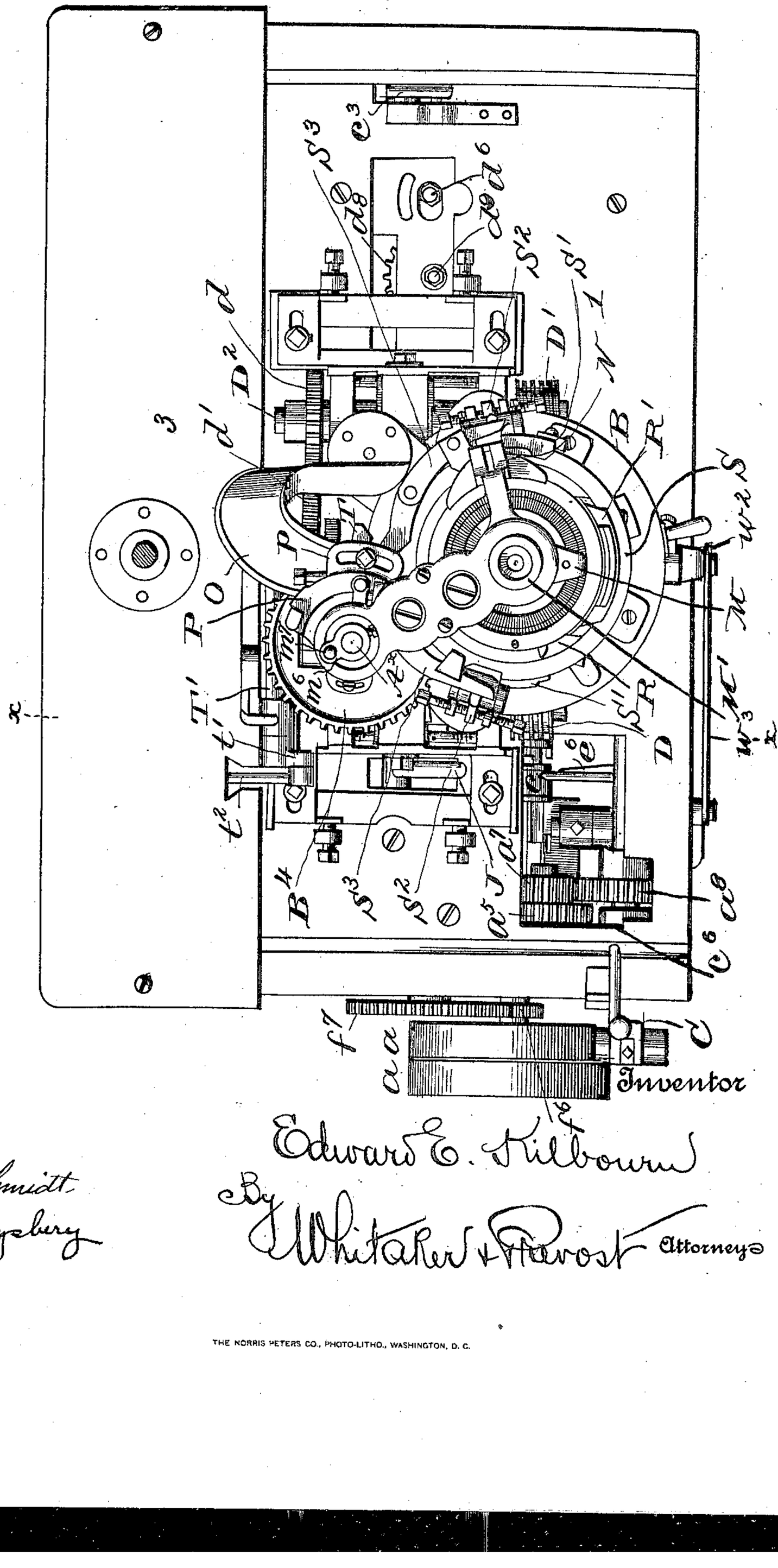
No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(Application filed May 4, 1896. Renewed July 11, 1899.)

(No Model.) 24 Sheets—Sheet 1.



No. 679,281. Patented July 23, 1901.

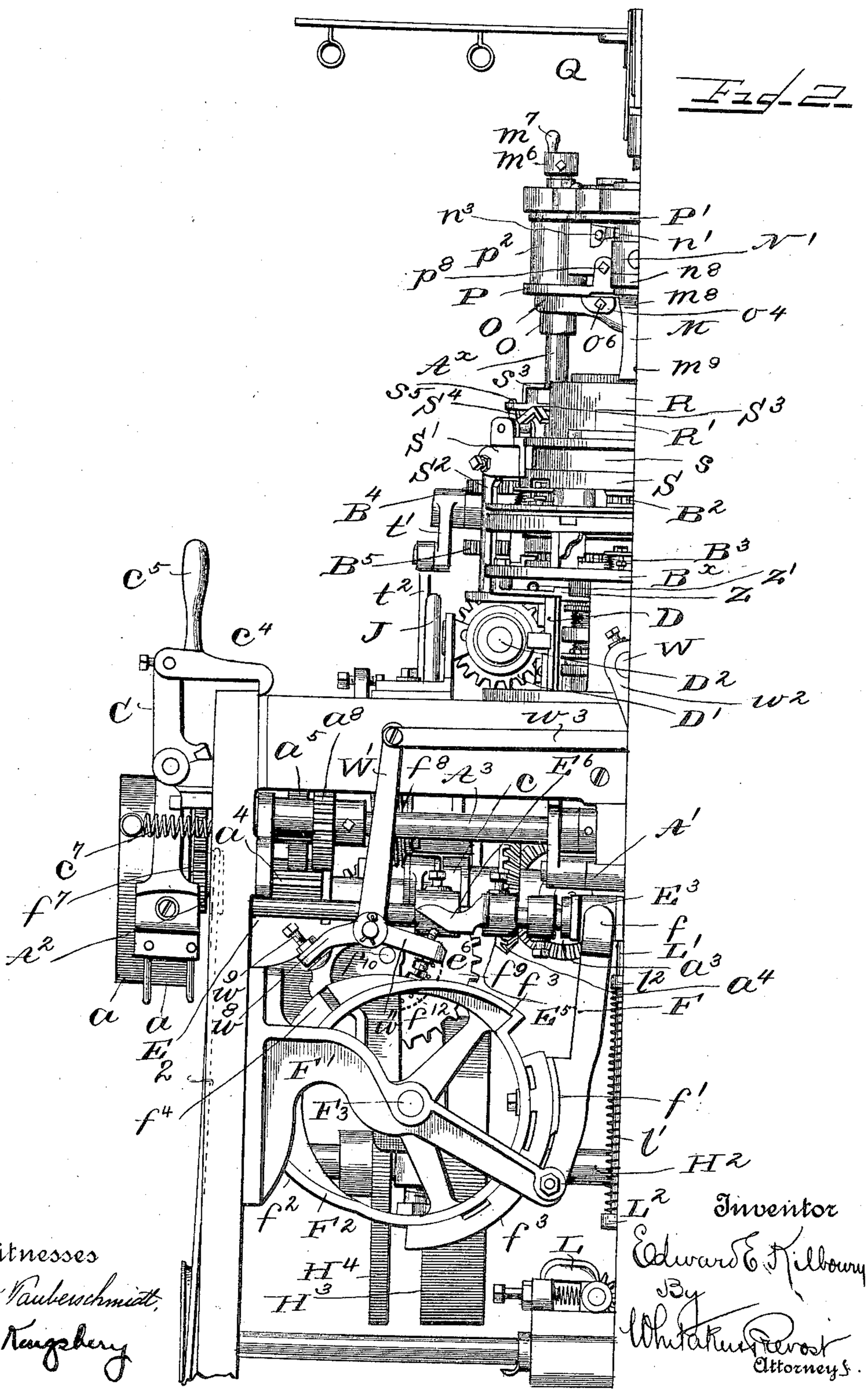
E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 2.

Fig. 2.



No. 679,281. Patented July 23, 1901.

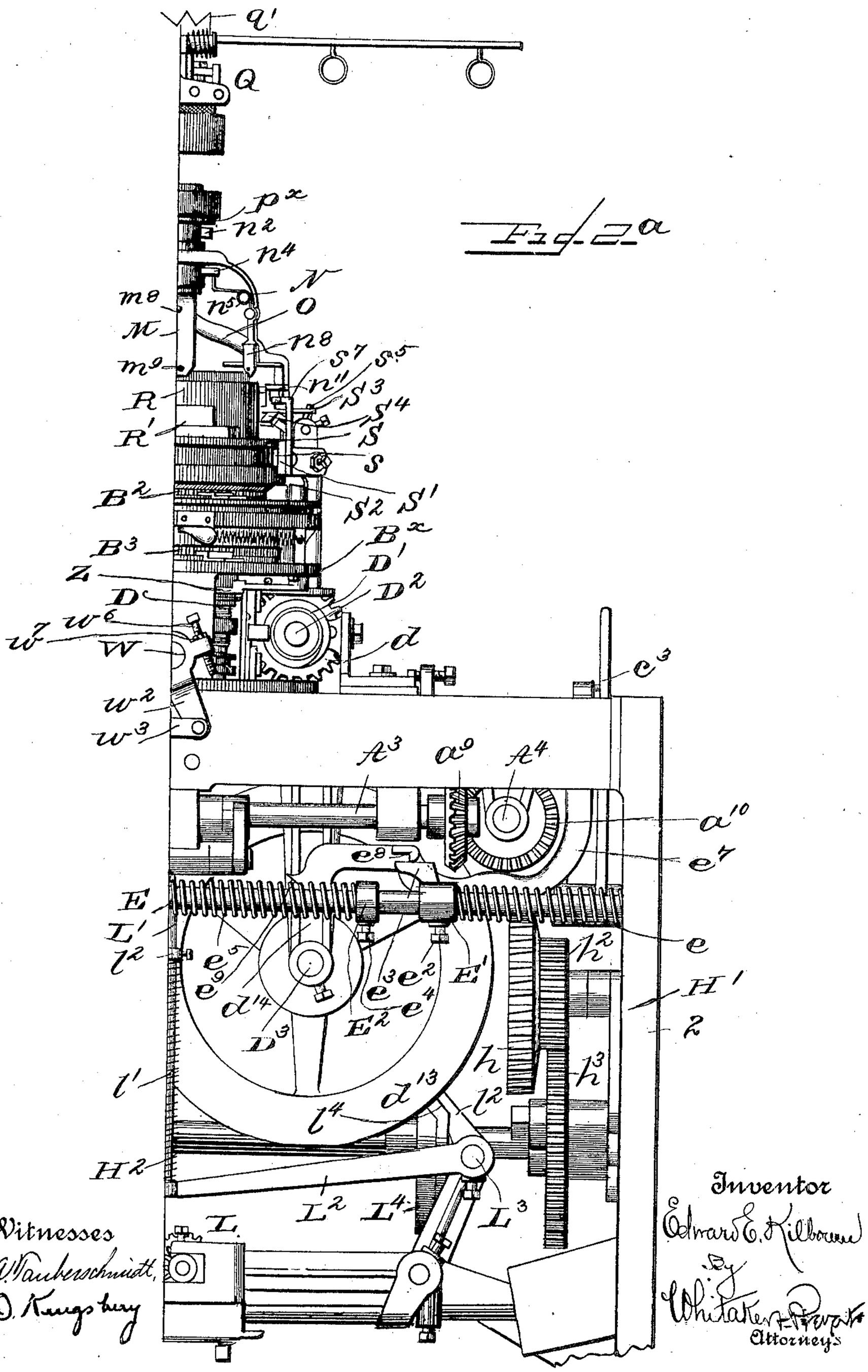
E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 3.

Fig. 2a



Witnesses
G. A. Tauberschmidt,
D. O. Kingsbury

Inventor
Edward E. Kilbourn
By
Whitaker & Pierpont
Attorneys

No. 679,281. Patented July 23, 1901.

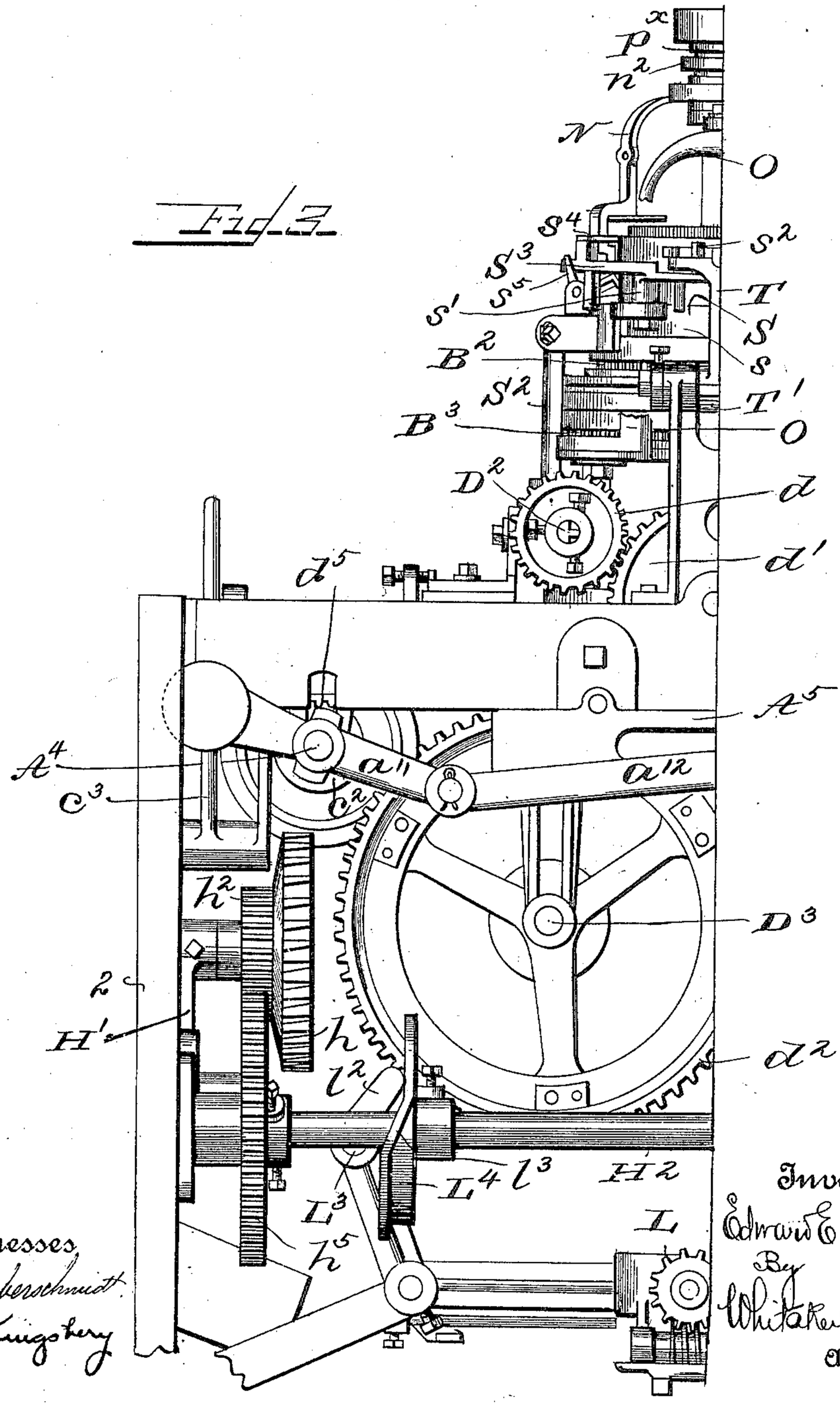
E. E. KILBOURN.

KNITTING MACHINE.

(Application filed May 4, 1896. Renewed July 11, 1899.)

(No Model.) 24 Sheets—Sheet 4.

Fig. 3.



Witnesses,
G. A. Tauberschmidt
L. D. Knigsbery

Inventor
Edward E. Kilbourn
By
Whitaker & Prevost
Attorneys

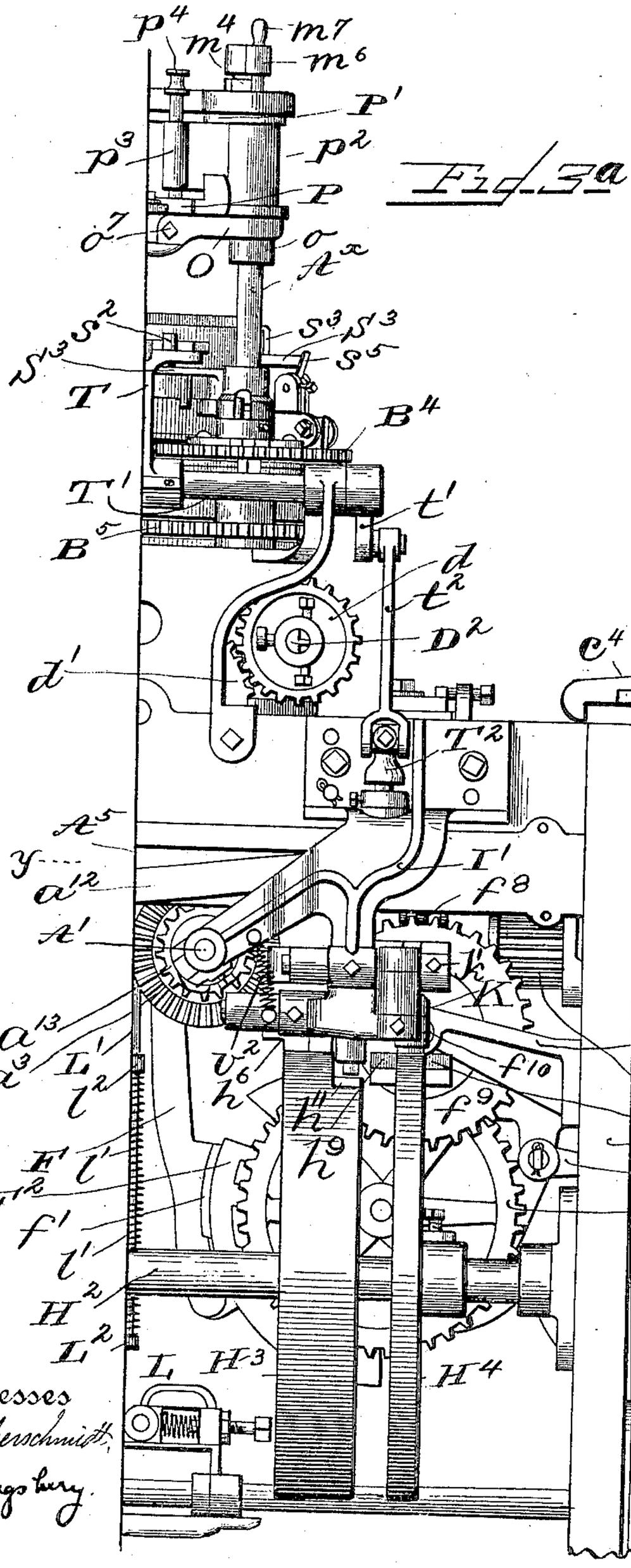
No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 5.



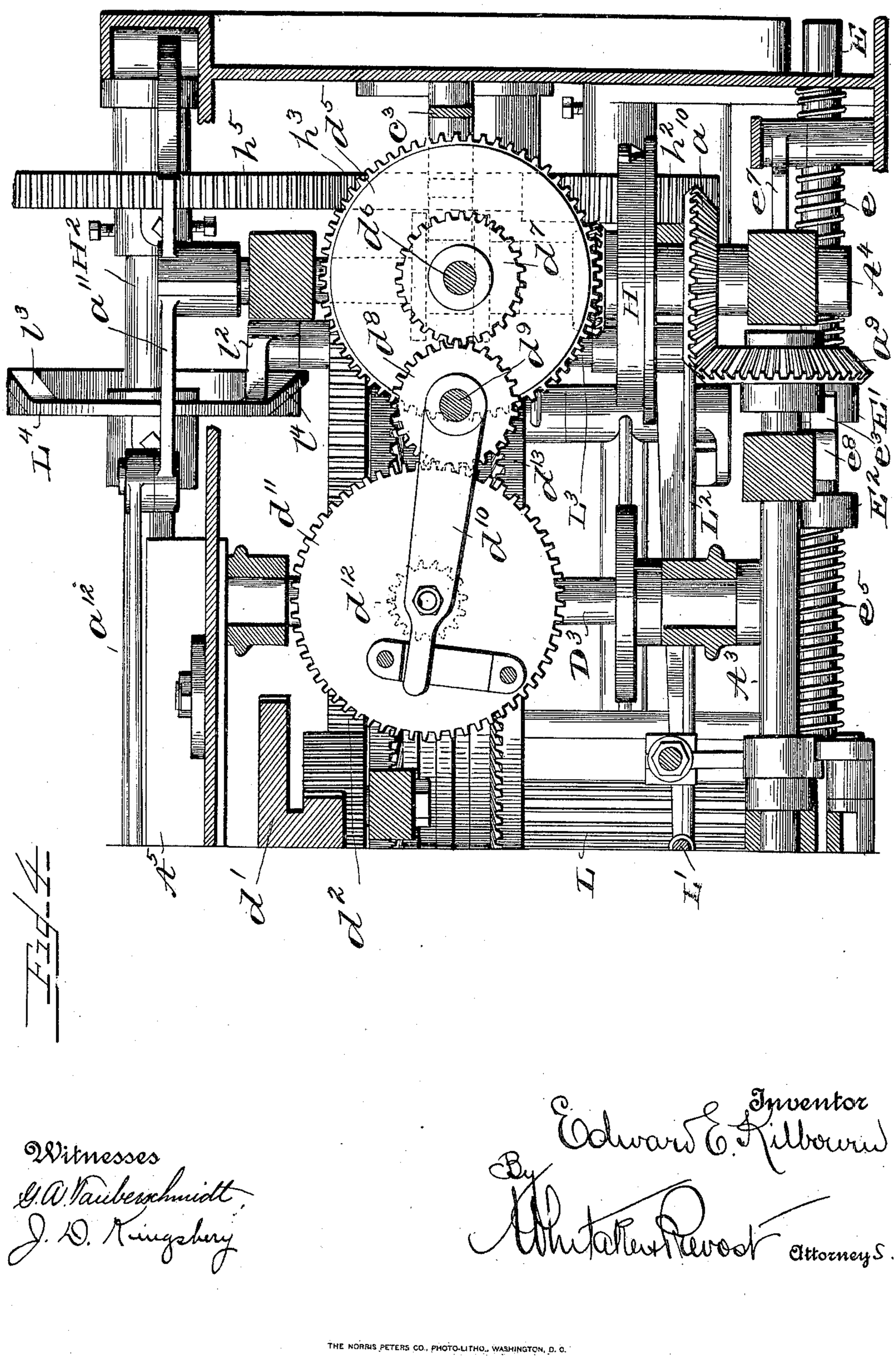
No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(Application filed May 4, 1896. Renewed July 11, 1899.)

