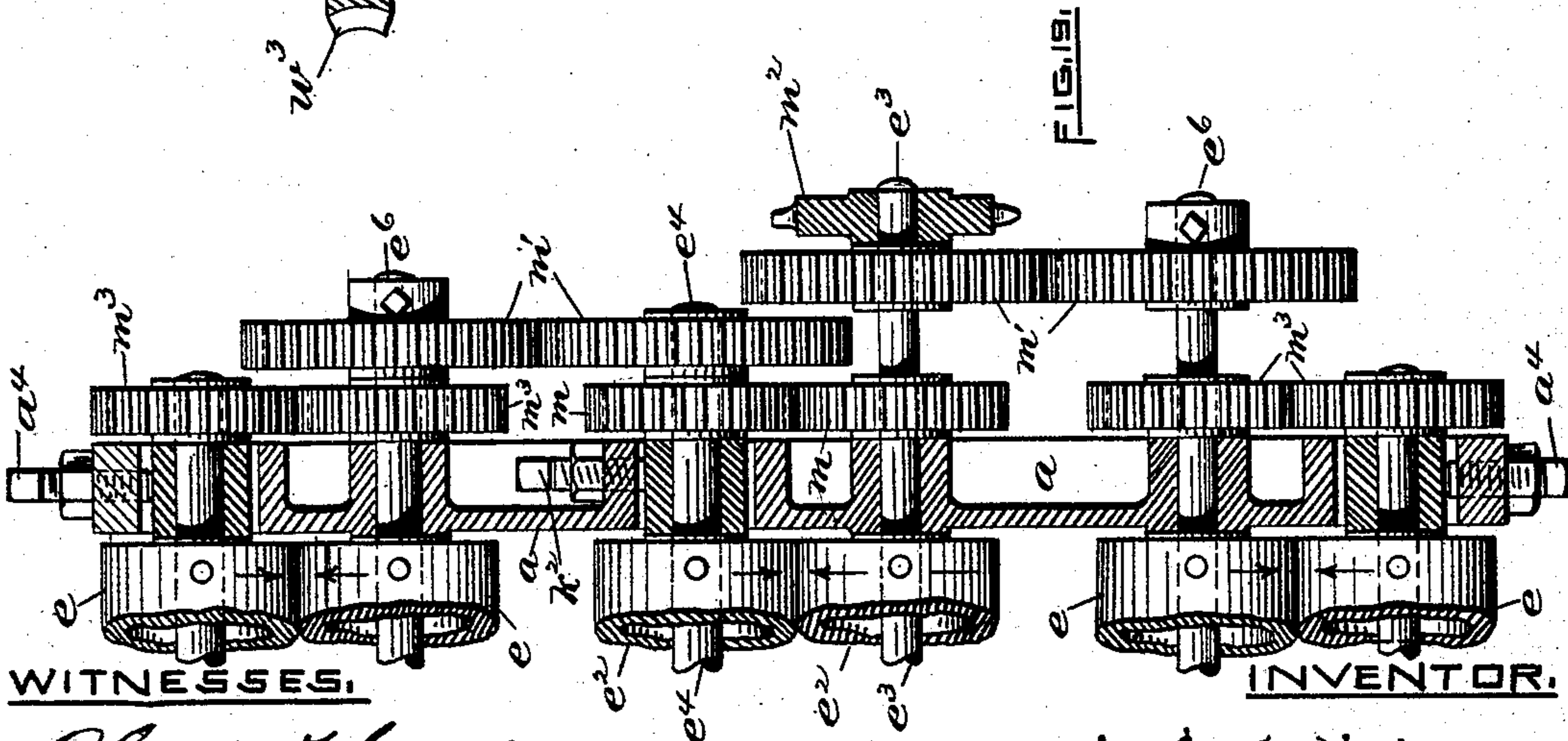


FIG. 19.

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UNITED STATES PATENT OFFICE.

LEVI E. SALISBURY, OF PROVIDENCE, RHODE ISLAND, ASSIGNOR TO HENRY A. CHURCH, OF SAME PLACE.

KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 455,464, dated July 7, 1891.

Application filed May 29, 1890. Serial No. 353,543. (No model.)