(No Model.) 24 Sheets—Sheet 6.



Witnesses
G. A. Taubenschmidt.
J. D. Ringsbery

Inventor
Edward E. Kilbourn
By Whittemore Wood Attorneys.

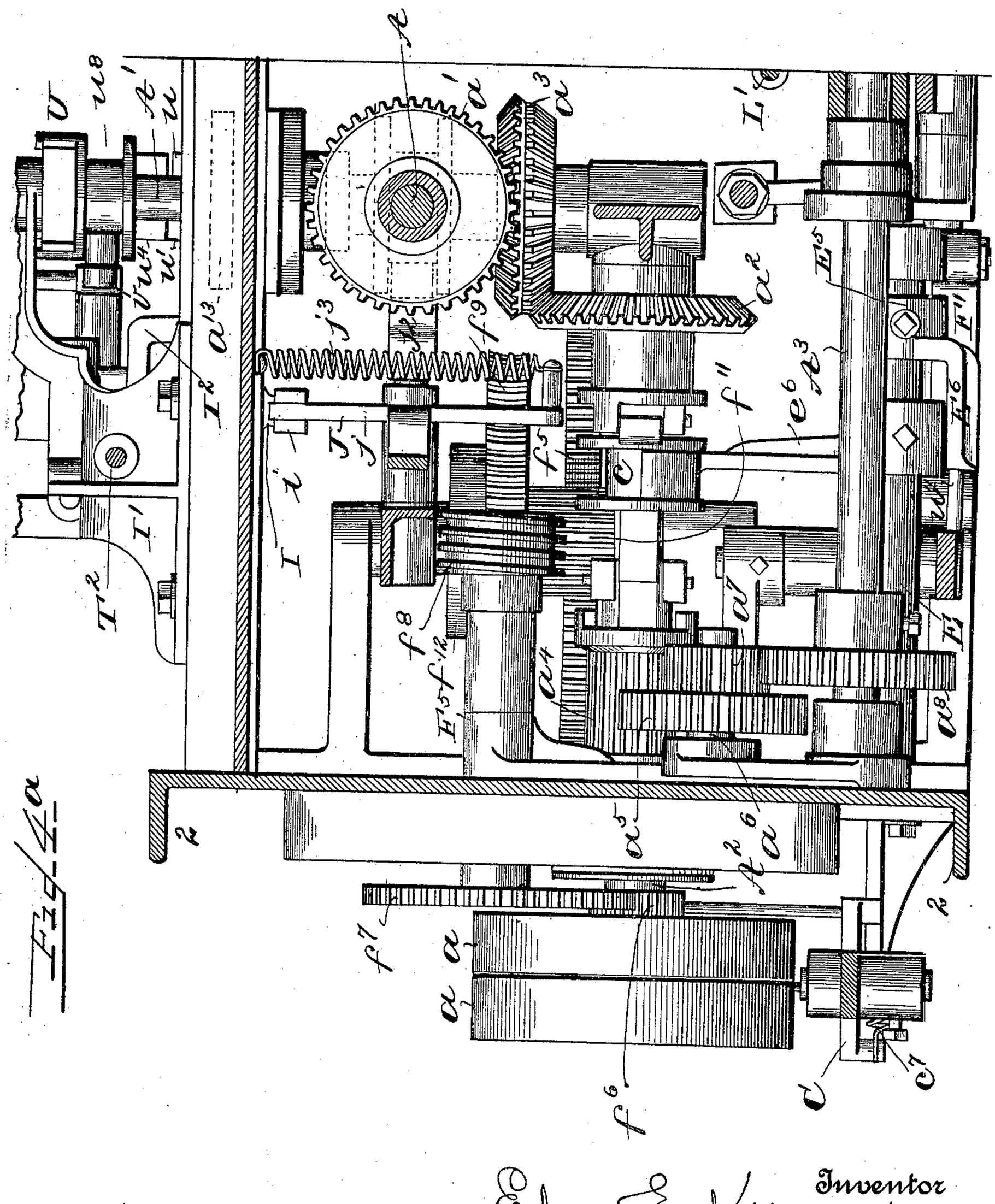
No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 7.



Witnesses
G. A. Taubenschmidt,
J. D. Kingsbury.

Inventor
Edward E. Kilbourn
By Whittemore & Prevost
Attorneys

No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 8.

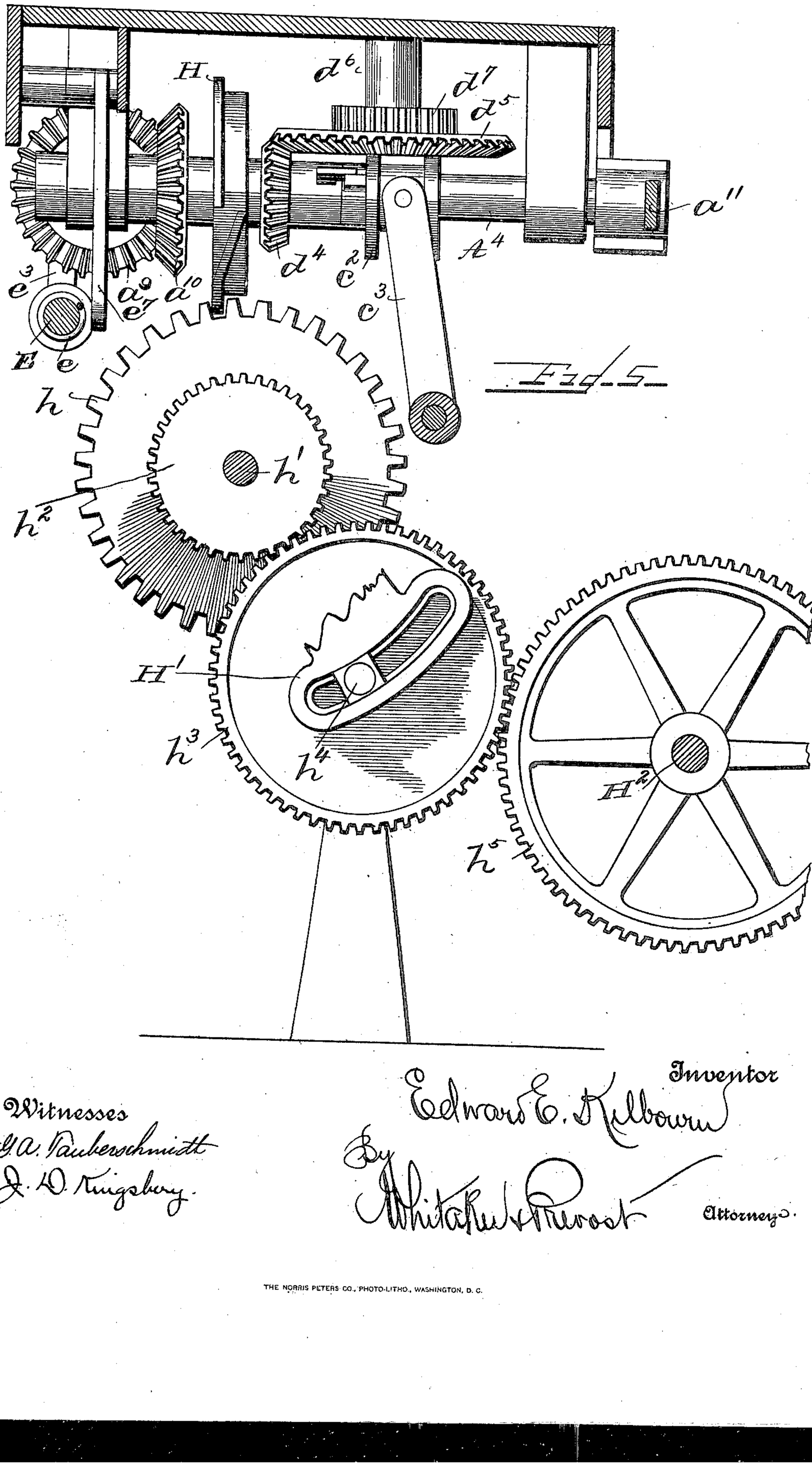


Fig. 5.

Witnesses
G. A. Tauberschmidt
J. D. Kingsbury.

Inventor
Edward E. Kilbourn
By Whitaker & Wright
Attorneys.

No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 9.

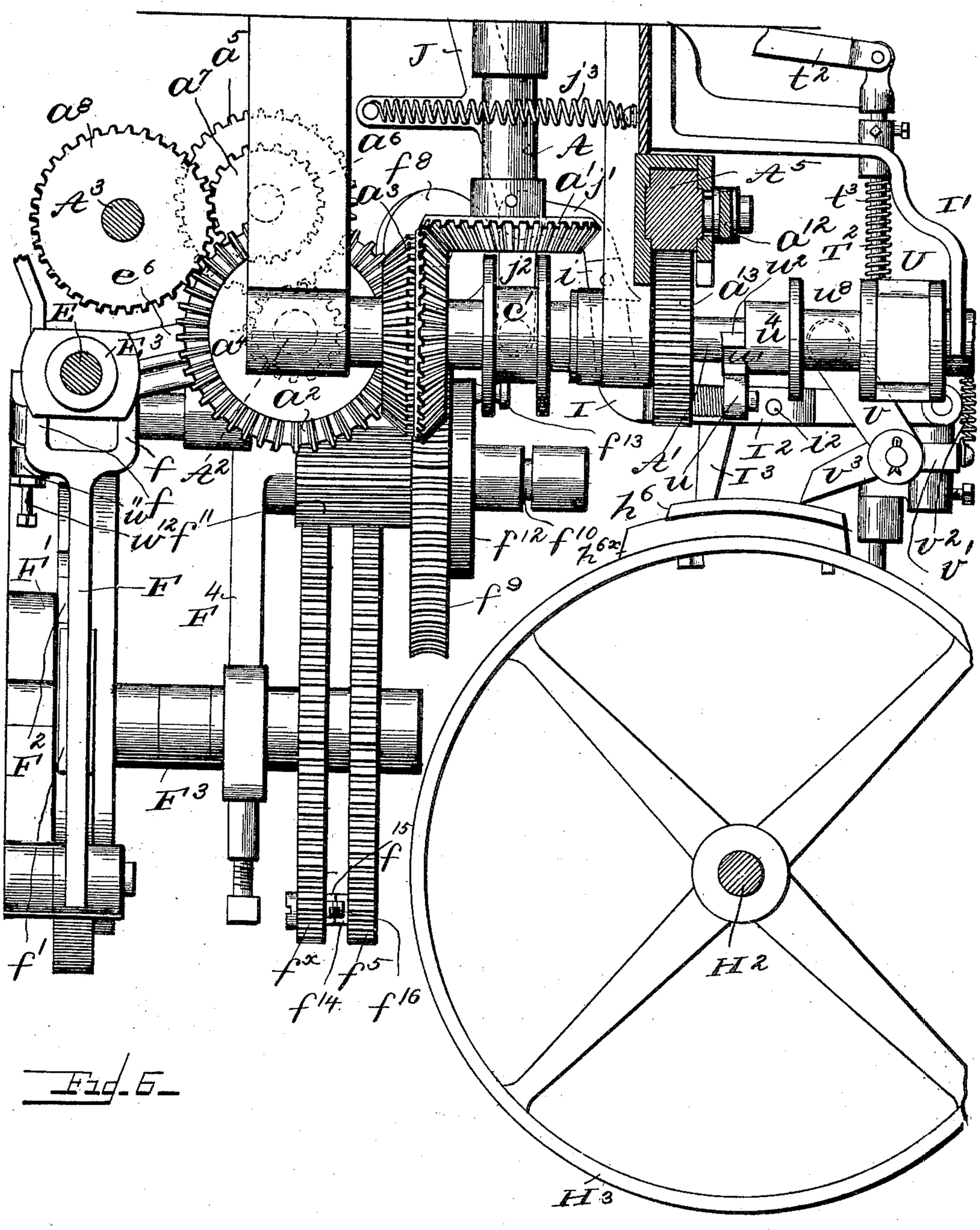


Fig. 6.

Witnesses
G. A. Tauberschmidt.
L. D. Kingsbury.

Inventor
Edward E. Kilbourn
By Whittaker & Prevost
Attorneys.

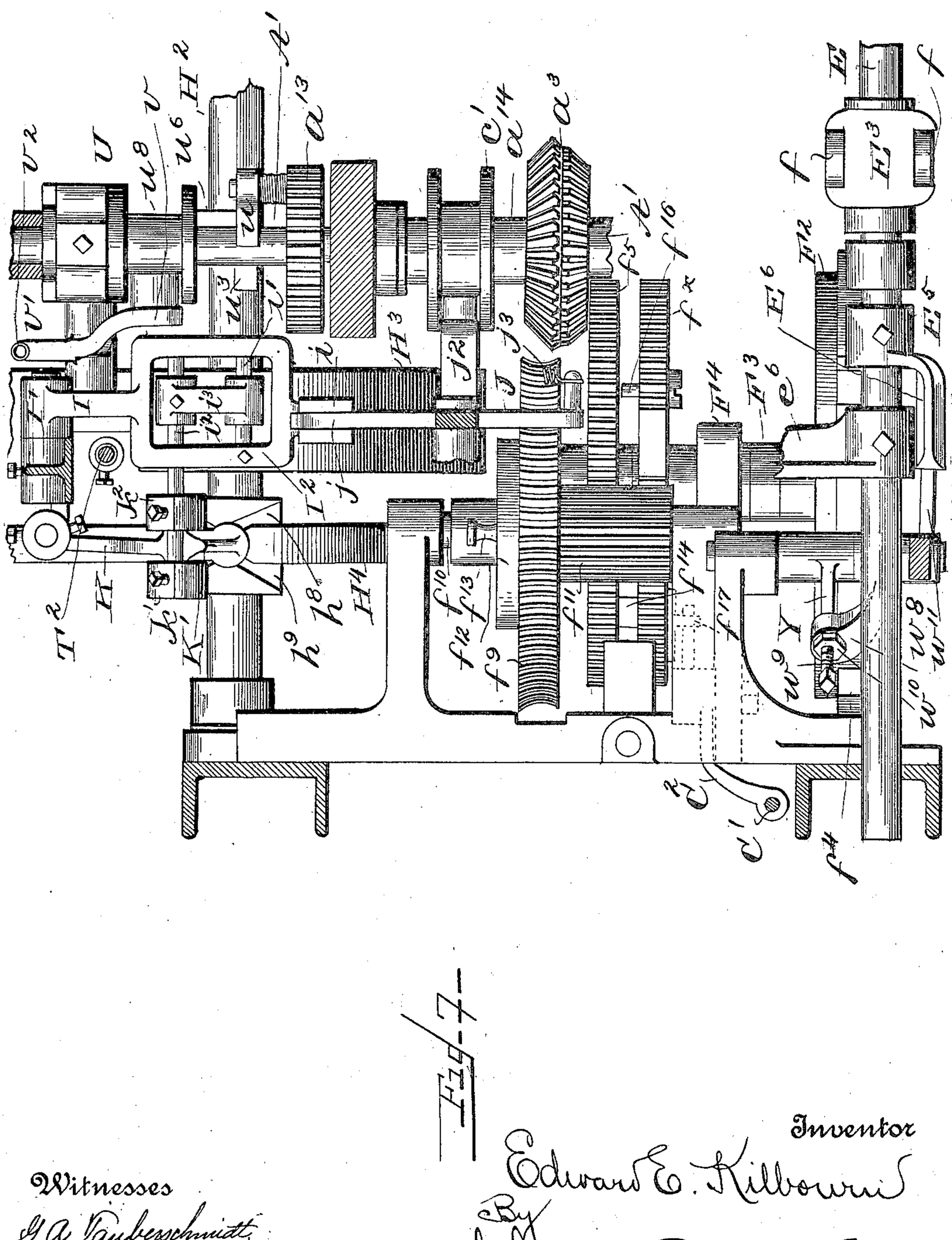
No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(Application filed May 4, 1896. Renewed July 11, 1899.)

(No Model.) 24 Sheets—Sheet 10.



Witnesses
G. A. Taubeschmidt.
J. D. Kingsbury.

Inventor
Edward E. Kilbourn
By Whitaker & Frost Attorneys

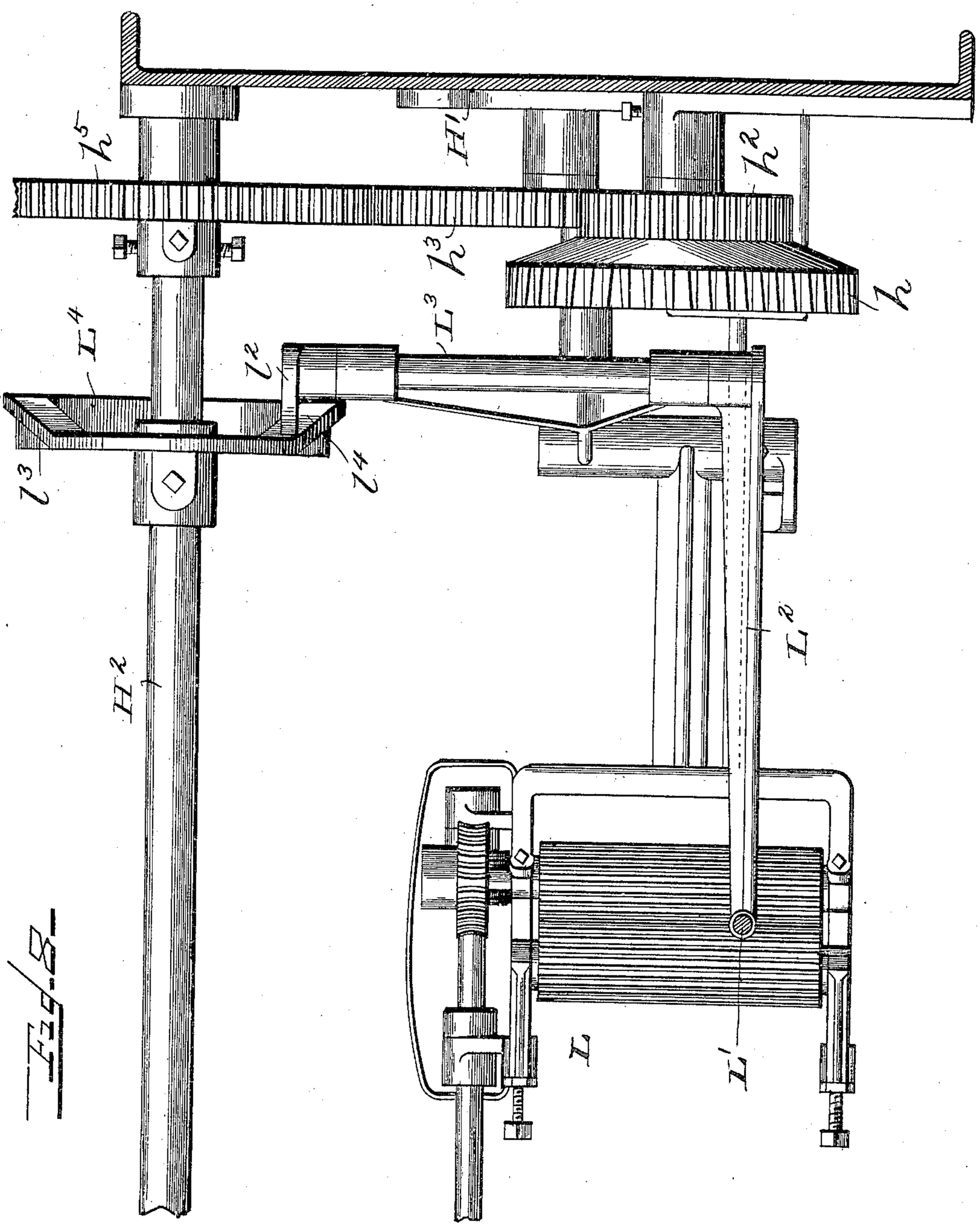
No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 11.



Witnesses
G. A. Faiberschmidt,
J. D. Kingsbury.

Inventor
Edward E. Kilbourn
By Whitaker & Pierce
Attorneys

No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 12.

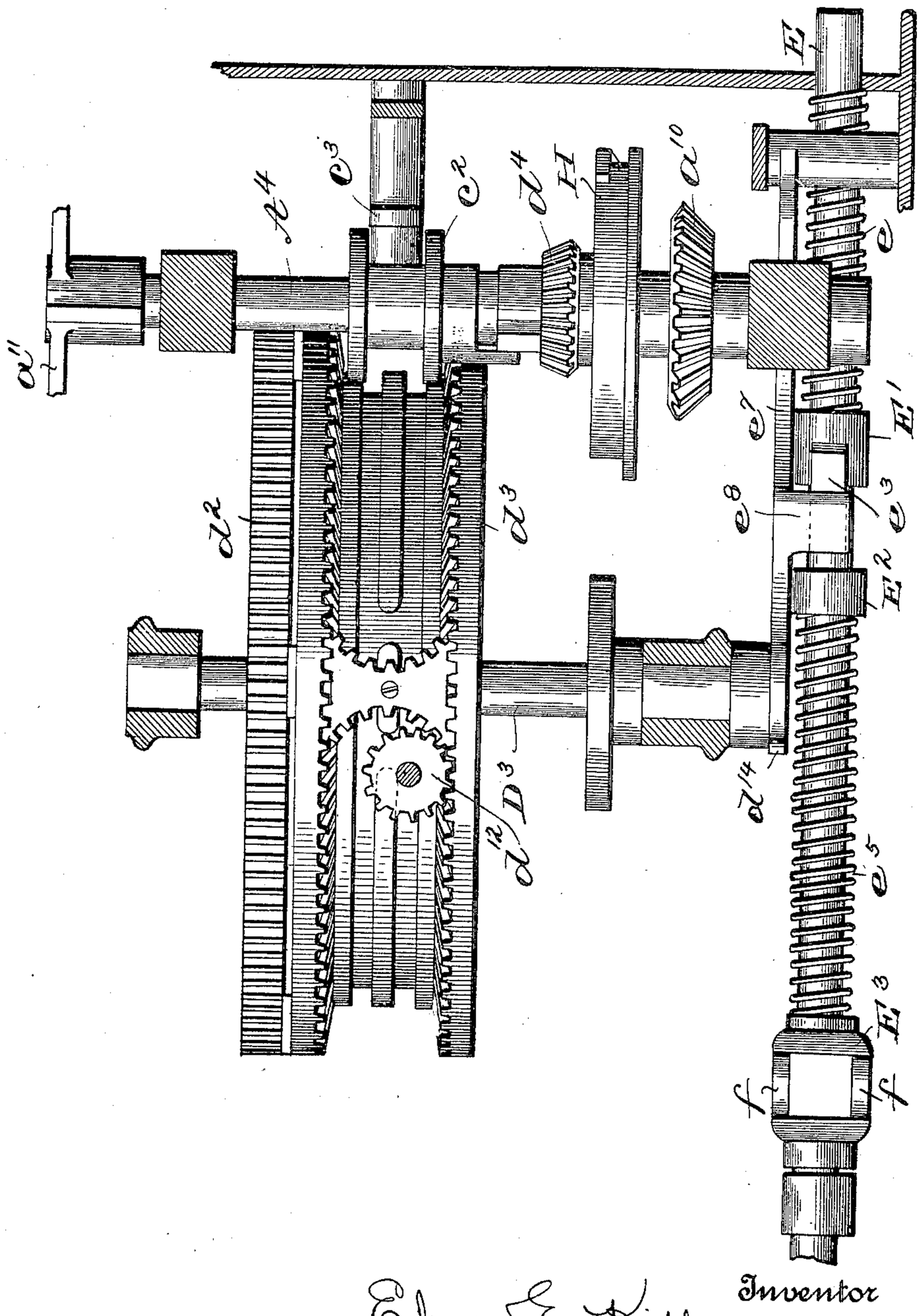


FIG. 5.

Witnesses
G. A. Tauberschmidt,
J. D. Humphrey.

Inventor
Edward E. Kilbourn
By Whitaker & Prevost
Attorneys

No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 13.

Fig. 10.

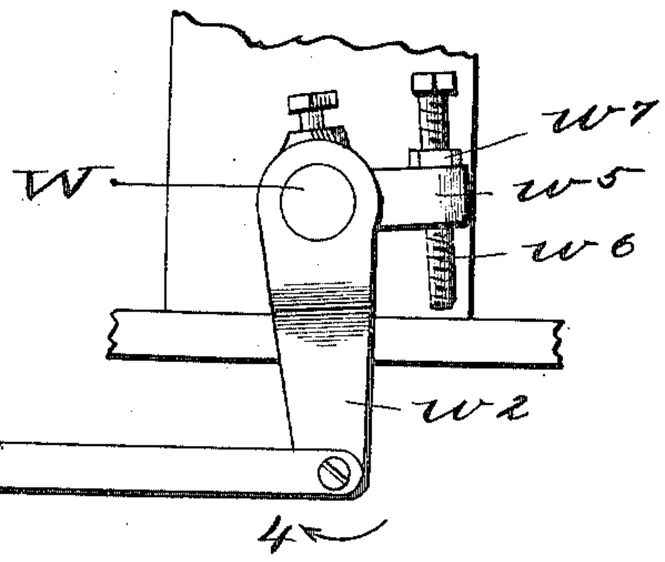


Fig. 11.

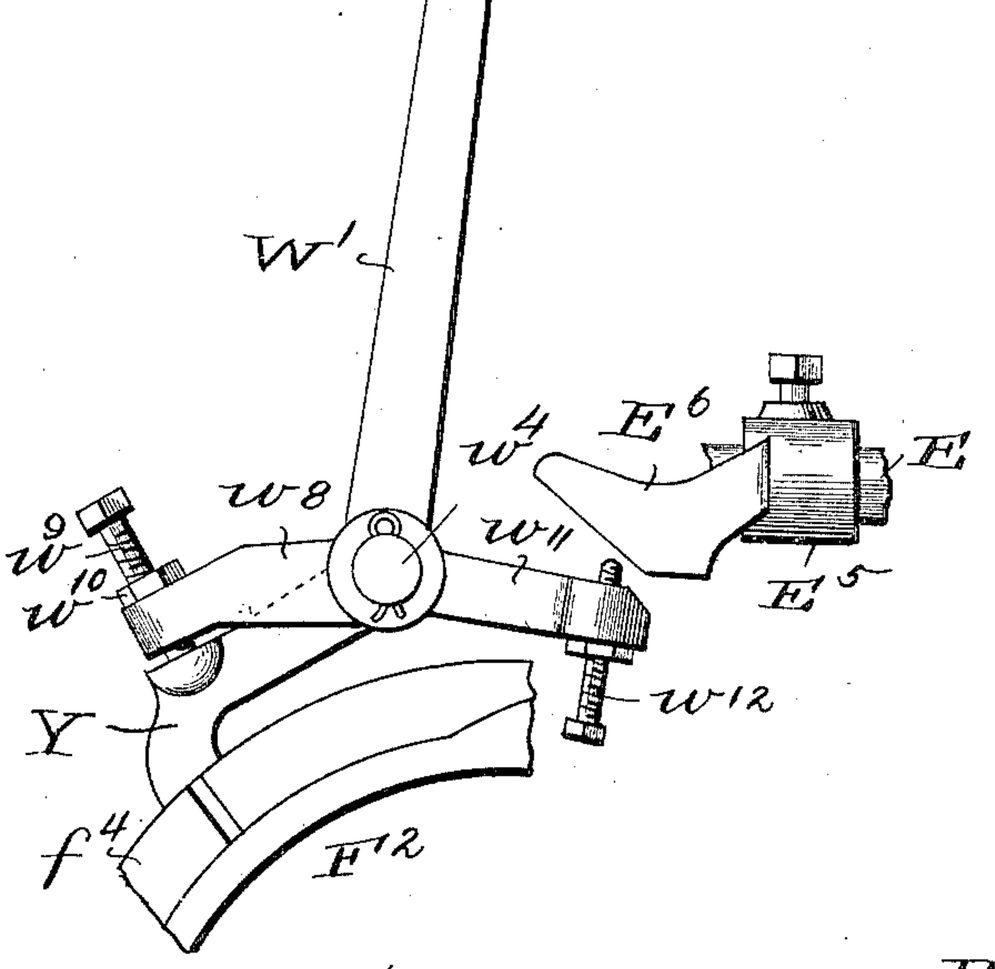
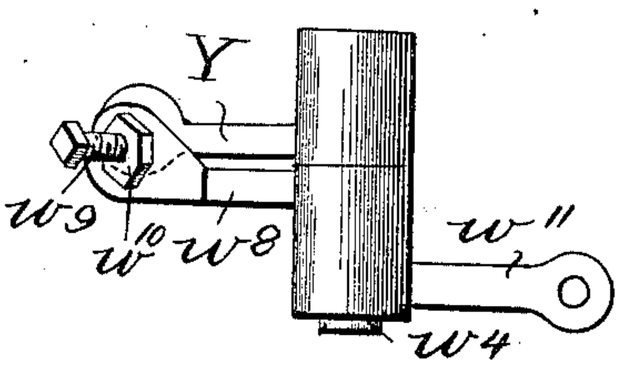
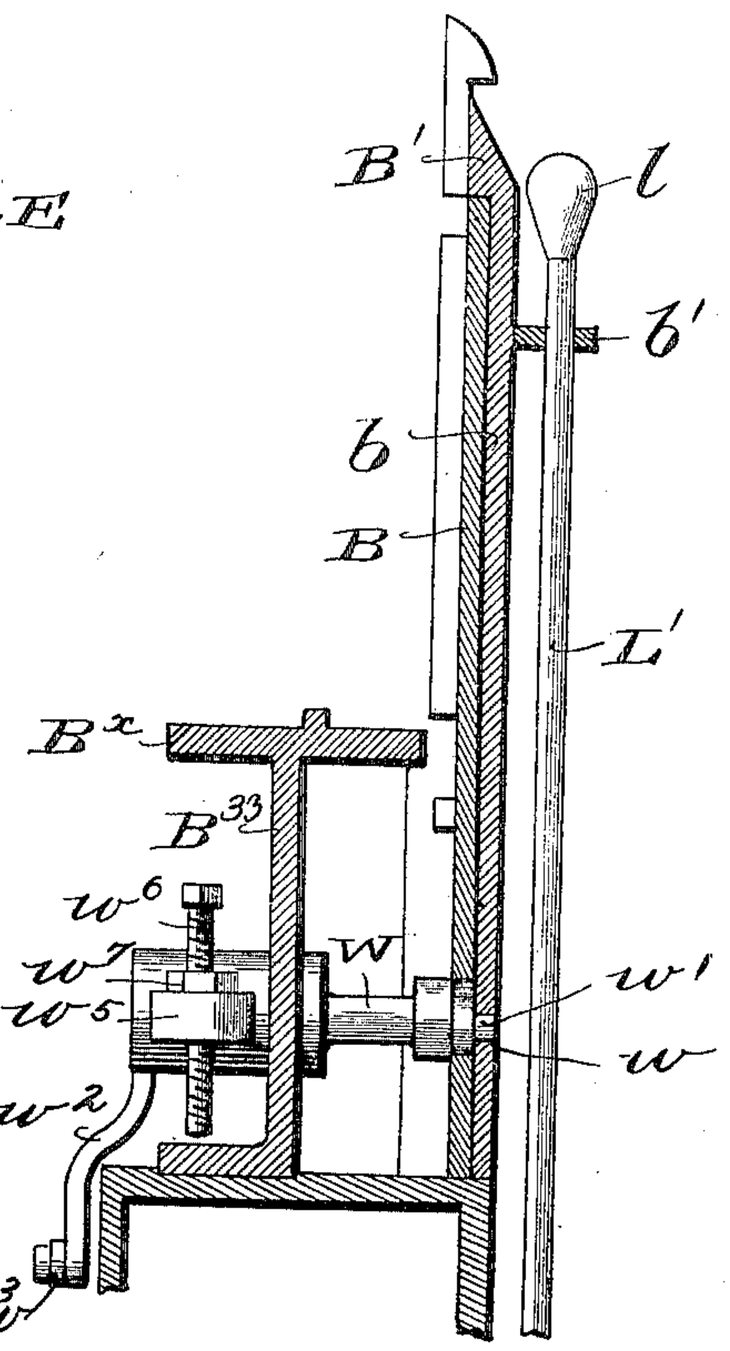


Fig. 12.





Witnesses
G. A. Tauberschmidt
J. D. Kingsbury

Inventor
Edward E. Kilbourn
By Whitaker & Prevost
Attorneys.

No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 14.

Fig. 13.

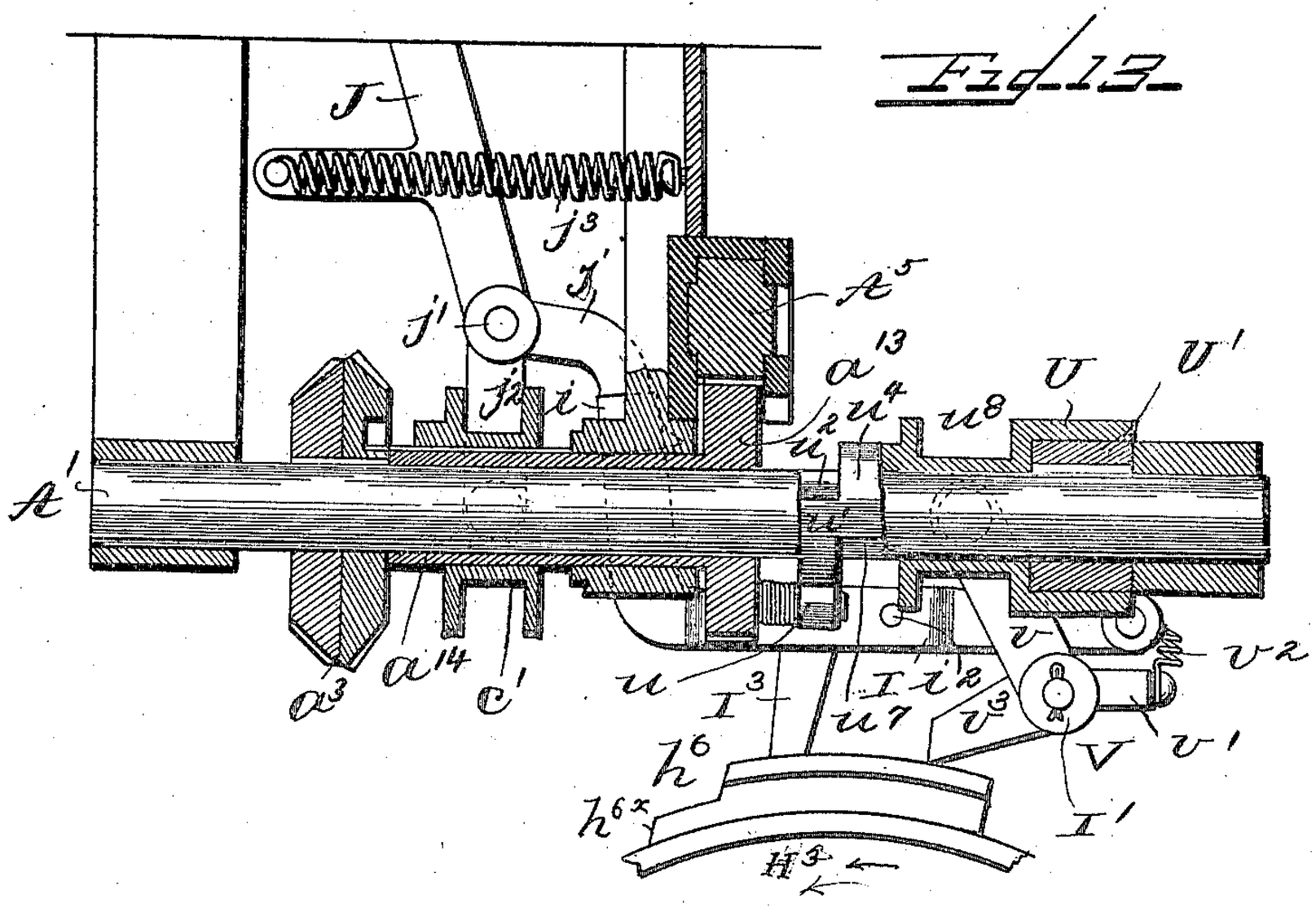


Fig. 14.

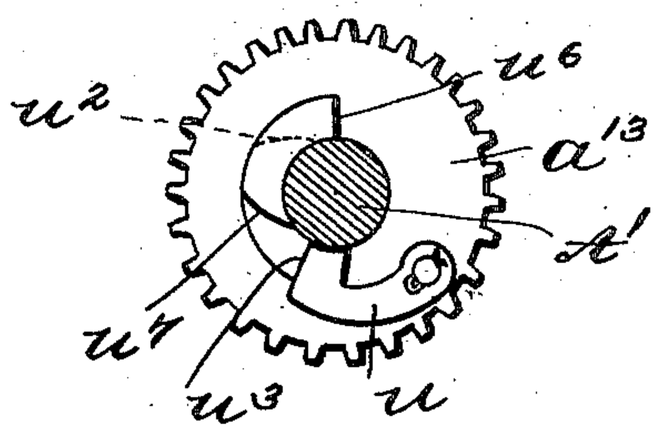


Fig. 15.

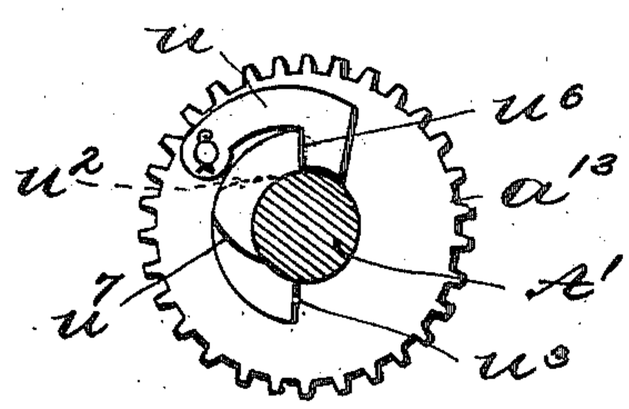
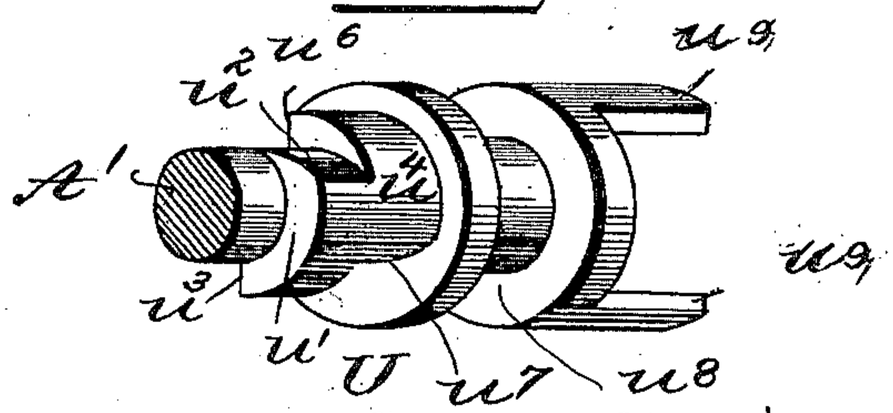


Fig. 16.



Witnesses
G. A. Tauberschmidt,
J. D. Kingsbury

Inventor
Edward E. Kilbourn
By Whittemore & Prevost
Attorneys

No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 15.

Fig. 18.

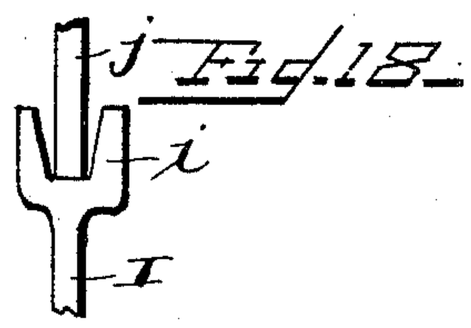
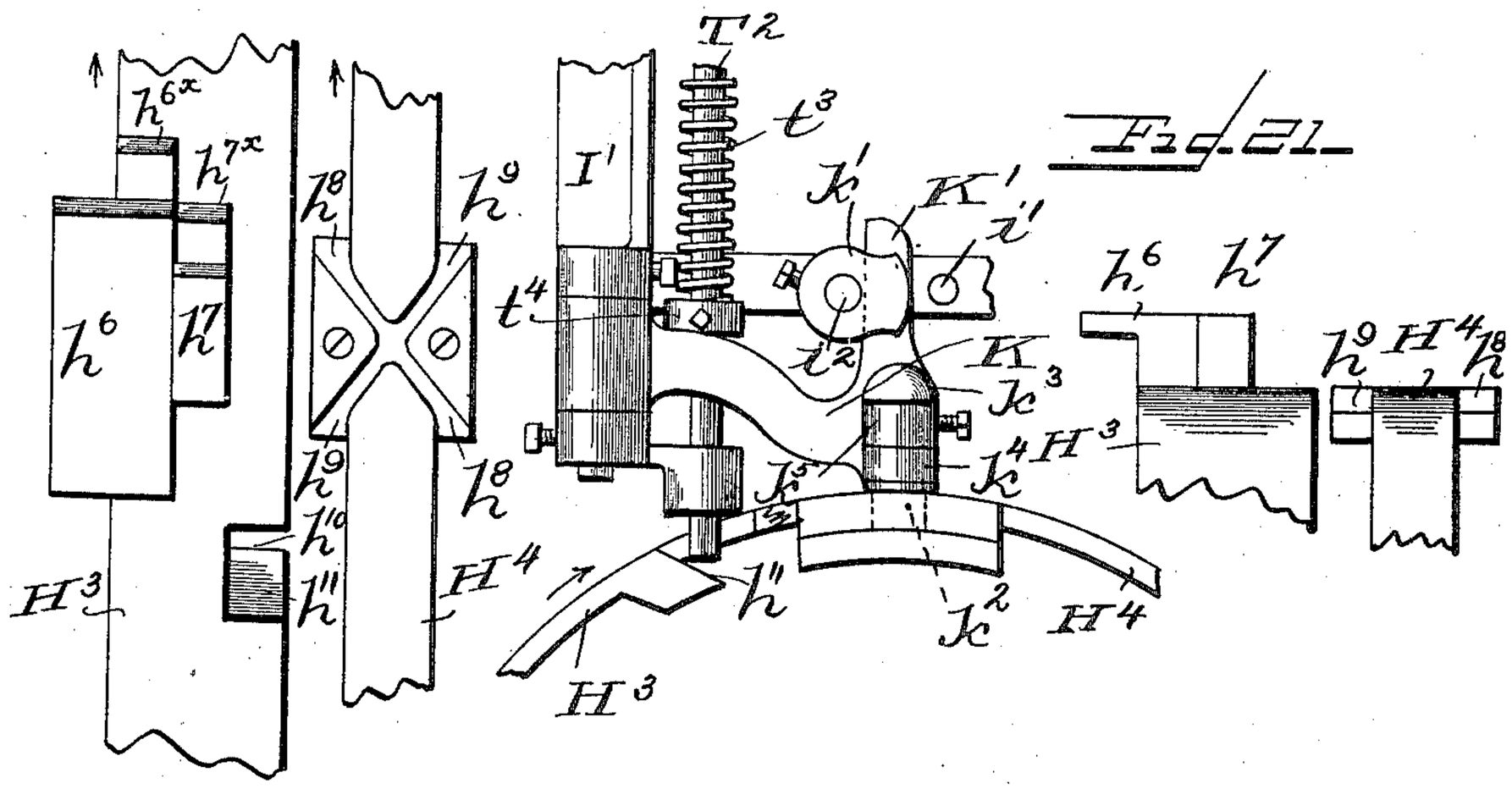


Fig. 17.