To all whom it may concern:

Be it known that I, LEVI E. SALISBURY, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Knitting-Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

In the production of knitted fabrics it has been usual heretofore to employ machines in which the needles are arranged around the peripheries of cylinders or "circular-knitting machines," as they are termed. In some instances the needles of such machines are reciprocated vertically by continuously-revolving cams. In others the cams are normally stationary and cylinders carrying the needles are caused to revolve. Sometimes, however, the needles have been arranged and mounted in fixed straight bars susceptible of adjustment. A knitting-machine having vertically-moving needles arranged in groups or series is shown and described in a United States patent granted to me September 11, 1883, No. 284,905. An objection to the fabric produced by that machine, as represented, as well as to fabrics knitted as usual on circular machines generally, is that the finished product or cloth possesses too much elasticity as compared with cloth woven on a loom in which the weft-threads are nearly straight. In the patented machine just referred to a series of continuously-traveling weft-threads are used, all of which are successively and consecutively looped around the warp-threads, the latter also being looped to a certain extent during the operation.

The object of my present invention is to produce a machine adapted and arranged to produce a knitted fabric having somewhat more than usual the qualities of woven fabrics.

To this end the invention consists, essentially, in the combination of mechanisms for actuating a series of vertically-reciprocating

needles arranged in groups or sections, a series of mounted and guided warp-threads, an upper series of suitably-guided continuously-traveling knitting or weft threads interlocking with each other and with the warp-threads, and a lower series of guided continuously-traveling straight filling or weft threads alternating with the first-named weft-threads and laid continuously along one side of the warp-threads.

It also consists in certain novel devices for simultaneously operating the two series of weft-thread carriers and other mechanisms for rendering the machine more efficient, all as will be fully hereinafter set forth and claimed.

In the accompanying five sheets of drawings, illustrating my improved knitting-machine, Figure 1, Sheet 1, is a side elevation, a portion being broken away or omitted. Fig. 2, Sheet 2, is a partial top view showing the upper series of mounted weft-threads. Fig. 3 is an enlarged vertical sectional view taken through the upper frame or table and carrier on line *xx* of Fig. 2. Fig. 4 is a partial top view of the same, a portion being broken away. Figs. 5 and 6 are respectively top and side views of one of the links forming the carrier. Fig. 7, Sheet 3, is a front end view of the machine, some of the driving mechanism being omitted. Fig. 8 is an end view, enlarged, of the front head or upper portion of the main frame, and showing the lower table in section or cut transversely through line *ll*, Figs. 1 and 10. Fig. 9 is a corresponding view of the back head, taken on line *zz* of Fig. 1. Fig. 10 is a broken vertical sectional view taken longitudinally of the machine through the two heads or ends. Fig. 11, Sheet 4, is an enlarged vertical sectional view taken transversely through the upper portion of the machine or on line *xx*, Fig. 1, and showing the relation of the weft-threads, needles, cams, &c. Fig. 12 is a side view of one of the longitudinal frames or ties which support the needle-bars and needle-actuating mechanism. Fig. 13 is an end view. Fig. 14 is a side view, in partial section, of the arrangement for vertically adjusting the needle-bar. Fig. 15 is a plan of the same and also showing in horizontal section a portion of the needle-bar. Fig. 16 is an enlarged

transverse sectional view showing the needle-bar, frame, cam, &c. Fig. 17 is a side view of a portion of one of the cam-carrying shafts, showing the manner of arranging the cams thereon. Fig. 18, Sheet 5, is an enlarged horizontal sectional view taken at the front of the machine on line *m m*, Fig. 1, showing the manner of actuating the "take-up" or friction rolls between which the fabric passes to the winder-roll. Fig. 19 is a similar horizontal view taken on line *o o*, Fig. 1, at the rear end of the machine, showing the tension devices for the warp-threads and said take-up rolls. Fig. 20 is an enlarged vertical sectional view showing the relation of the several threads to the needles, &c. Fig. 21 is a side view of the same; and Fig. 22 represents, enlarged, a piece of the fabric loosely knitted.