Fig. 19.

Fig. 20.

Fig. 21.



Witnesses
G. A. Tauberschmidt.
J. D. Kingsbury.

Edward E. Kilbourn Inventor
By Whitaker & Prevost Attorneys.

No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 16.

Fig. 22.

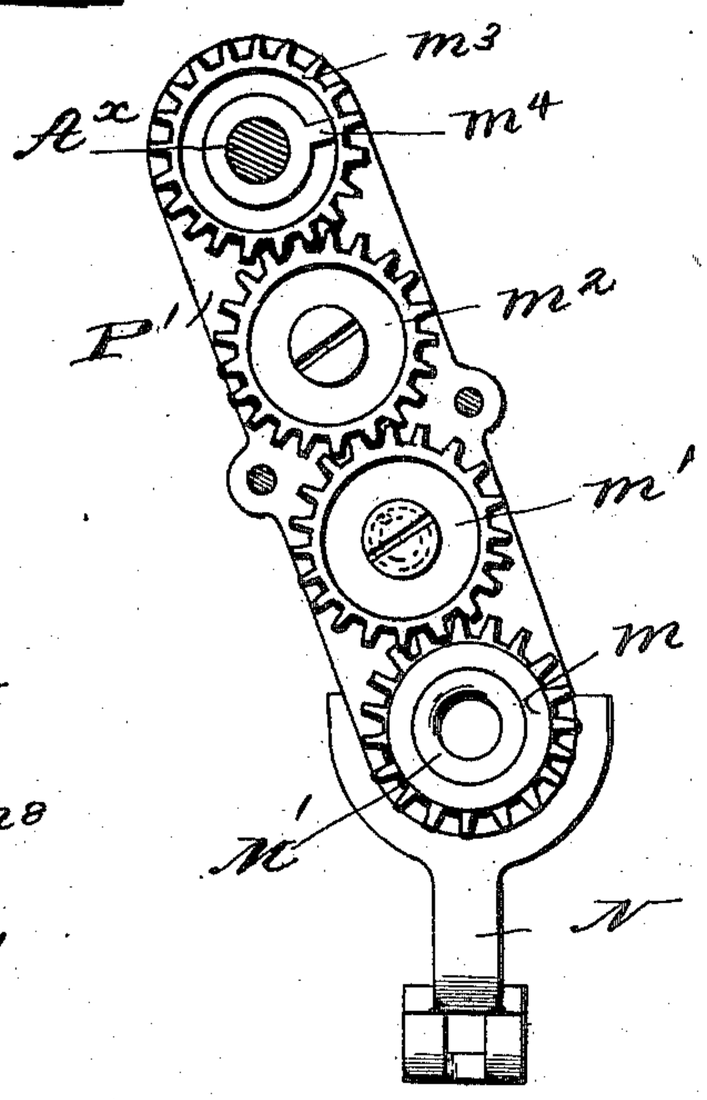


Fig. 49.

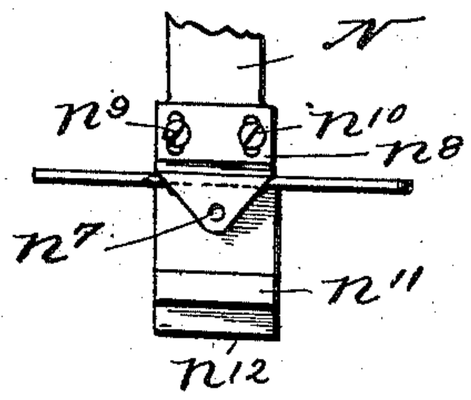


Fig. 50.

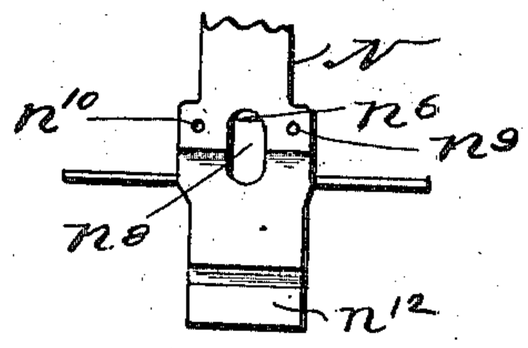
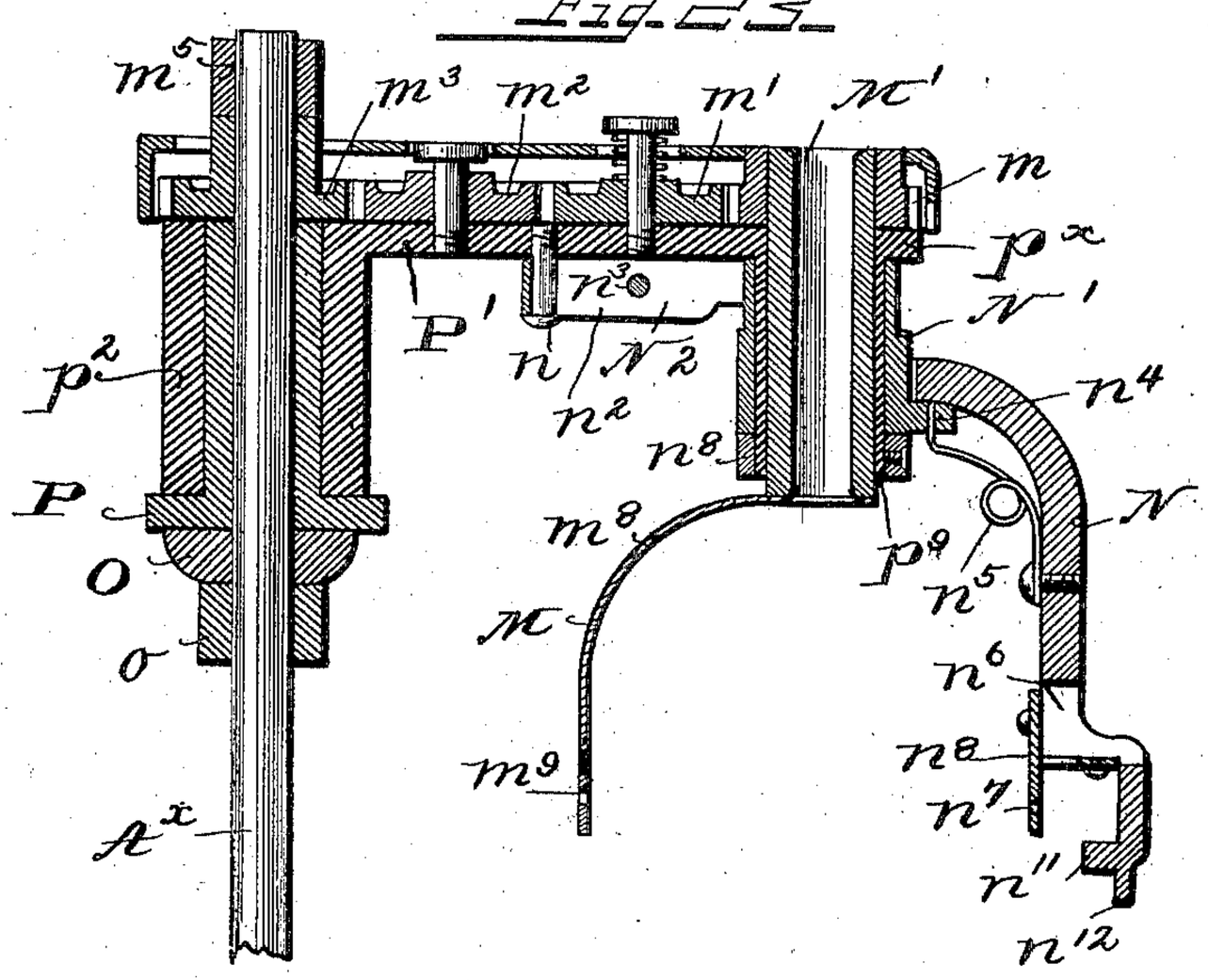


Fig. 23.



Witnesses,
G. A. Tauchenschmidt,
L. D. Kingsbury

Inventor,
Edward E. Kilbourn
By Whitaker & Perrot Attorneys.

No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 17.

Fig. 24

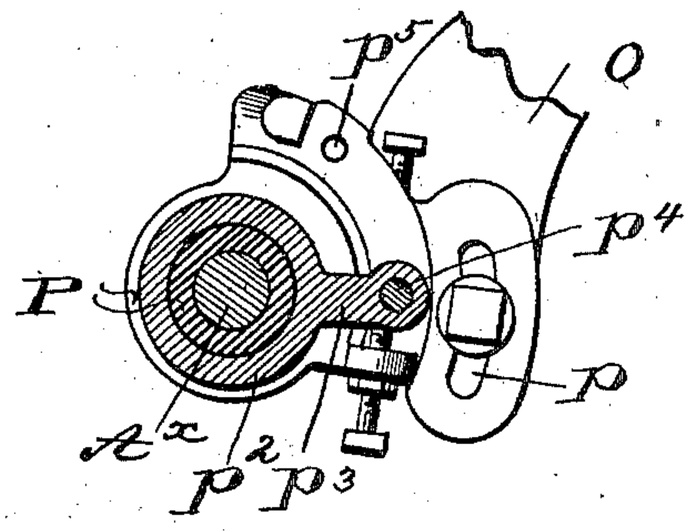


Fig. 30

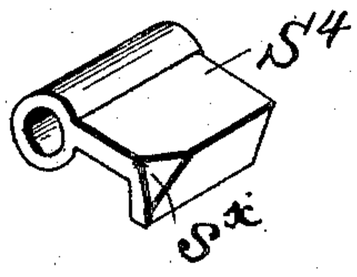


Fig. 25

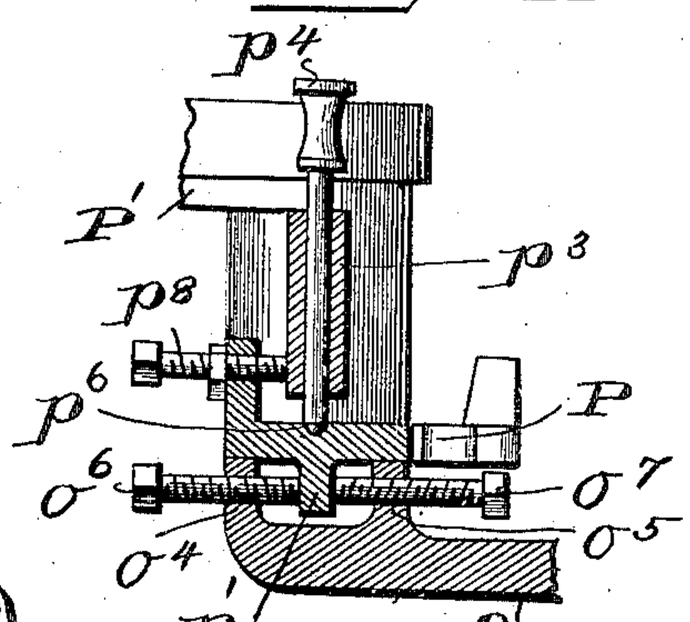


Fig. 26

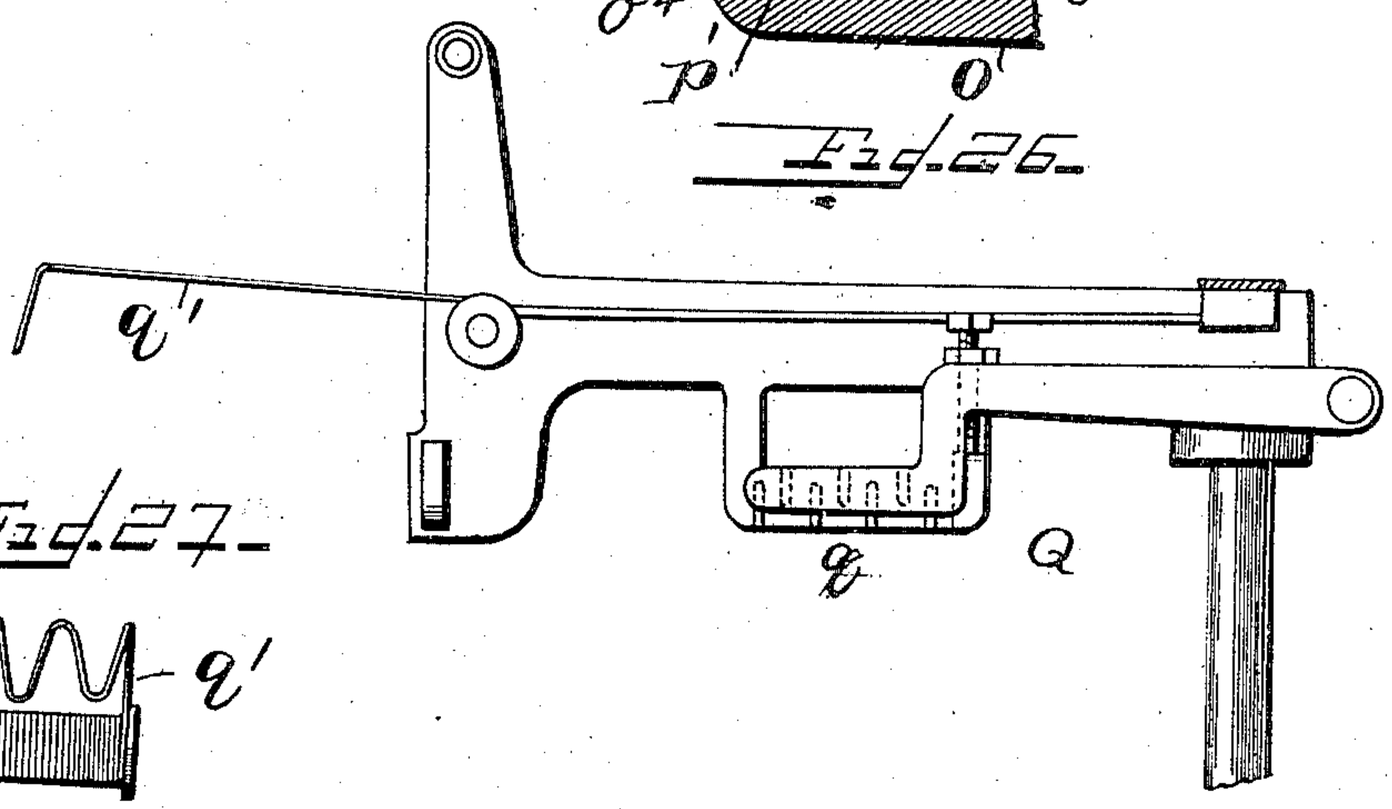


Fig. 27

Witnesses,
G. A. Tauberschmidt.
J. D. Kingsbury

Inventor,
Edward E. Kilbourn
By Whitaker & Frost Attorneys

No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 18.

Fig. 28.

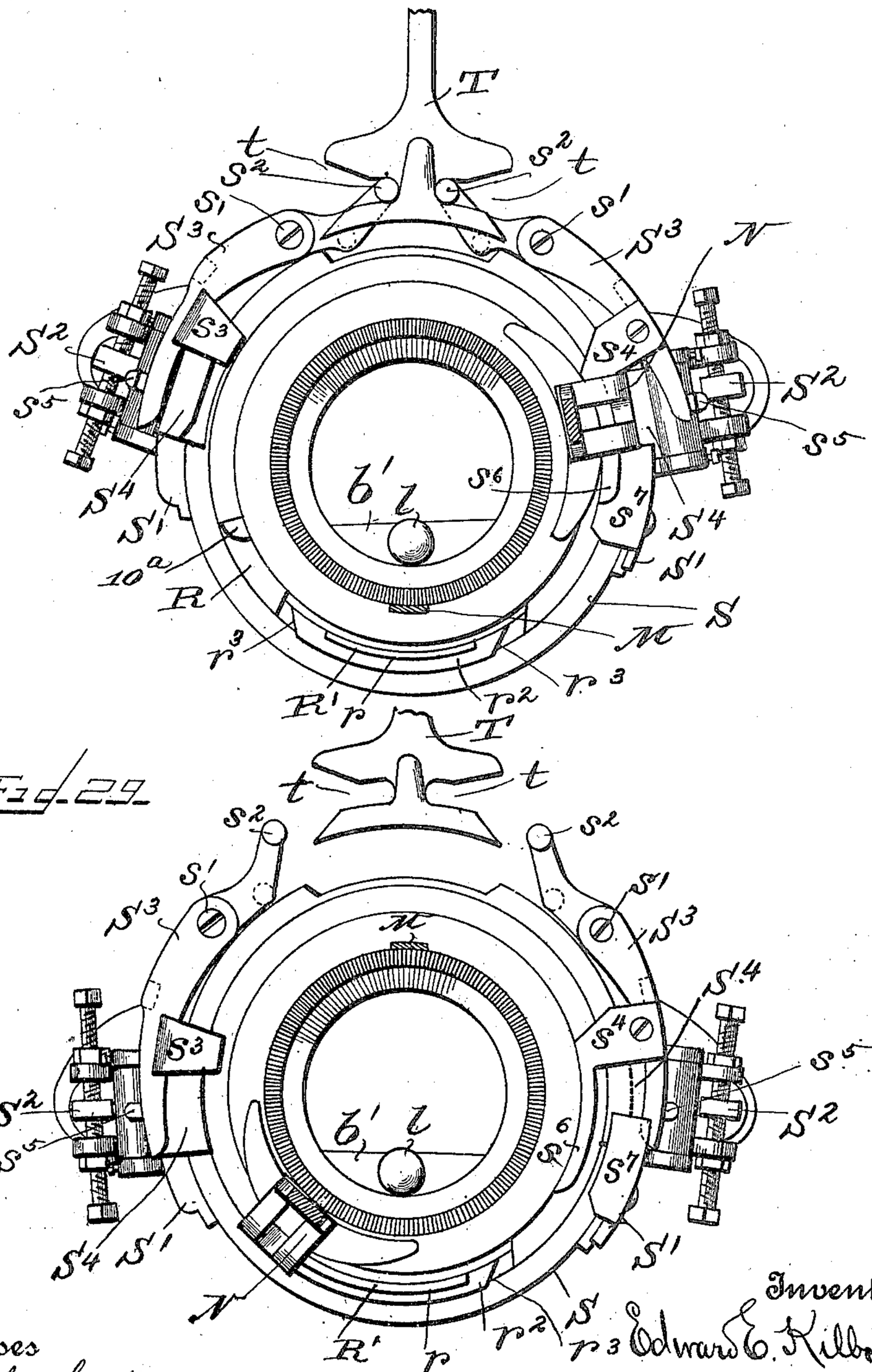


Fig. 29.

Witnesses
G. A. Rauberschmidt
J. D. Kingsbury.

Inventor
Edward E. Kilbourn
By
Whitaker & Prost
Attorneys.

No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 19.

Fig. 35.

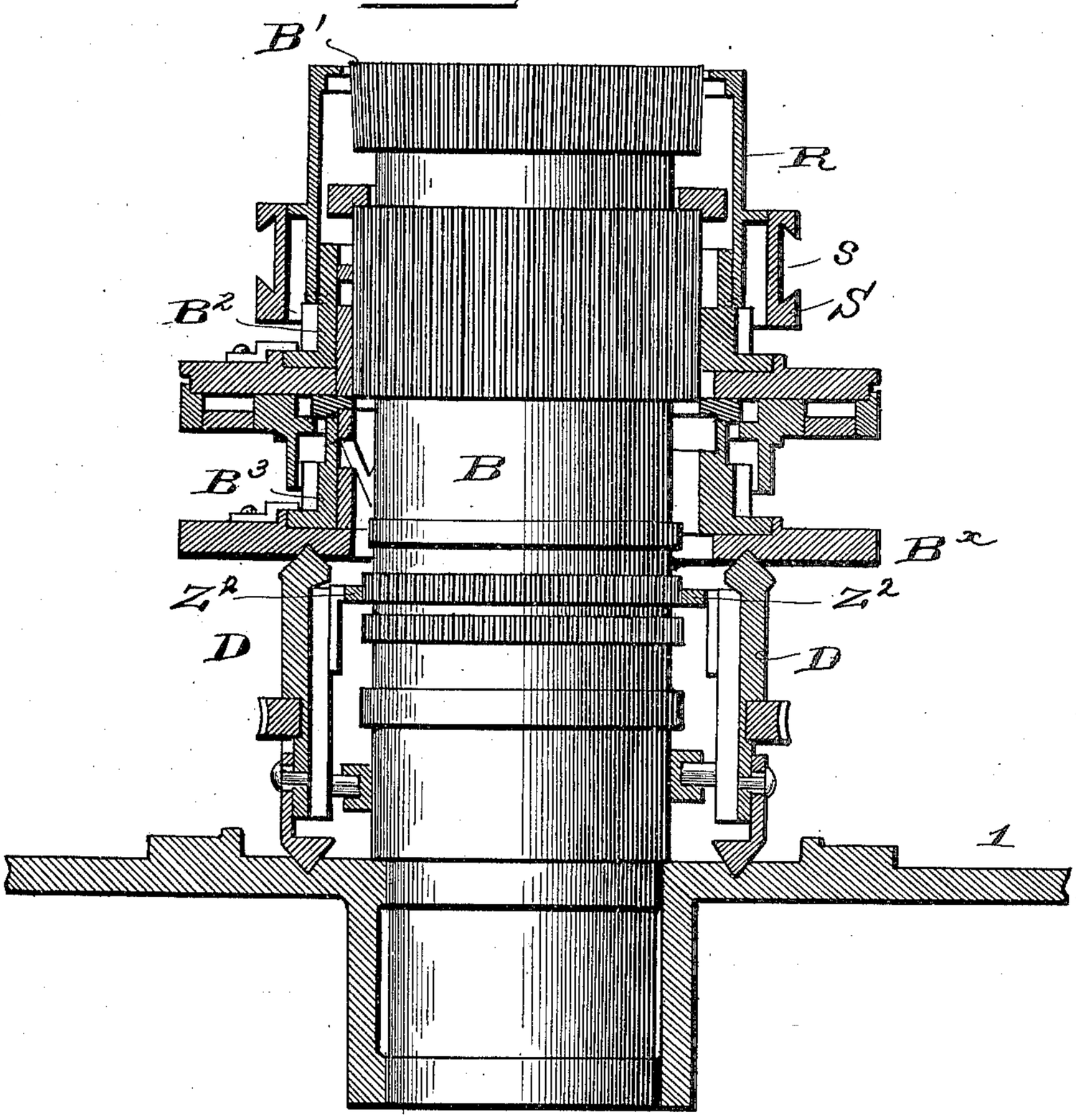


Fig. 31.

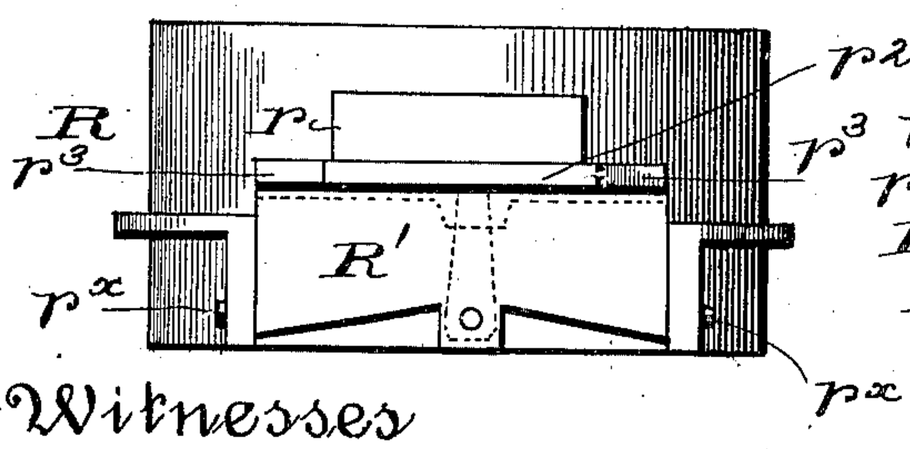
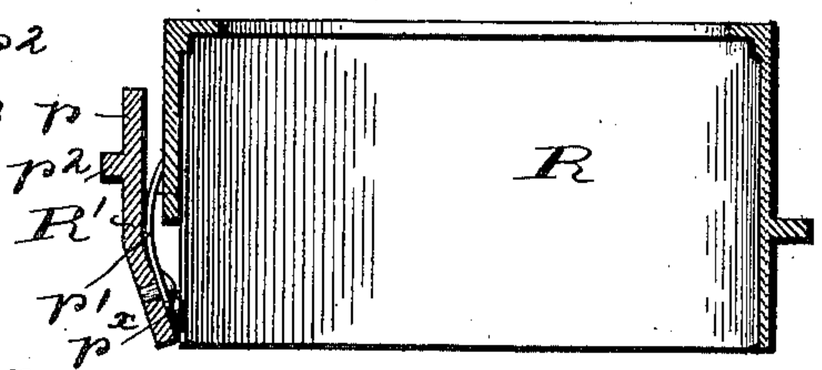


Fig. 32.



Witnesses
G. A. Tauberschmidt,
J. D. Kingsbery.

Inventor.
Edward E. Kilbourn.
By Whitaker & Prout
Attys

No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 20.

Fig. 33.

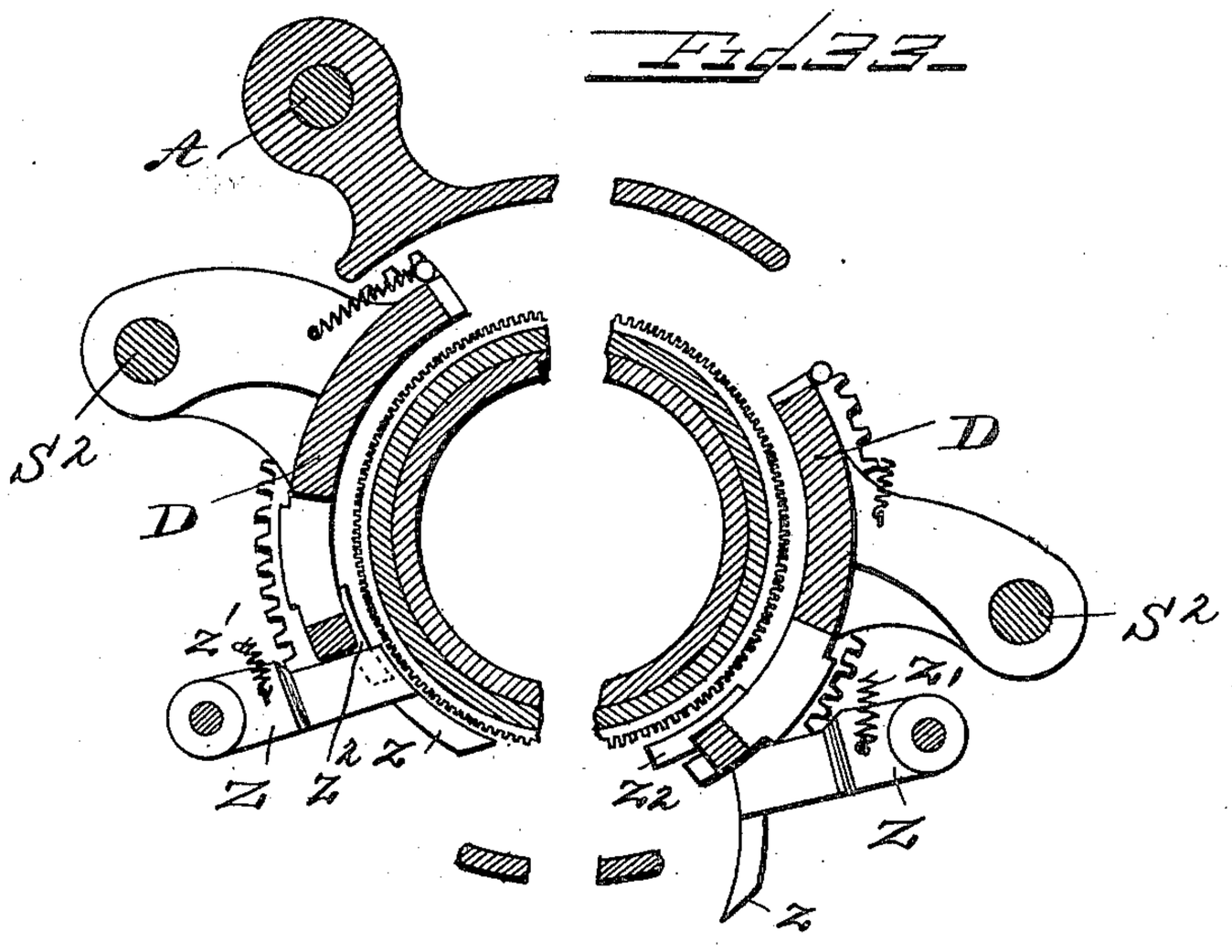


Fig. 34.

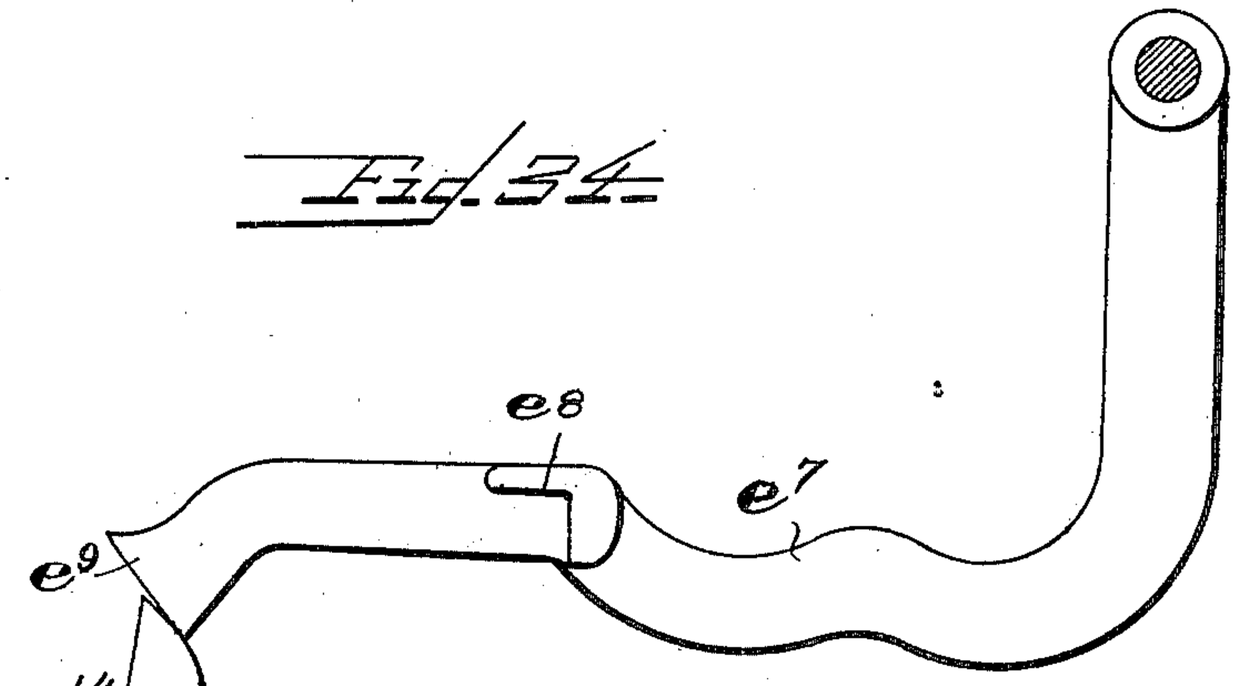
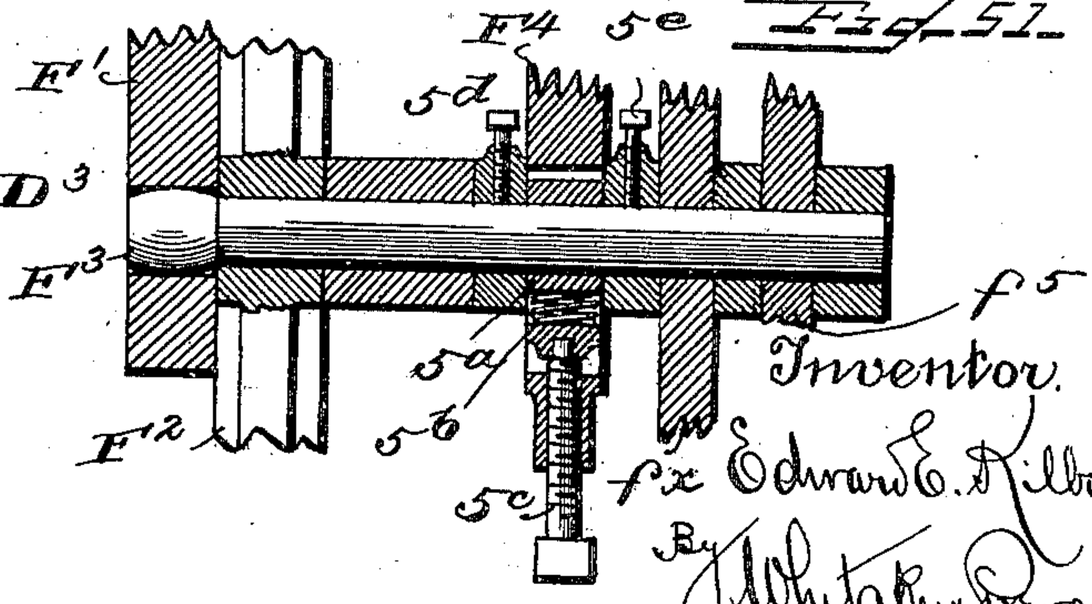


Fig. 51.



Witnesses.
G. A. Tauberschmidt.
J. D. Kingsbury

No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 21.

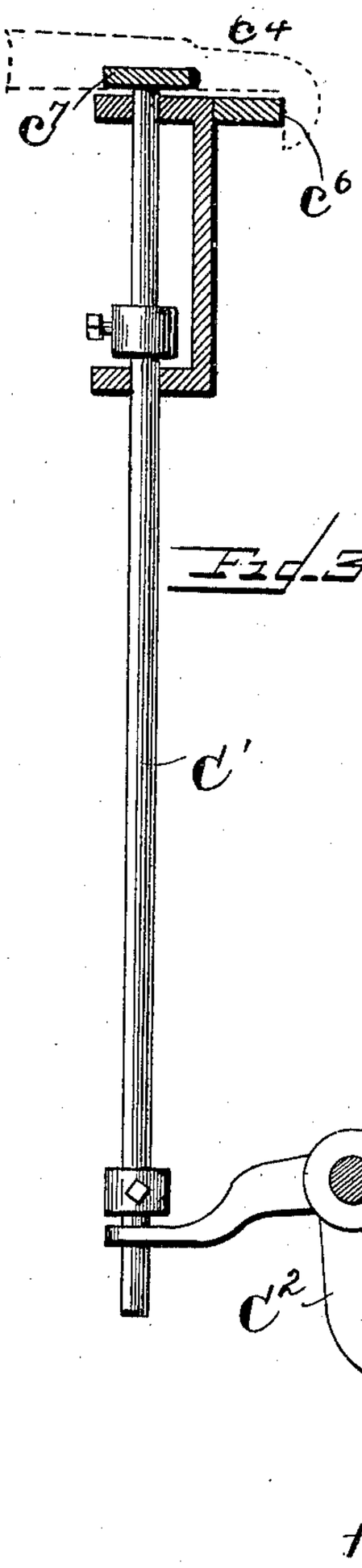


Fig. 39.

Fig. 40.

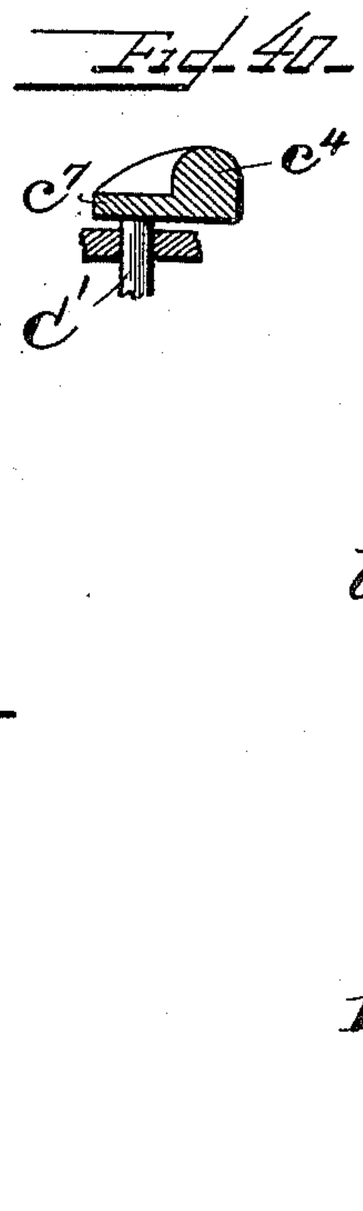


Fig. 38.

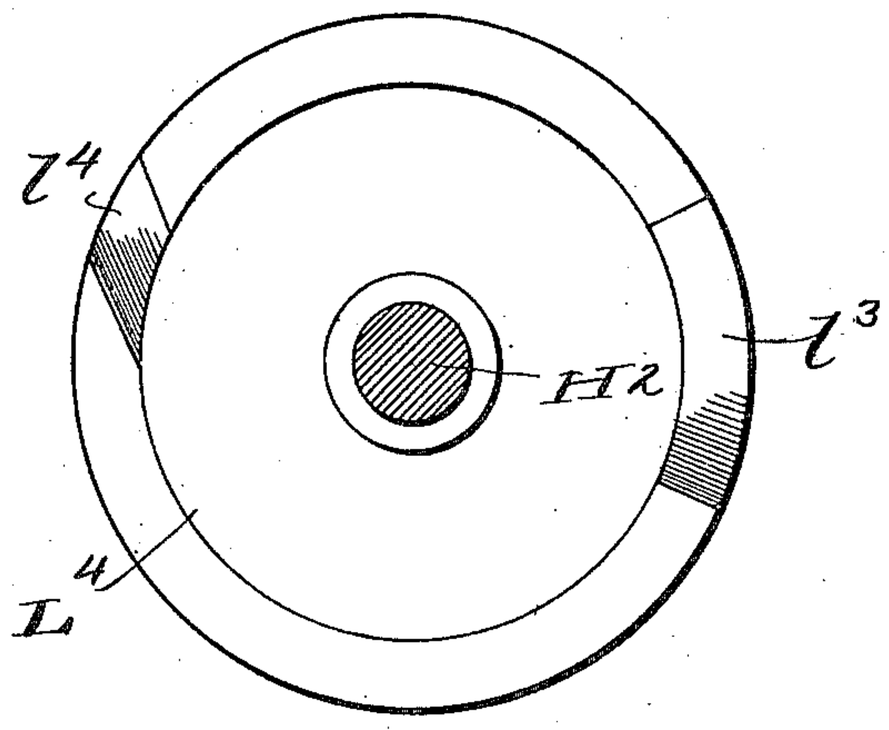


Fig. 36.

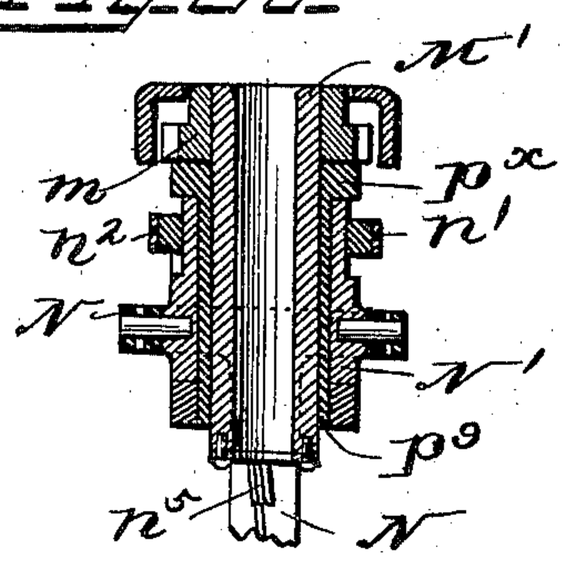
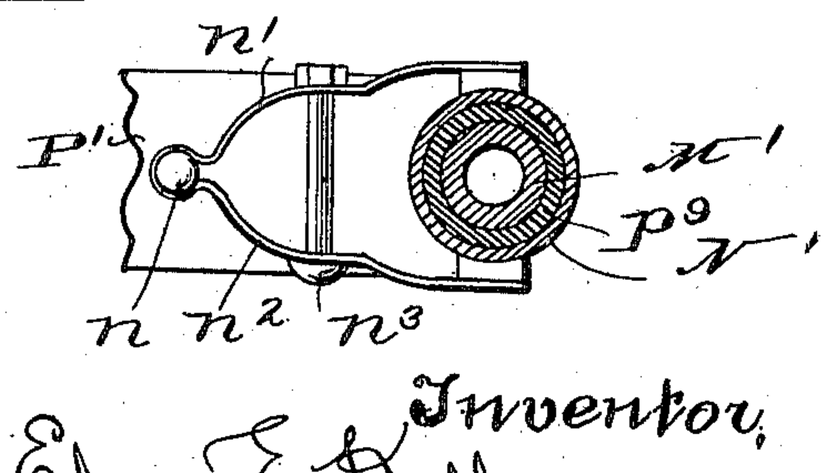


Fig. 37.