A description of my improved knitting-machine more in detail and the manner of its operation is as follows:

a a, referring to the drawings, Fig. 1, indicate the two end frames or standards, having any suitable form, or, as shown in Fig. 7, the frames are separated from each other longitudinally by a distance substantially the same as is required for the needles, or, in other words, corresponding with the length of the needle-bars. The frames are secured to and surmounted by a ribbed bed or table *b*, the ends being rounded similar to the frame *c*. (Shown by Fig. 2.) The bed is slotted longitudinally through its center, (see *b⁸*, Figs. 2 and 11,) the length of the slot being practically the same as the length of the needle-bars, to be described later on. As before stated, the machine is duplex or adapted to knit two pieces of fabric simultaneously, one on each side of the machine, the two pieces being connected at the edges. The fabric as produced passes down through the slot *b⁸* to and between the center friction or tension rolls *e²*.

c designates a top bed or table mounted directly over the bed *b*. The upper bed is substantially the same as the lower one both in form and construction, except that it has a much larger slotted opening *b⁹* formed through its center portion.

The two beds are vertically separated a suitable distance and are each provided with laterally-extending lugs or ears, through which combined supporting and tie rods *t* pass vertically, nuts *t⁸* serving to bind the whole together. Each bed is provided on top with an open continuous groove *i*, having inwardly-extending flanges or projections. Each groove is adapted to serve as a guide for the chain which carries its respective series of knitting or weft threads, the said flanges at the same time acting as a guide laterally and preventing the chain from rising out of the groove. The chain itself as drawn is composed of a series of blocks or units *n*, provided with teeth arranged segmentally. The several units are connected by links *l²*, so arranged that the chain is ren-

dered flexible and endless. The units are flush with or project a short distance above the top of the guide-flanges, so as to receive the weft-thread carriers.

At the front end of the machine a short driving-shaft *d* is mounted immediately below and centrally with the lower bed *b*, the shaft being driven by a belt *b²*, passing over a clutch-pulley *p*, suitably mounted on the shaft. The pulley may be made as common—that is, the pulley proper is loose upon the shaft. A clutch member is splined to the latter, having a head or rim arranged to engage frictionally the pulley upon forcing the clutch member endwise, thereby causing the shaft to revolve in unison with the pulley. A bevel-gear *g* is also mounted on the shaft, which intergears with a gear secured to the lower end of the vertically-mounted shaft *t²*. This latter shaft extends above the upper bed *c*, and has secured thereto a gear-wheel *g²*, which, through the medium of an intermediate wheel *g³*, Figs. 1, 4, &c., engages and actuates the upper carrier-chain. A similar arrangement of gears *g¹*, having the same diameters, simultaneously operates the lower carrier-chain. To the last-named chain are secured the bobbin holders or carriers *s*. These bobbins have a yarn-load consisting of filling or weft threads *h*, which are introduced to the back side of the needles *x* and at the under side of the warp-threads *w* and extend around the fabric in a practically straight line—that is, without looping or without interlocking with the other threads. The bobbins do not revolve on their axes, the yarn being simply drawn off through guides at the top of the carriers, which lead it to the needles. A substantially similar arrangement is employed for the upper series of bobbins, which carry the interlocking or knitting threads *h¹*, the corresponding carriers *n²* guiding these threads singly from the upper ends of the bobbins to a guide tube or plate *n⁵*, adjustably secured by screws *n⁶* to a depending arm *n³*, attached to the lower portion of the carrier-frame (see Fig. 11) and over the warp-threads.

Intermediate of the two series of continuously-traveling threads *h h¹* just described are mounted at each side of the machine grooved warp-plates *o¹*, these plates being attached to studs *o*, secured to and depending from the under side of the upper bed *c*. The yarn or warp threads *w* are wound upon oppositely-arranged beams, whose axles *w¹* are supported in open bearings formed in the lower portion of the end frames *a*. (See Fig. 7.) The warp-yarn in its passage to the guide-plates *o¹* passes through a let-off device, (see Figs. 7 and 19,) wherein at each side of the machine are shown mounted a pair of oppositely-revolving rolls *e* of equal diameters positively driven by a gear-train *m¹ m³*. The axles of the outer rolls are mounted in boxes susceptible of lateral adjustment by means of the adjusting-screws *a⁴*, thereby enabling the at-

tendant readily to adjust the rolls to receive any size or number of yarn. As thus drawn it will be seen that the warp-yarn w passes from the beam around the inner or rear roll 5 and down between it and the front roll, then around the under and front sides of the front roll, thence upwardly and over a stationary guide-rod r , mounted in bearings r' , secured to the ties t , and finally into the warp-plates 10 o' to the needles.

Motion is imparted to the gears m' , Figs. 1, 19, &c., by means of a worm w^2 , (secured to the driving-shaft, Fig. 1,) which meshes with a toothed wheel w^3 , mounted on a stud or 15 short shaft, Fig. 18, carrying a bevel-gear w^2 , gearing with a larger gear u , secured to a shaft e^3 , extending lengthwise of the machine. This shaft projects some distance beyond the rear frame a , Fig. 19, and carries one of the said 20 gears m' , which engages a similar gear secured to a shaft e^6 , carrying the inner friction-roll e . A gear m^3 , also secured to this last-named shaft, actuates the front roll by means of a similar gear m^3 , secured to its shaft. The other pair 25 of friction-rolls e are driven by a gear m , secured to the said shaft e^3 , Fig. 19, which gears with a similar gear m , secured to a parallel shaft e^4 , also carrying a gear m' , which meshes with another one secured to the other inner 30 roll's shaft e^6 , the latter having a gear m^3 , engaging a similar gear secured to the front roll's shaft. By this means the several rolls are operated simultaneously and at the same relative velocities.

The draft or tension upon the fabric may be effected to a certain extent by a lateral adjustment of the shaft e^4 , although practically such adjustment of the shaft is mainly for the purpose of receiving between the pair of 40 rolls e^2 fabrics having different thicknesses. These rolls are secured to the said shafts e^3 e^4 and revolve in opposite directions by gear-wheels m . One of these rolls e^2 , Fig. 18, the one secured to the shaft e^4 , is adapted to lateral 45 adjustment by means of set-screws k^2 . The other shaft e^3 is provided at its rear end with a sprocket-wheel m^2 , which by means of a link belt l^5 and a sprocket-wheel l^6 , secured to the arbor of the take-up roll, Fig. 1, transmits a 50 rotary movement to the roll f , thereby winding the fabric upon the beam-roll.

The devices for operating the needles may be described as follows, although I make no claim herewith to the mechanism therefor by 55 itself: At the front and back ends of the machine are mounted short vertical frames or heads $a' a^2$, respectively, (see Sheets 3 and 4 of the drawings,) the frames being rigidly secured to the lower bed b and standards a . The 60 two ends $a' a^2$ are united by two longitudinal frames a^4 , bolts a^6 serving to hold the parts together. These frames are arranged right and left and are separated transversely a short distance, or, say, equal to the width b^8 65 of the lower bed's opening. Along the lower inner edge of each frame a^4 is formed a rectangularly-shaped groove a^{10} , into which is fit-

ted a similarly-shaped bar y . The bars are provided with inclined openings v^2 , extending transversely through them. The rear ends 70 of the bars are tapped to receive each a short screw-threaded shaft y' , Fig. 14, which passes freely through a corresponding hole y^4 , formed in the rear head a^2 . To the inner face of each frame a^4 is secured by bolts a^8 a needle-bar v , 75 said bolts passing through slots a^9 , formed in the frames, and being tapped into the needle-bars. In the inclined openings v^2 of the bars y are arranged short tongues v' , secured to the needle-bars, the same being fitted into the 80 said openings. By means of this construction it is obvious that by turning the screw y' (first loosening the bolts a^8) the needle bars or plates v may be given a vertical adjustment. The object of adjusting the needle- 85 bars is to regulate or vary the length of the loops or stitches—i. e., elevating the bar causes the needles to shed longer stitches, and vice versa. The upper front edge portion of each bar v is grooved, as at v^4 , Fig. 20, to receive 90 the needles x , the latter being secured each to a cam-frame f^2 , adapted to travel up and down between the face of the needle-bar and the inner face of the flange z , secured by bolts 95 z' to the frame a^4 . The latter frames are bored or turned at a^7 , so as to serve as bearings for the series of washers or collars k^4 . Concentric with the bearings are arranged the cam-shafts l , which extend longitudinally 100 of the machine, and are mounted to revolve in the two end frames $a' a^2$. To these shafts l are secured series of spirally-arranged cams k^3 , one for each cam-frame. The washers k^4 are also fast upon the cam-shafts. The cams k^8 just referred to are clearly represented in Figs. 105 16 and 17. In the latter figure the spiral line indicates the arrangement of the cams, one complete revolution or helix forming a series or group, (see g^6 ,) to each of which groups or sections should be added a knitting-thread 110 guide n^5 and a filling-thread guide s' . As drawn in said Fig. 17, the section g^6 may be, say, three inches in length and include eighteen cams. Therefore the warp-threads w and needles would be six per inch, the sections 115 being repeated every three inches throughout the length of the needle-bars. The cams and cam-frames are constructed and arranged and adapted for operation substantially as shown and described in my patent, No. 284,905, here- 120 inbefore referred to. Motion is imparted to the two cam-shafts l simultaneously by a gear d^2 , secured to the driving-shaft d , from which gear, through the medium of intermediate gears d^3 , (shown by broken lines, Fig. 8,) the 125 two intergearing wheels d^4 , secured to the front ends of the cam-shafts, are revolved in opposite directions.