Witnesses,
G. A. Tauberschmidt,
J. D. Kingsbery.

Inventor,
Edward E. Kilbourn
By Whitaker & Wroot
Attys.

No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 22.

Fig. 41.

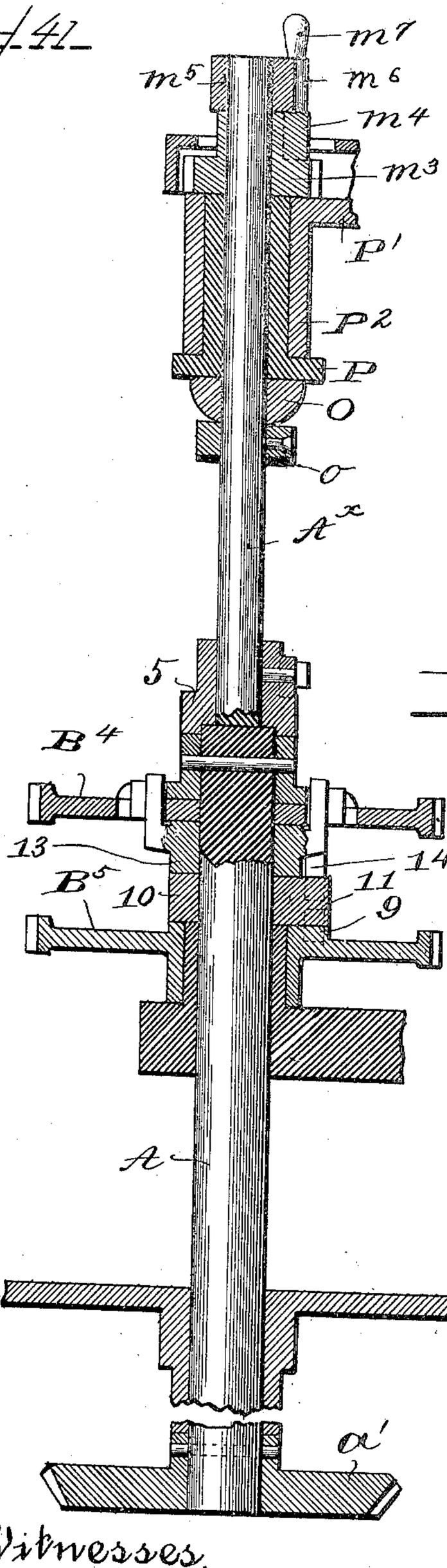


Fig. 43.

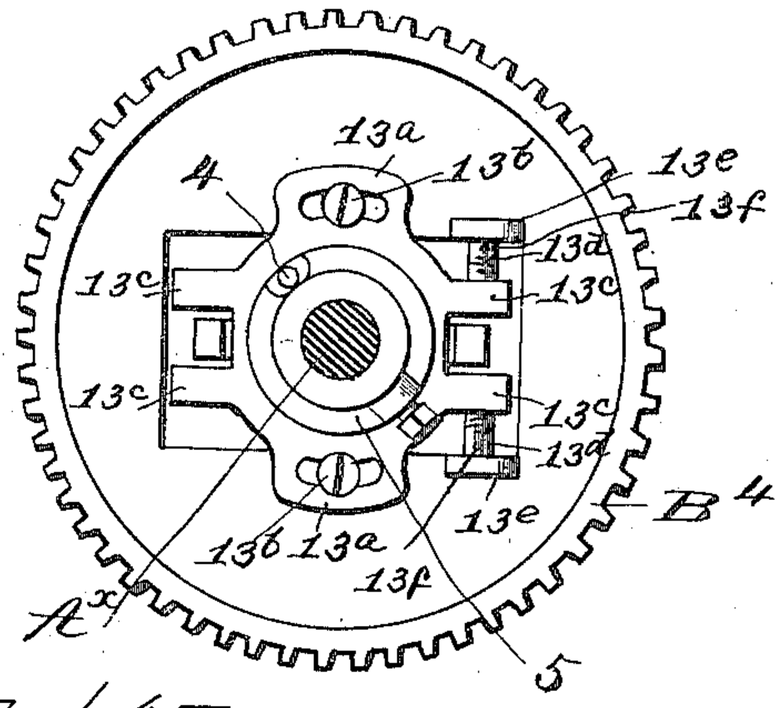


Fig. 42.

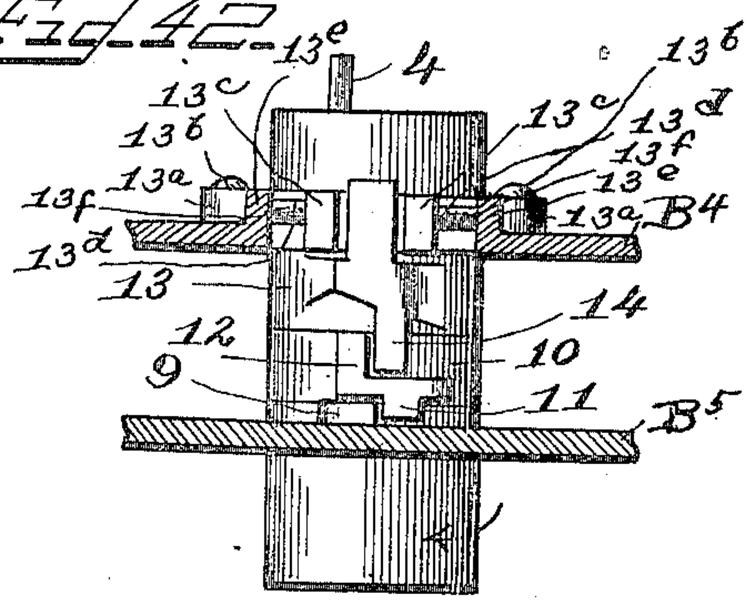
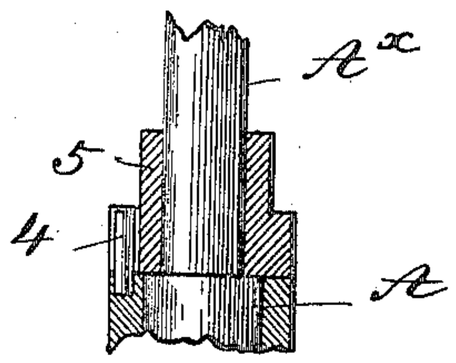


Fig. 44.



Witnesses,
G. A. Tauberschmidt
J. D. Kingsbury.

Inventor,
Edward E. Kilbourn
By Whittaker & Prout
Attys.

No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 23.

Fig. 45

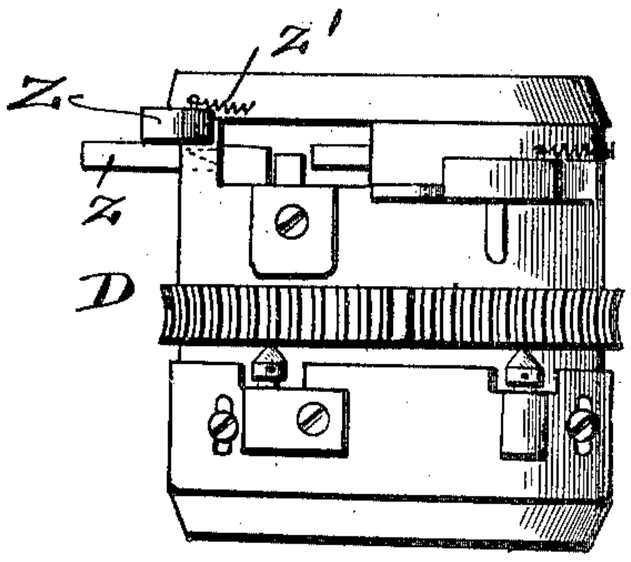


Fig. 46

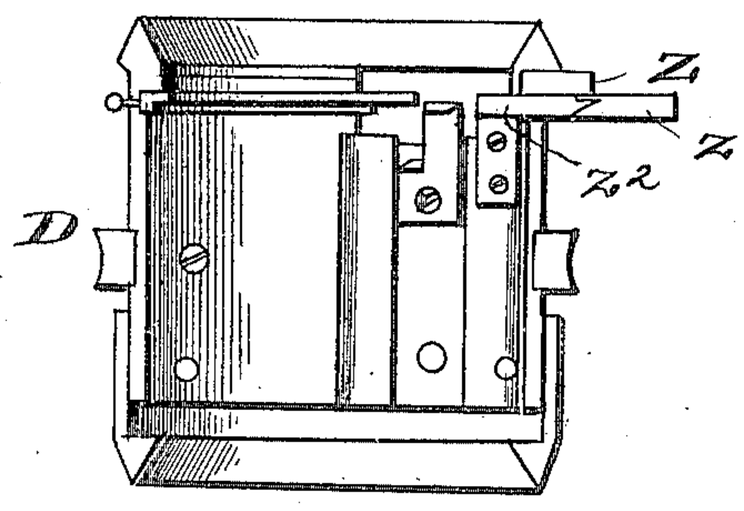


Fig. 48

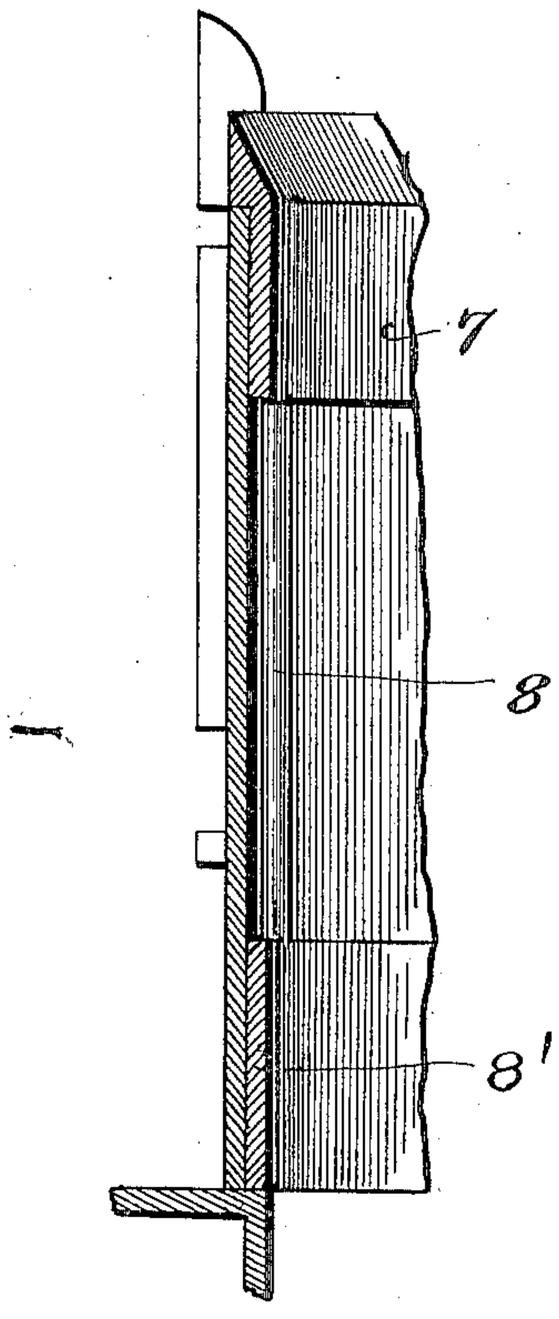
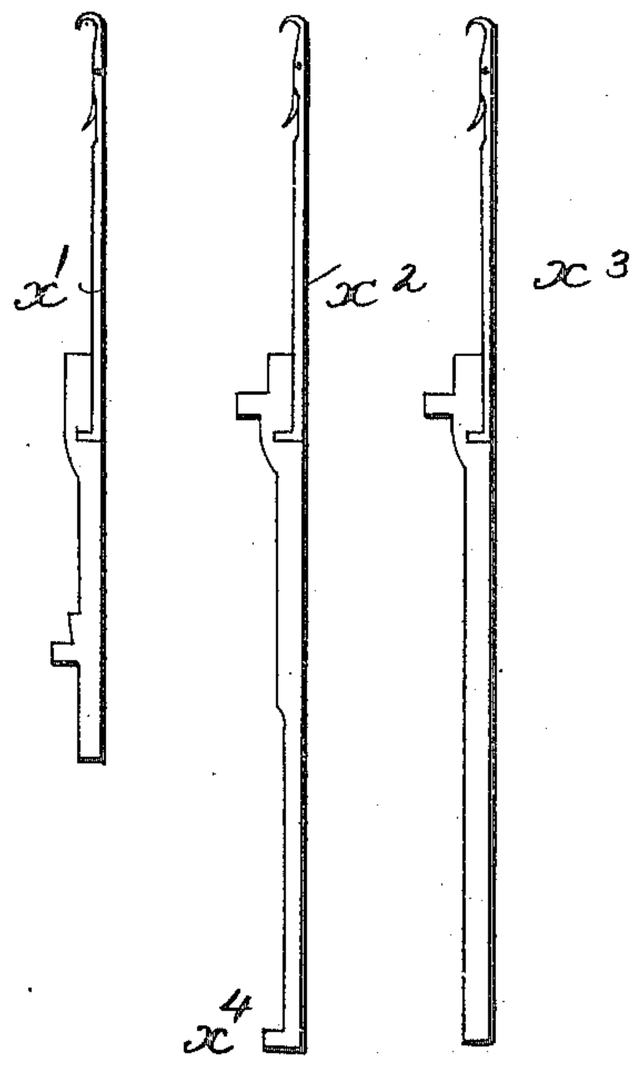


Fig. 47



Witnesses

G. A. Tauberschmidt.

J. D. Kingsbury.

Inventor,

Edward E. Kilbourn

By Whitaker & Prout

Attys.

No. 679,281. Patented July 23, 1901.

E. E. KILBOURN.

KNITTING MACHINE.

(No Model.) (Application filed May 4, 1896. Renewed July 11, 1899.)

24 Sheets—Sheet 24.

Fig 52

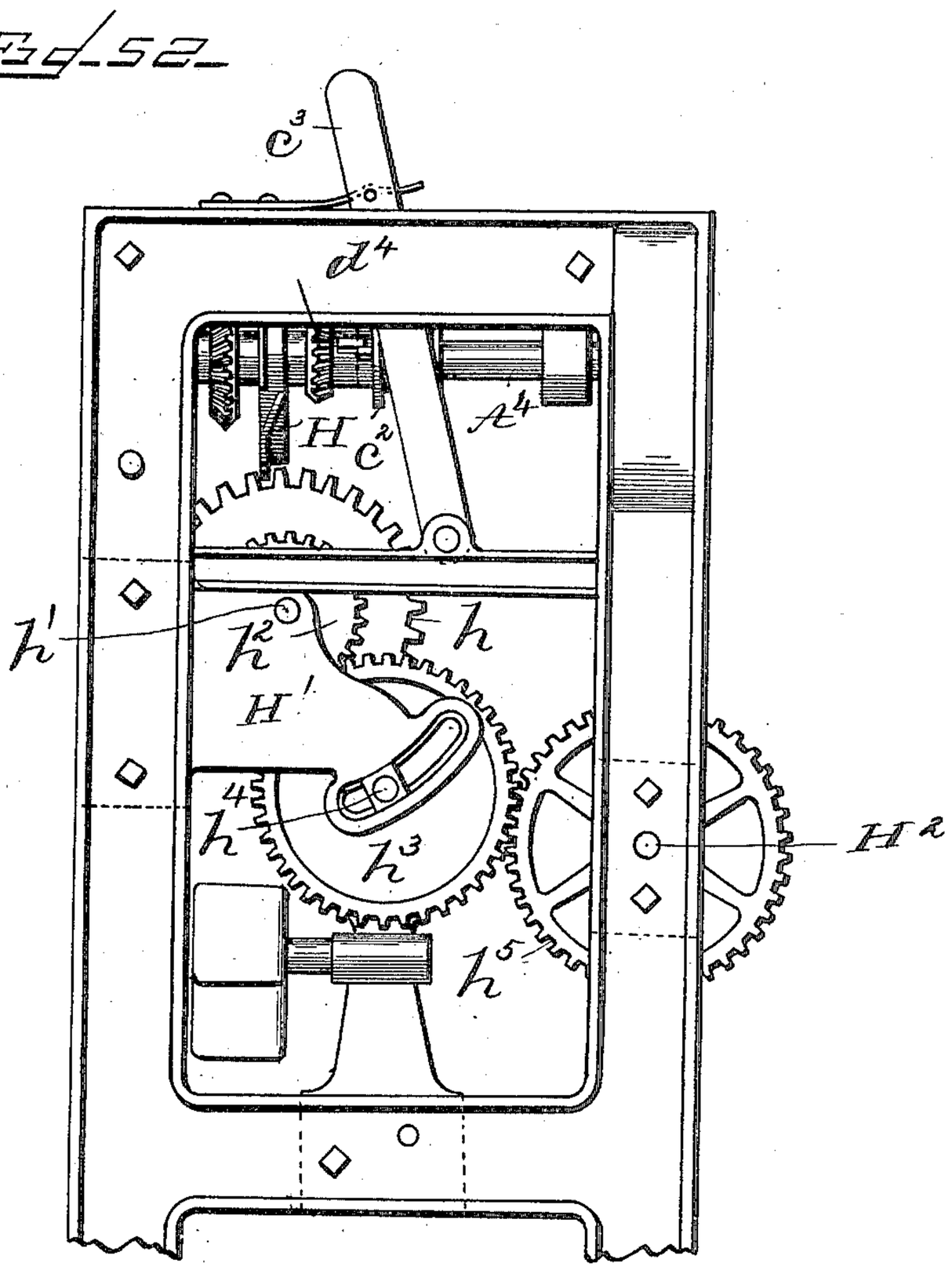
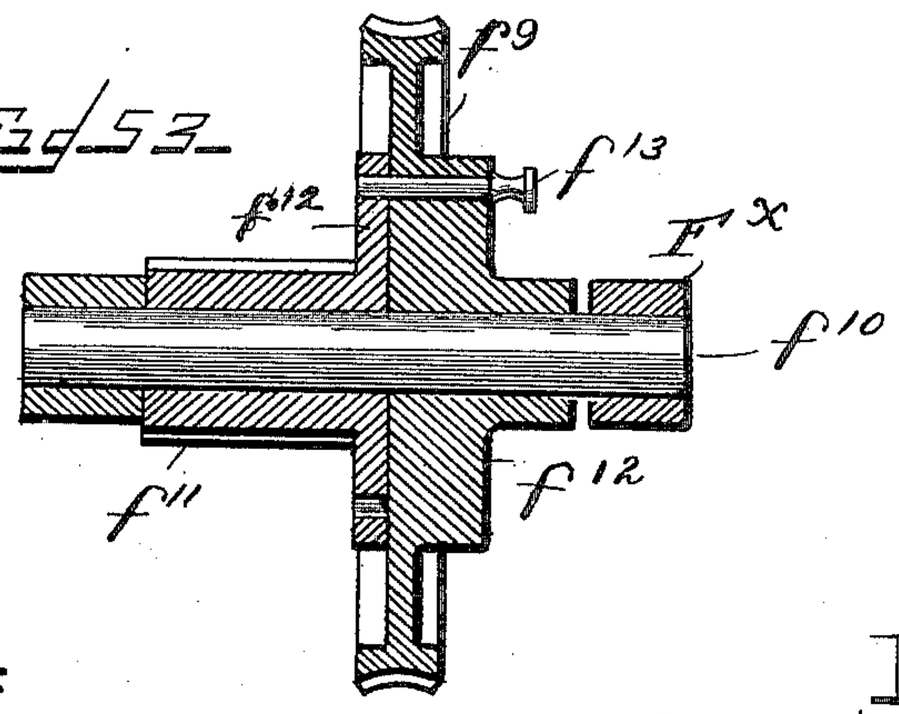


Fig 53



Witnesses—

G. A. Tauberschmidt,

J. D. Kingsbery

Inventor—

E. E. Kilbourn

By his attys

Whittaker & Prevost

UNITED STATES PATENT OFFICE.

EDWARD E. KILBOURN, OF NEW BRUNSWICK, NEW JERSEY.

KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 679,281, dated July 23, 1901.

Application filed May 4, 1896. Renewed July 11, 1899. Serial No. 723,466. (No model.)

To all whom it may concern:

Be it known that I, EDWARD E. KILBOURN, a citizen of the United States, residing at New Brunswick, in the county of Middlesex and State of New Jersey, 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.

This invention has reference to circular-knitting machines, and more particularly those machines of this class which are adapted to be rotated for circular work and reciprocated for reciprocating work.

The object of this invention is to lessen and reduce to a minimum the labors of attending to such machines when in operation and to improve the construction in various particulars, which are hereinafter set forth.

The invention consists in certain new constructions and novel combinations of parts which are disclosed in the following description and claims and which constitute additions to and improvements of the invention set forth in my former patent, No. 432,946, of July 22, 1890.

In order that my present improvements may be clearly understood, I have represented in the accompanying drawings a circular-knitting machine embodying my improvements, it being understood that while I have here shown the best form in which I have contemplated embodying my invention the construction can be varied somewhat to suit the views of different makers and users without departing from the principle of my invention.

Figure 1 is a top plan view of my improved machine. Figs. 2 and 2ª taken together give a front view in elevation of the machine, Fig. 2 giving the left and Fig. 2ª the right hand end of the same. Figs. 3 and 3ª taken together give a like rear view in elevation. Figs. 4 and 4ª taken together give a like top plan view of the mechanism beneath the bed-plate. Fig. 5 is a view of the mechanism at the left end of the machine for actuating the pattern-cam shaft. Fig. 6 is a sectional view of the mechanism below the bed-plate, taken on line *x x*, Fig. 1, looking from the left end of the machine. Fig. 7 is a top plan view of the same mechanism viewed from above line *y y*, Fig. 3ª. Fig. 8 is a plan view of the mechanism for actuating the heel-tension. Fig. 9 is a top plan view of the mangle-wheel for reversing the movement of the picker-slides. Figs. 10, 11, and 12 are detail views of the stitch-changing mechanism, Fig. 11 showing also a part of the heel-tension device. Fig. 13 is a part-sectional view on the line of the cylinder-actuating shaft. Figs. 14, 15, and 16 are details of parts connected therewith. Fig. 17 is a view from the left-hand end of the machine of the cylinder-actuating shaft and clutch-actuating mechanism. Fig. 18 is a detail of a part of the clutch-actuating devices. Figs. 19, 20, and 21 are detail views of the pattern-cam and coacting parts. Fig. 22 is a view of driving-gear for the thread-guide for circular work. Fig. 23 is a vertical sectional view of the same and connected parts. Figs. 24 and 25 are details of constructions for the adjustment of the thread-guides. Figs. 26 and 27 are detail views of tension and conducting devices for knitting-threads. Figs. 28 and 29 are top plan views of devices for driving and controlling the reciprocating thread-guide in two different positions, the thread-guide being shown in section. Figs. 30, 31, and 32 are detail views of parts of the same. Fig. 33 is a partial horizontal sectional view showing holders for narrowing-needles. Fig. 34 is a view of the detent-lever for holding the spring shifting-bar and its actuating-tappet. Fig. 35 is a sectional view of the needle-cams, picker-carriers, and supporting parts, the needle-cylinder being shown in full lines. Figs. 36 and 37 are details showing additional details of the reciprocating thread-guide. Fig. 38 is a detail of the cam for actuating the heel-tension. Figs. 39 and 40 are details of the automatic belt-shifting devices. Figs. 41, 42, 43, and 44 are details showing the connections with shaft A for operating the cam-cylinders and the circular thread-guide. Figs. 45 and 46 are inside and outside views of the picker-carriers. Fig. 47 is a view of the different needles employed in the machine. Fig. 48 is a modified form of devices for supporting the needle-cylinder nosing, and Figs. 49 and 50 are views showing the construction of the lower end of

the reciprocating thread-guide. Fig. 51 is a sectional view showing in detail the manner of mounting the pattern-cam shaft. Fig. 52 is a partial end view of the right-hand end of the machine. Fig. 53 is a sectional view of the worm-wheel f^9 and pinion f^{11}.

The machine represented in the figures of the drawings just enumerated is in many particulars constructed substantially like that shown in my former patent, No. 432,946, and it will be convenient to describe the present machine by referring more or less to the said former patent.

It will be understood that while many of my improvements are improvements on my former machine they are applicable to most if not all other forms of circular-knitting machines.

In the drawings, 1 is the bed-plate of the machine, and 2 2 are the supporting-standards, forming with the bed-plate the frame of the machine.

3 is a table secured to the bed-plate, which supports the thread or yarn supporting and guiding devices.

In the machine I employ a needle-cylinder B with a movable nosing B′, which is provided with hooked sinkers in substantially the same manner as in my previous patent. This nosing may be attached to a cylinder *b*, extending downwardly within the needle-cylinder for a purpose to be hereinafter explained. The needles employed are shown in Fig. 47 and are arranged and distributed as described in my former patent.

x' designates the needles operated by the lower cam-cylinder B^3 and which are thrown out of operation during narrowing and widening.

x^2 and x^3 are the needles operated by the upper cam-cylinder B^2 during both circular and reciprocating work, those designated by the reference-letter x^2 being the needles which are acted on and thrown out of and into operative position during narrowing and widening and which are termed "fashioning-needles." These cam-cylinders are operated by gears B^4 B^5, carried by a vertical shaft A, which I term the "vertical cylinder-shaft," and this shaft derives its motion from a shaft A′, extending transversely of the machine and which I term the "main operating-shaft," as this shaft serves to give motion to the cylinders, whether circular or reciprocating knitting is being done.

The narrowing and widening for the heels and toes of stockings is effected by raising and lowering certain of the needles x^2 at the sides of the machine, as done in my former machine, by pickers carried by segmental carriers D D, each of which carriers is provided with a worm-segment which is engaged by a worm D′ on a shaft D^2. These worm-shafts are located on opposite sides of the needle-cylinder, and each is provided with a pinion *d*, which is engaged by a gear-wheel d', causing them to rotate in the same direction. The gear d' is actuated by proper connecting-gearing from a spur-gear d^2, secured on a shaft D^3 and which is connected with a mangle-gear d^3, also mounted on the same shaft. All of the devices so far described for narrowing and widening are substantially the same as in my former patent.

The devices for actuating the cylinders for rotary work and for actuating the cylinders and the narrowing and widening devices in the machine here illustrated differ from those of my former patent, and these I will proceed to describe.

At the left end of my machine is a short shaft A^2, extending longitudinally of the machine. This shaft is provided with the usual fast and loose pulleys *a a*, and a belt-shipper C is located in close proximity to these pulleys for throwing the machine into and out of operation. The shaft A^2 I term the "power-shaft," as the power to drive the machine is applied thereto. This shaft is provided with a bevel-gear a^2, running loosely thereon and gearing with a double bevel-gear a^3, fixed on the main operating-shaft A′. (See Figs. 4^a and 6.) One face of the bevel-gear a^3 gears with a bevel-gear a', fixed to the vertical cylinder-shaft A. A pinion a^4 is also loosely mounted on the shaft A^2 near the end of the machine. On the shaft A^2, between the gear-wheels a^2 and a^4, is splined the clutch *c*, which is adapted to be thrown into engagement with either of the said gear-wheels and cause the engaged wheel to rotate with the shaft. When the gear a^2 is so engaged, a continuous rotary motion is given to shafts A′ and A and the cam-cylinders. The gear a^4 is in engagement with the gear-wheel a^5, loosely mounted on the pin or gudgeon a^6, secured to the frame of the machine. Integral with or secured to the wheel a^5 is a pinion a^7, which engages a gear a^8 on a shaft A^3, extending longitudinally of the machine, near the front side of the same. Near the right-hand end of the machine shaft A^3 is provided with a bevel-gear a^9, which gears with a bevel-gear a^{10} on a shaft A^4, extending transversely of the machine. This shaft is provided with the crank a^{11}, which is connected by a pitman a^{12} with a rack A^5, mounted in guideways at the rear side of the machine. The rack A^5 engagas a spur-gear a^{13}, mounted loosely upon the main operating-shaft A′. The gear a^{13} is provided with a sleeve a^{14}, which extends inwardly to the gear a^3. On this sleeve is splined a clutch member c', which is provided with a projection to enter a recess in the gear a^3 to connect said gear a^3 and shaft A′ with the gear a^{13}. It will therefore be apparent that when the clutch *c* engages the gear a^2 a continuous rotary motion will be given to the shafts A′ and A and that when the clutch *c* engages the gear a^4 the gear a^{13} will be given a reciprocating motion, which can be communicated to shafts A and A′ by the proper movement of the clutch c'. Shaft A^4 is provided with a bevel-wheel d^4, which gears with a

bevel-wheel d^5, mounted loosely on a pin or gudgeon d^6, depending from the bed-plate of the machine. On the upper side of the bevel-wheel d^5 is a pinion d^7, rigidly connected therewith. This pinion gears with pinion d^8 on a pin d^9, and on this pin is pivoted an arm or lever d^{10}, which carries a spur-gear d^{11}, meshing with the pinion d^8, and this gear has connected with it a bevel-gear d^{12} (shown in Fig. 9 and in dotted lines, Fig. 4) to engage with the mangle-wheel. These parts are all substantially as in my former patent. It will thus be seen that as soon as the clutch c is so shifted as to give motion to the rack A^5 the mangle-gear is actuated and puts in motion the narrowing and widening devices controlled thereby.

As shown in Fig. 5, the bevel-gear d^4 is loosely mounted on the shaft A^4, and a clutch c^2 is provided by which it can be connected with or disconnected from the shaft. A lever c^3 for actuating this clutch extends above the bed-plate at the extreme right of the machine. In order that the labor of attending upon the machine may be reduced to the minimum, the machine is provided with automatic devices for moving the clutches c and c' in both directions to effect the proper changes in the operation of the machine.

The clutch c is controlled by mechanism which will now be described. This series of devices is new with my present machine. Near the front of the machine, but below the plane of the shaft A^3, a rod E is mounted in bearings, so as to be capable of sliding longitudinally of the machine. At the right-hand end of the sliding rod E a coiled spring e encircles the rod, having one end bearing against the frame of the machine and the other bearing against a collar E′, secured adjustably upon the rod by a set-screw e^2. This collar is provided (see Figs. 2^a and 9) with a lug e^3, having a broad upper surface. A little to the left of the collar E′ is another collar E^2, adjustably secured to the rod by a set-screw e^4. A coiled spring e^5 encircles the rod E and has one end bearing against the collar E^2 and its opposite end bearing against a collar E^3, mounted loosely on rod E. (See Fig. 9.) This collar E^3 is recessed at its sides to receive the forked ends $f\,f$ of a lever F, pivoted at its opposite end to a bracket F′. This lever has an elongated concave face f', which bears against the surface of a cam-wheel F^2. The rod E has an arm e^6 rigidly secured thereto, which extends rearwardly and has a forked end engaging a groove in the clutch c, as is usual in such devices. Of the two springs e^5 and e the spring e^5 is slightly the stronger. The cam-wheel F^2 has two cam-grades f^2 and f^3. The latter has a long concentric portion which is secured to the wheel by bolts and nuts to permit of its adjustment to and from its fixed portion or to permit the removal of one and its replacement by another of the desired qualities. When placed upon the cam-wheel, the movable part is capable of a considerable change of position, care being taken that such part shall not be moved from the stationary part far enough to permit the bearing-face f' of the lever F to drop between them. The separation of the two parts produces no other effect than to lengthen the cam so long as the bearing f' can bridge the space between them. When the bearing f' is upon the highest portion of the cam-grades, the clutch c is brought into engagement with the bevel-gear a^2 and the cam-cylinders are rotated for continuous circular work. When the bearing f' leaves the cam, the spring e^5 expands and forces the upper end of the lever to the left and carries the rod E to the left to disengage the clutch from the bevel-gear a^2. The spring e has been until this moment compressed, in which condition it is stronger than the expanded spring e^5. As soon as the spring e^5 expands the spring e expands, carrying the rod E farther, and brings the clutch into engagement with the pinion a^4, putting the narrowing and widening mechanism into operation. On the shaft D^3 of the mangle-wheel is a tappet d^{14}, which during circular work bears against the under side of a detent-lever e^7. As soon as the narrowing and widening devices are put in motion the shaft D^3 begins to revolve, withdrawing the tappet from under the detent-lever, permitting the same to drop, bringing a lug or shoulder e^8 on the same to the right of the lug e^3 on the collar E′ and locking the rod from any retrograde movement. As the narrowing and widening goes on, the cam-wheel F^2 revolves one of the cam-grades $f^2\,f^3$ of said wheel, and, coming in contact with the bearing of the lever F, the lever is moved to the right, compressing the spring e^5. This operation affects no movement of the rod E, as it is securely locked by the detent-lever. The detent-lever e^7 is provided with the cam-surface e^9 at or near its free end. When the widening movement has been completed, the tappet d^{14} returns to its first position and in doing so comes in contact with the cam-surface e^9 and raises the detent-lever, withdrawing the shoulder e^8 from engagement with the lug e^3 on the fixed collar E′. The spring e^5 now expands, carrying the clutch c out of engagement with the pinion a^4 and into engagement with the bevel-gear a^2, causing the machine to resume circular work.

The cam-lever F is operated by the following instrumentalities: The cam-wheel F^2 is mounted upon a shaft F^3, which is supported in a bearing in the bracket F′ and in a bracket F^4. On this shaft F^3 are mounted two mutilated gear-wheels $f^\times$ and f^5, which I term "pattern-wheels," and of which one, f^5, is rigidly secured to the shaft, and the other, $f^\times$, is loose thereon. On shaft A^2, outside of the frame of the machine, is a pinion f^6, intermeshing with a gear f^7 on a shaft F^5, which extends through the framing of the machine, and at its inner end is provided with a worm f^8. The worm f^8 engages the worm-wheel f^9, which latter is movably sup-

ported on a pin or gudgeon f^{10}, supported by a bracket $F^{\times}$, secured to one of the end standards or to some other part of the frame. A long pinion f^{11} is also loosely mounted on said pin or gudgeon f^{10}. The said long pinion f^{11} is provided with an annular flange f^{12}, (see Figs. 2 and 53,) provided with a row of perforations or holes, and a pin f^{13} passes through the worm-wheel and engages one of the apertures in the said flange, locking the two for joint movement. By withdrawing the pin f^{13} from the flange f^{12} the pinion f^{11} can be moved by hand without moving the worm-wheel should this be found desirable for any purpose in operating the machine. The pinion f^{11} engages both of the mutilated gear-wheels $f^{\times}$ f^{5}. The mutilated gear f^{5} is provided with a lug or projection f^{14}, projecting toward the wheel $f^{\times}$, and the wheel $f^{\times}$ is provided with a block f^{15} on the side adjacent to the wheel f^{5}. The wheel $f^{\times}$ also is provided with an annular series of openings preferably screw-threaded, in one of which is placed the screw or pin f^{16}. The projection of the wheel f^{5} is between the block f^{15} and the pin f^{16} of the wheel $f^{\times}$. The mutilated part of the gear f^{5} is in advance of the mutilated part of the wheel $f^{\times}$. When the pinion f^{11} comes to the mutilated part of the wheel f^{5}, that wheel, its shaft F^{3}, and the cam-wheel F^{2} remain stationary, but the wheel $f^{\times}$ is kept in motion until the pin f^{16} is brought in contact with the projection f^{14}. The wheel f^{5} is then moved forward until the teeth of the wheel again engage the teeth of the pinion. Both wheels move in unison until the pinion reaches the mutilated portion of the wheel $f^{\times}$, when that wheel remains stationary until the projection f^{14} comes in contact with the projection f^{15}, when the teeth of the wheel $f^{\times}$ are brought into engagement with the teeth of the pinion, and the two wheels again move in unison until the pinion f^{11} again reaches the mutilated part of the wheel f^{5}. When the pinion f^{11} has passed the mutilated part of one of the pattern-wheels, on reëngaging the teeth of the gear it may sometimes occur that a tooth of the pinion will strike the top of a tooth of the wheel. In order to provide against accident to the parts by reason of this, the shaft of the mutilated pattern-gears is elastically mounted so as to yield and prevent breaking.

The end of the shaft F^{3} which turns in the bracket F′ is preferably made with a curved bearing engaging surface to permit lateral movement of the opposite end of the shaft. (See Fig. 51.) The bracket F^{4} is slotted, and the block 5^{a}, through which the shaft passes, is placed in said slot and is supported by a spring 5^{b}. The force of the spring can be adjusted by a screw 5^{c} in a well-known way. Collars 5^{d} and 5^{e} are placed on shaft F^{3} on each side of the bracket F^{4} and keep the bearing-block 5^{a}, as well as the shaft, in position.

Should the teeth of the pinion engage the teeth of the mutilated pattern-gears, the shaft F^{3} will be forced downward, the spring 5^{b} yielding and carrying the shaft and the gears upward when a proper mesh has been secured.

In the construction shown in the drawings the two wheels $f^{\times}$ f^{5} make one entire revolution during the knitting of a single stocking; but such wheels may be made of such size and be so timed as to make more or less than a single revolution. These wheels control the number of rows of stitches put into a stocking, and when the rows of stitches are increased the cams on the cam-wheel are relied upon to distribute them between the foot and leg. The pin f^{16} can be adjusted to give the desired length to the stocking.

In knitting half-hose a ribbed section for the upper part of the leg is generally first run on the needles. In such cases the machine must be stopped after the completion of each stocking. When this is desired, I provide a pin f^{17}, which is secured to the mutilated wheel $f^{\times}$ by one or more screws entering the series of openings in such wheel. (See Figs. 7 and 39.)

The belt-shipper C has attached thereto a pawl c^{4}, to which is rigidly secured a handle or hand-grasp c^{5}. When the upper end of the belt-shipper is forced inward to shift the belt from the loose to the fast pulley, the pawl engages with the side of an aperture in the bed-plate c^{6}. The pawl c^{4} has a horizontally-extending flange c^{7}, which rests over an aperture in the bed-plate, in which is located a sliding rod C′. This rod extends downwardly and passes through an arm of the bell-crank lever C^{2}, pivoted to the bracket F^{4}. The rod C′ has a collar adjustably secured to it above the arm of the lever, so that the upward movement of the arm raises the rod and it in turn lifts the pawl c^{4} and releases it from its engagement with the bed-plate, permitting a spring c^{7}, (see Figs. 2 and 4^{a},) connected to the belt-shifter below the pivot of the same, to shift the belt to the loose pulley. One arm of the lever C^{2} extends into the path of the pin f^{17}, and said pin coming in contact therewith depresses that arm of the lever, effects the raising of the other arm, and the release of the belt-shifter. When it is desired to knit full-length hose, the pin f^{17} is removed from the wheel $f^{\times}$.

The clutch c' is not actuated to begin reciprocating work as soon as the clutch c is shifted to stop circular work, for reasons which will be made to appear hereinafter. The clutch c' is actuated by a separate mechanism operated from the mechanism which actuates the narrowing and widening devices and after this mechanism has been put in operation.

On the shaft A^{4} between the bevel-gears a^{10} and d^{4} is secured a worm h. This worm engages a worm-wheel h, mounted loosely on a pin or gudgeon h', supported by a bracket H. Rigidly connected with the screw-wheel h is a pinion h^{2}, which gears with a spur gear-wheel h^{3} also mounted on a pin or gudgeon

h^4, supported by the bracket H′. This pin h^4 is adjustably mounted in the bracket H′, the same passing through a curved slot therein, in which it is held by an appropriate clamping-nut. The spur-gear h^3 meshes with a gear-wheel h^5, mounted on a shaft H^2, which extends the whole length of the rear side of the machine and turns in bearings supported by or constructed in the frame of the machine. Upon the shaft H^2 near the left end of the machine is mounted a cam-wheel H^3, provided with the cam-grades h^6 h^7. A lever I is pivoted to a bracket I′. (See Figs. 3^a, 7, 17, and 18.) This lever I is provided with a forked end i, which engages the lower end of an arm j of the clutch-lever J. This clutch-lever controls the clutch c', is pivoted at j', and has a fork j^2 engaging a groove in the clutch in the usual manner. The upper end of the lever J extends upward through a slot in the bed-plate of the machine, so that it can be grasped by the operator when desired. The lever I has a part of the same expanded into the rectangular frame I^2. In this frame is secured the rod i', and a rod i^2 is loosely mounted in the frame and is free to slide transversely of the lever. A tappet-bar i^3 is secured to the rod i^2 and slides freely on the rod i'. To this tappet-bar is attached the tappet I^3, which is caused to alternately engage one of the cams h^6 or h^7. A spring j^3 is connected at one end to the frame of the machine and has its opposite end secured to the lever J, and when the lever J is free to respond to the tension of the spring it serves to move the lever, so as to bring the clutch into engagement with the bevel-gear a^3 and hold it in that position. When, however, the tappet engages with one of the cams h^6 or h^7, the lever I is raised and effects the movement of the lever J to release the clutch.

It is important that the movement of the lever I to effect the proper changes should be as nearly instantaneous as possible. To effect a quick movement, the inclines of cams h^6 h^7 must be of such length that one movement of the cam-wheel H^3 by the worm h will be sufficient to enable the tappet I^3 to pass to the highest grade of such cams. In order that this may be assured, a preliminary movement of the lever I is given by the forward extensions $h^{6\times}$ and $h^{7\times}$ of the cams. These extensions are of such a length that the tappet will be engaged and carried to the foot of the greater incline at one movement of the cam-wheel. The lever I is raised a short distance by this action and it and its connections with the clutch c' are brought into such a position that the next movement of the cam-wheel effects a sufficient movement of the clutch to stop reciprocating knitting.

During circular knitting for the leg or foot of the stocking the tappet I^3 rests on the highest grade of the cams h^6 h^7, and on the stoppage of circular work the shaft H^2 is put in motion, the cams are moved from under the tappet, permitting it to drop and the clutch c' to engage the bevel-wheel a^3, thereby starting reciprocating work. The cams h^6 h^7 are of different lengths, so that the number of courses of reciprocating knitting is varied according to whether the tappet is engaged by the cam h^6 or h^7. In knitting stockings it is desirable to have a greater number of short courses of stitches in the heel than in the toe. To effect this, the tappet is transferred from the cam h^6 to the cam h^7, or vice versa, as desired.