Now, in order to produce the fabric shown (enlarged) in Fig. 22, it should be borne in 130 mind that the several straight filling-threads h are introduced at the back of the needles and below the warp-threads in advance of the several upper or knitting threads h' , the lat-

ter being introduced at the front of the needles and above the warp-threads. These threads h' are looped into or interlock with each other and with the several warp-threads w , substantially as shown in said figure. Fig. 21 shows the relation of the threads $h h'$ to each other for one series or section. (See arrow direction also.) By this it will be seen that the knitting-threads are looped singly into each other, then passed between and around the warp-threads and over the filling-threads to hold the latter in place.

I claim as my invention—

1. A knitting-machine having the needles arranged in a series of groups or sections, mechanism, substantially as described, consisting of two parallel oppositely-revolving shafts having secured thereon a multiple series of spirally-arranged cams and washers alternating with the cams, and guided cam-moving frames secured to the needles for simultaneously operating the said needle-sections, stationary guides arranged to introduce warp-threads to the needles, a continuously-traveling guide for each needle-section arranged to introduce a knitting-thread above the warp-threads, and similarly traveling guides adapted to introduce to each needle-section a filling-thread below the warp-threads, substantially as hereinbefore set forth.

2. The combination of a line of needles, a revolving cam-shaft, cams spirally arranged in groups or sections around the cam-shaft and secured thereon, cam-frames connected with the needles arranged to be actuated by the cams, fixed washers alternating with and revolving in unison with the cams, stationary guides arranged to introduce warp-threads to the needles, a continuously-traveling guide for each needle-section arranged to introduce a knitting-thread above the warp-threads, similarly-traveling guides adapted to introduce to each needle-section a filling-thread below the warp-threads, and feeding and take-up mechanisms, substantially as hereinbefore set forth.

3. A knitting-machine provided with needles operating in multiple groups or sections by means of two oppositely-revolving shafts,

having secured thereon a corresponding number of sections of spirally-arranged cams and washers alternating with the cams, cam-actuated frames secured to the needles, stationary guides arranged to introduce warp-threads to the needles, a traveling guide for each section carrying and introducing a knitting-thread above the warp-threads, a traveling guide for each section carrying and introducing a filling-thread below the warp-threads and in advance of the said knitting-thread, mechanism for continuously feeding the warp-threads, and mechanisms for controlling the tension of the fabric and winding it upon a roll, substantially as set forth.

4. A knitting-machine having two laterally-separated straight lines of needles, stationary guides arranged to introduce warp-threads thereto, mechanism, substantially as described, for operating the needles in groups or sections, a traveling upper endless chain carrying a series of yarn-guides, as n^5 , a traveling lower endless chain carrying a similar series of yarn-guides, as s' , and mechanism for actuating the said chains in unison, the last-named guides being arranged to travel in advance of the upper guides, substantially as and for the purpose specified.

5. A grooved needle-bar having needles mounted to travel therein, a slotted lower bar connected with said needle-bar, provided with a screw for adjusting the height of the latter bar, and cam frames or jacks attached to the needles, in combination with a revolving cam-shaft, cams secured thereto, spirally arranged in continuous groups or sections adapted to engage and actuate the cam-frames, washers or collars k^4 , secured to the cam-shaft alternately with the cams, and a supporting-frame arranged to engage the peripheries of said collars to form a bearing therefor, substantially as hereinbefore set forth.

In testimony whereof I have affixed my signature in presence of two witnesses.

LEVI E. SALISBURY.

Witnesses:

CHARLES HANNIGAN,
GEO. H. REMINGTON.