To the bracket I′ is pivoted an arm K, Figs. 7 and 20. This arm extends inward and has an upwardly-extending projection K′, having a position between collars k' k^2 on the rod i^2, sliding in the lever I. These collars are secured to the rod i^2 by set-screws and can be adjusted to the position desired. The inner end of the arm K is provided with a traveler K^2, (shown in dotted lines in Fig. 20,) which is at the lower end of a rod journaled in lugs k^3 k^4 on the arm K and secured in position by a collar k^5 and set-screw, the rod being free to turn in its bearings. By the side of the cam-wheel H^3 and on the same shaft is secured another wheel H^4, provided with a block having intersecting cam-grooves h^8 h^9. The traveler is approximately in line with the tappet I^3, and at the end of knitting the toe of a stocking the tappet I^3 will have engaged the front of the cam h^6 and the traveler will have entered groove h^8. The parts will remain at rest during the next succeeding courses of circular knitting for the leg of the stocking. The traveler having moved to about the intersection of the grooves h^8 and h^9 will have drawn the tappet somewhat toward the cam h^7. On the circular motion being again stopped the shaft H^2 is again intermittently moved by the screw-wheel H, and the traveler following the groove h^8 draws the rod i^2 toward the left end of the machine and the tappet I^3 onto the cam h^7, so that as soon as the other parts are in the proper position the tappet is permitted to drop and the reciprocating work is begun. The traveler remains at the side of the wheel during the revolution of the wheel and on completing its revolution the tappet engages with the cam h^7, while the traveler enters groove h^9. The motion of the shaft is arrested when the traveler is at or near the intersection of the cam-grooves and the tappet has been moved a part of the distance toward cam h^6. This operation knits the heel of the stocking. After the foot has been knit by circular knitting and the shafts A^3 and A^4 have been put into operation the shaft H^2 commences to move and the traveler follows the groove h^9 to the other side of the wheel H^4, transferring the tappet I^3 to cam h^6. A greater period elapses before the tappet leaves the cam h^6, permitting the narrowing devices to advance somewhat in their operations without knitting. When the tappet leaves the cam, the traveler is on the opposite side of the wheel H^4 from what it was on the previous movement of these parts, and

on the completion of the rotation of the shaft H^2 the tappet engages with the cam h^6 and is raised a little before the narrowing and widening devices have returned to their original positions, while the traveler enters groove h^8 and the motion of the parts is arrested with the traveler at the intersection of the grooves in like manner as before. This last cycle of operations forms the toe of the stocking with a less number of courses of stitches and less fullness than at the heel. Of course it will be understood that the cams h^6 h^7 might be shifted instead of the tappet.

It is desirable to have the fabric as it is knitted given a certain tension, and to effect this I employ a tension device L of ordinary construction, which is operated in a well-known way. On the commencement of the narrowing for heel or toe the needles out of operation and the first few needles thrown out of operation by the narrowing devices sustain the pull of the tension, and the loops upon the needles doing the reciprocating knitting are practically relieved from tension. In order to provide a tension for the needles in operation, I employ a device which I term the "heel and toe tension."

On the inside of the hollow cylinder b, to which the nosing is attached, is a web b', which serves as a guide or bearing for the upper end of a rod L', the upper end of which is provided with a knob or ball l, which affords a curved and smooth surface of considerable extent to engage the knitted web. Instead of the knob or ball the rod L' might be provided with a friction roll or wheel, the engagement of the web being on the outside of the knitted fabric adjacent to the needles between the fashioning-needles or those that are thrown out of operation during the process of narrowing. The rod L' extends downward to nearly the tension device L and loosely engages an opening in an arm L^2 of the rock-shaft L^3. A spring l' encircles the lower portion of the rod L' and bears upon the upper side of the arm L^2. The rod L' is provided with a collar l^2, secured to the rod by a set-screw, so as to be adjustable thereon. The rod L' is thus maintained in its position by the arm L^2 bearing against the spring l', which is made of such strength as to yield easily, so that when the upper end is brought in contact with the knitted material a gentle spring tension is applied thereto. On the shaft H^2 is mounted a cam-disk L^4, against which a short arm l^2 of the rock-shaft L^3 bears, the weight of the rod L' serving to keep the same in contact with the cam-disk. The disk L^4 is provided on the side with two cam-grades l^3 and l^4. The incline of the former is much longer than the latter. (See Fig. 38.)

The worm H, it will be noticed, which gives motion to the shaft H^2, has the flange engaging the worm-wheel straight for nearly its entire length and is inclined only a short distance at one end, so that as it engages the tooth in advance a short quick motion is given to the wheel. The remainder of the time during its revolution the thread or web of the screw merely serves to hold the worm-wheel stationary. The cam-disk L^4 is so adjusted upon the shaft H^2 that after a few courses of the heel or toe have been knitted the cam-grade l^3 is brought in contact with the arm l^2 and the rod L' is slightly raised, and at each revolution of the worm-wheel and each successive movement of the shaft H^2 it is raised a little higher until the highest part of the cam-disk is reached, which is about the time that the narrowing has been completed. The spring l' having been greatly compressed now exerts a considerable force or tension upon the knitted material during the widening, and when the heel or toe is completed the arm l^2 has reached the shorter cam-grade l^4, when the rod l' is lowered by one or two movements of the shaft H^2.

In knitting stockings it is desirable to knit the heel and toe with two threads or with a stronger and heavier thread than that used in the other parts of the stocking. In order to accomplish this, I employ two thread-guides M and N, (see Fig. 23,) the former for circular work and the latter for the heel or toe thread or threads for reciprocating work. These thread-guides are supported and operated in the following manner: A curved standard O (see Fig. 1) is secured to a bracket extending outward from the ring $B^\times$ at one side of the cylinder and a little to the rear of the same, and said standard extends irregularly upward, terminating in a bend, which forms a bearing for the upper end of the shaft $A^\times$, which extends upwardly in direct alinement with the shaft A. (See Figs. 23, 24, 25, and 41.) The shaft $A^\times$ is provided with a collar o beneath the standard. A plate P, provided with an upwardly-extending sleeve fitting loosely upon the shaft, rests on the standard and has a slot p, through which a bolt or screw passes and engages a threaded aperture in the standard. On the under side of the plate P is a rib p', which lies between two upwardly-extending flanges o^4 o^5 on the standard. Two screws o^6 o^7 pass through the flanges o^4 and o^5 and impinge against the rib p', by which the plate can be moved very small distances to secure a fine adjustment thereof. The screw or bolt passing through slot p when the plate is moved to the proper position clamps the plate and holds it rigidly in position. A bracket P' is placed above the plate P, which is provided with a hub p^2, which loosely engages the sleeve of plate P and turns upon the same as on a pivot. This bracket has an arm $p^\times$, which extends out over the needle-cylinder. This hub has a flange p^3, extending outward, which has a vertical opening therein and in which is movably located a pin p^4. The plate P is provided with two openings p^5 p^6, with which the pin p^4 may be made to engage. When brought into engagement with the opening p^6, the arm is over the cylinder and is retained in that po-

sition, and when the pin engages the opening p^5 it retains the arm away from the cylinder and out of operative position. A screw p^8, provided with a jam-nut, passes through a screw-threaded aperture in an upwardly-extending flange on the plate P and acts as a stop for the arm p^3 when moving it into operative position. The arm $p^\times$ of the bracket P′ at its free end is provided with a thread-guide hub p^9, which forms a bearing for both of the thread-guides, as will now be described. Inside of the hub p^9 is a hollow cylinder or shaft M′, to the upper end of which is secured the spur-gear m and to the lower end is secured the circular thread-guide M. The gear-wheel m is connected by idlers m' m^2 with a gear m^4, journaled on the upper side of the bracket-arm $p^\times$. The gear m^3 is loosely mounted on the upper end of the shaft $A^\times$. The hub of the gear m^3 is provided with the radially-extending lug m^4. The shaft $A^\times$ is provided at the top with the collar m^5, secured to the shaft by a set-screw. This collar has a radially-extending projection m^6, in which is movably mounted a pin m^7 in position to engage with the lug m^4 when the shaft is rotated. This construction provides for giving rotary movement to thread-guide M when the shaft $A^\times$ is rotated, and the collar m^5 is adjusted to give the guide the proper relation to the knitting-cams. When reciprocating work is being done, the thread-guide M remains stationary, the pin m^7 moving from one side of lug m^4 to the other without moving the gear m^3. In order that this may be done with certainty and regularity under all circumstances, I connect the two shafts A and $A^\times$, so that on oscillating the shaft A there is a little lost motion between the reverse movements of the shaft $A^\times$. To effect this, I provide the upper end of the shaft A, Figs. 42 and 43, with an upwardly-extending pin 4, and the shaft $A^\times$ is provided with a collar 5, rigidly secured thereto by a set-screw, which collar has a recess engaging the pin 4. This recess is some three or four times the diameter of the pin, and on oscillating the shaft A the pin engages first one side and then the other of the recess, giving the requisite lost motion to prevent the moving of the circular thread-guide.

On the outside of the hub p^9 is mounted the sleeve N′, which rests on the collar n^8. This sleeve is free to turn on the hub p^9, but is held stationary by friction unless power be applied to move it. In this instance I have shown the friction device N^2 secured to the under side of the arm $p^\times$ by the screw or bolt n. (See Fig. 37.) The friction device consists of two spring-arms n' n^2, the free ends of which bear against the sleeves N′, and between the supporting-bolt n and the sleeve the two spring-arms are connected by the bolt n^3, by which the pressure of the arms on the sleeve may be adjusted.

The upper end of the reciprocating thread-guide is forked, the two arms of the fork extending on opposite sides of the sleeve, where they are pivoted to the same. (See Fig. 36.) A lug n^4 on the sleeve beneath the thread-guide limits the inward movement of the guide. A spring n^5 has one end engaging an aperture in this lug, the other end being secured to the inner side of the thread-guide arm. This spring serves to maintain the guide in its inner or operative position unless withdrawn from it by the action of other devices.

The thread for the circular thread-guide is brought downward from some support through the interior of the hollow shaft M′. It then passes through an opening m^8 to the outside of the guide M, then downward through the opening m^9 to the needles. The thread or threads for the reciprocating thread-guide is brought downwardly from a support outside of the outer end of the arm $p^\times$ and passes through an opening n^6 in the lower part of the guide (see Fig. 50) and through the delivery-eye n^7 (see Fig. 49) to the needles. This delivery-eye is in a plate n^8, which is secured to the inside of the thread-guide N by screws n^9 n^{10}, passing through slots in the plate, securing the adjustment of the delivery-eye. The opening n^6 is at the junction of an outwardly-extending or offset portion of the guide with the main body. The plate n^8 is opposite this opening; but sufficient space is left between the offset portion and the plate to permit the thread to pass downward to the delivery-eye n^7. The bobbins supplying the threads may be supported upon the leaf 3 or in any other preferred manner. I provide a tension device q, which is in this instance mounted on the support Q. I also provide a take-up q', which is mainly of use in connection with the thread or threads for reciprocating work, though the thread for circular work may also be engaged thereby.

The thread-guide N when in operation is actuated by devices similar in some particulars to those used for operating the thread-guide for reciprocating work in my former patent, to which reference has been made herein; but in the present case the general principle of actuating the guide has been entirely changed and the devices for arresting the movement of the guide have also been modified.

The movement of the reciprocating thread-guide is effected from the upper cam-cylinder, which is oscillated to effect the knitting by the needles in operation during the forming of the heels and toes. Secured to the upper cam-cylinder, so as to move with it, is an inclosing casing R and the driver-plate R′. This casing is united to the upper cam-cylinder by overlapping the upper part of the cam-cylinder and forms an upward extension of the same. As it is really a part of the cam-cylinder, it is not separately referred to in my said former patent, but is described herein as a casing, as it cases in the upper part of the needle-cylinder. Its construction is

clearly shown in Fig. 2 of Sheet 3 of my former patent. This plate is pivoted to the casing at $r^{\times}$ or otherwise hinged to the casing, so as to have a short movement toward and from the said casing. A spring r' is employed to hold it normally in its outward position. The thread-guide has near the lower end of the same a portion extending outward beyond the plate containing the thread-delivery eye. On the inner side of this portion of the guide is the lug n^{11}. When this thread-guide is in position to present its thread or threads to the needles, the lug n^{11} presses against the casing R and the depending portion n^{12} is in the path of the upper end r of the driver-plate R'. When the plate is moved by the cam-cylinder, one of the square ends of the plate R' comes in contact with lug n^{12} and moves the guide with it; but it is not desired to move this guide much beyond the last needle in operation at the side of the machine. In order to stop the thread-guide at the points desired, I provide a driver-releaser and stop or bumper at each side of the machine. These devices differ from those of my former patent. I provide around the casing R a ring S, which is provided with a dovetail groove s. In this said groove are slides, to which are secured the stop-carriers S', one on each side of the machine. These stop-carriers embrace or otherwise engage with the standards S^2, connected with the picker-carriers of the machine. The connection between the picker-carriers and the stop-carriers is the same. The ring S and its groove are the same as in my former patent, No. 432,946, of July 22, 1890. Two levers S^3 S^3 are pivoted to these carriers at s', each of which is provided with a pin s^2 s^2 to engage with the recesses t t of an arm T, projecting upward from a rock-shaft T' at the back of the machine. One of the levers S^3 is provided with a stop s^3 and the other with a stop s^4, which arrest the motion of the thread-guide at the end of each of its movements in reciprocating work. Before the thread-guide comes in contact with these stops it is released from the driver by the releasers S^4, which are pivoted to the stop-carriers and when in operative position lie upon the top of ring S. One of these releasers is shown in Fig. 30 in a reversed position, the under side being uppermost. The driver R' has a rib or enlarged portion r^2 extending each side beyond the main portion of the driver. Each end of this rib or enlarged part r^2 has a cam or inclined surface r^3. The releasers are placed in such a position that a little before the thread-guide arrives at one of the stops the cam or inclined surface r^3 comes in contact with the releaser at that side of the machine. The movement of the cam-cylinder carries the driver past the releaser, the cam forcing the driver inward out of engagement with the thread-guide. The thread-guide working at all times under the retarding influence of the friction device N^2, the latter as soon as the driver is disengaged begins to retard the movement of the thread-guide and lessens the speed of the same and the force with which the guide engages the positive stop, which prevents further movement. The rear end of the releaser is provided with the inclined or cam surface $s^{\times}$, and on the return of the driver the end of the rib r^2 engages this cam-surface, lifting the releaser and permitting the driver to pass by the same in position to engage with the thread-guide and carry it to the other side of the cylinder, where the like series of operations take place. Each of the releasers is provided on its upper side with the lug or projection s^5, Fig. 3, lying close to the outer side of the levers S^3 S^3, and the stop s^4 is provided with the arm s^6, which lies inside of the lower end of the guide. When the operation of widening has been completed, the thread-guide is arrested by the stop s^4 outside of the arm s^6. The rock-shaft T' is then turned and its arm T forced toward the cylinder, which, pressing upon the pins s^2 s^2, throws the other ends of the levers S^3 S^3 outward, carrying the reciprocating thread-guide with it out of the path of the thread-guide for circular work. As the levers S^3 S^3 move outward they also engage lugs or projections s^5 on the releasers, causing them to turn on their pivots, thereby raising them out of all liability of contact with the circular thread-guide or with the driver R'. It sometimes happens that from some cause the movement of the reciprocating thread-guide N is arrested before it has been carried against the stop s^4 and over the arm s^6. It must then be moved into that position before the circular thread-guide M can pass it for circular work. To accomplish this, I provide the casing R with the cam projection 10^a. When circular work is resumed, this projection will be in advance of the circular thread-guide and coming into contact with the lug n^{11} of the reciprocating thread-guide will engage therewith and move the same with the casing until the thread-guide is carried over the arm s^6 of the stop s^4 and until it is arrested by said stop. The cam will then act to throw the thread-guide outward into the proper position for circular work.

The rock-shaft T' is operated in a different manner from the corresponding shaft in my former patent. The shaft has at one end a crank-arm t', which is connected by a link t^2 to a vertically-sliding rod T^2. This rod T^2 extends downward through the bed-plate of the machine and has a spring t^3 bearing upon the collar t^4, tending to force it downwardly. (See Figs. 19 and 20.) The cam-wheel H^3 has an opening h^{10}, on one side of which is a cam h^{11}. When the cam-wheel reaches the completion of its revolution, the rod T^2 drops into the opening h^{10}, the spring forcing it downward and drawing on the crank t', so as to rock shaft T' and force the arm T toward the needle-cylinder, thereby throwing the levers

S^3 outward—their proper position for circular work. As soon as the cam-wheel is set in motion the cam h^{11} comes in contact with the lower end of rod T^2, raising it and reversing the motion of the arm T and the levers S^3, bringing the latter into the proper position for the operation of narrowing and widening. The cam-wheel has no other opening in line with the rod T^2, and the latter is in consequence kept in its raised position until the completion of the narrowing and widening, when it again drops into the opening h^{10}. The stop-carrier, to which is attached the stop s^4, is also provided with an arm s^7, having a broad inwardly-extending flange, which is placed in such position that the arm s^6 of the stop s^4 passes over it when moved outward and so that the reciprocating thread-guide will lie between the stop s^4 and the flange of s^7, and this thread-guide will then be held positively from movement in either direction.

During the operations of narrowing and widening the circular thread-guide M should occupy a position over the needles at the back of the machine, which are thrown out of operation at that time. It is difficult to get stopping mechanism which will operate to stop the machine so as to have this thread-guide always in the position desired. I provide a means which brings this thread-guide and all parts of the machine into the proper position to commence reciprocating work. The gear-wheel a^{13} has a spring-pawl u secured thereto. This pawl has two straight faces on opposite sides, so that either side can act upon a radial projection. A sleeve U (see Figs. 13, 16, and 17) is mounted on shaft A′, so as to be capable of sliding longitudinally of the shaft and yet under all circumstances rotate with it. This is in this instance effected by providing the sleeve with two projections u^9 u^9, which engage grooves in a collar U′, rigidly secured to shaft A′. This sleeve, which I term the "placing-sleeve," at its end nearest wheel a^{13} is cut away the greater portion of the distance around the shaft A′, leaving a small portion u', having the inclined face u^2 and the radial face u^3. Adjacent to the portion u' is another portion of about equal size, u^4, having the radial face u^6 and the inclined face u^7. The sleeve U has a groove u^8, similar to the groove of a clutch, and this is engaged by one arm v of a triple-armed lever V, mounted on the bracket I′. One arm of the lever V has a friction-roll engaging a groove on the sleeve U. Another arm v' is connected by a spring v^2 with the bracket, so that the force of the spring tends to force the sleeve toward the wheel a^{13}. The other arm v^3 of the lever is so located as to engage the cam h^6 on the cam-wheel H^3. The arm v^3 is rearward of the tappet I^3 and in the position of rest is near the rear end of the cam h^6. The pawl u during circular work rests in the plane of the part u' of the sleeve, and as the shaft A′ is rotated the incline u^2 passes under and raises the pawl u, which drops upon the shaft after passing the radial face u^3. When circular work is stopped and the narrowing and widening devices and the rack A^5 are put in motion, the wheel a^{13} is given an oscillating motion, carrying the pawl u with it. When the pawl comes in contact with the radial face u^3, the shaft is locked with the wheel and turns with it to the full extent of its movement. It makes no difference in what position the shaft A′ is left on the stoppage of circular motion, the pawl on engaging with the face u^3 always moves the shaft A to the same position. The shaft A′ carries with it the needle-cams and circular thread-guide, and as this movement is in the same direction as during circular work both cam-cylinders are moved, and thread is supplied to the needles during this movement. The pawl u leaves the lower cam-cylinder and the circular thread-guide in proper position for reciprocating work. On the completion of this movement the cam h^6 passes from under the arm v^3 of the lever V and the spring v^2 moves the sleeve U toward the gear-wheel a^{13}, bringing the part u^4 of the sleeve in line with the pawl. On the retrograde movement of the rack the opposite face of the pawl engages the radial face u^6 of the sleeve and turns the shaft in the opposite direction. The rod T^2 having by this been raised and the levers S^3 thrown inward, the reciprocating thread-guide and the upper cam-cylinder are moved thereby and brought into the proper position to commence reciprocating work. As the cam-wheel completes its revolution the cam h^6 engages the arm v^3 in advance of the tappet I^3 and retracts the sleeve to the position for circular work in advance of the shifting of clutches c' and c.

In knitting stockings it is desirable to have the stitches of different lengths at different parts to produce an article of the required capabilities. For instance, in knitting full-length hose the upper part of the leg should be knit with longer stitches than the lower or ankle part of the leg. It is also desirable that the stitches should be longer during the formation of the heel and toe, so that these parts may have the requisite size. I accomplish this automatically by devices shown in Figs. 2, 10, 11, and 12.

As has been before explained, the nosing of the needle-cylinder is secured to a means extending downward inside the needle-cylinder. This means may be itself a cylinder, or it may be of the form shown in Fig. 48. In the lower part of the nosing-support is a horizontally-disposed slot w, which receives a crank-pin or eccentric w' on a shaft W, journaled in one of the supports B^{33} of the ring $B^{\times}$, surrounding the needle-cylinder at or near the lower edge of the lower cam-cylinder. This shaft W has secured to it a crank w^2, extending downward, and a link w^3 connects this crank with the upwardly-extending

arm of a three-armed lever W′, journaled at w^4. The weight of the nosing and its support tends to move the crank w^2 in the direction of the arrow 4, Fig. 10, and an arm w^5 is secured to the crank, through a screw-threaded aperture of which a stop-screw w^6 extends and which is provided with a jam-nut w^7 to firmly hold the same in place. The screw is adjusted to the position in which it is desired to have the nosing during the knitting of the shortest stitch. The lever W′ has an arm w^8, which extends to the left and over the outer end of an independent lever Y, which is in this instance journaled on the pivot of the lever W′. The cam-wheel F^2 is provided with a cam-grade f^4 out of the vertical plane of the cam-grades f^3 f^2. The lever Y is arranged to bear upon this cam-grade and when it is raised thereby is brought into contact with the arm w^8 of the lever W′, raising the same and turning the crank w^2 in a direction opposite the arrow 4, whereby the nosing is raised and the stitches lengthened. When the cam-grade f^3 is in position for commencing the leg of the stocking, the cam f^4 will be in position to give the greatest length of stitch, and this cam gradually curves downward to gradually decrease the stitch.

In order to afford means for adjusting the length of stitch, the arm w^8 is provided with a screw w^9 and jam-nut w^{10}. An arm w^{11} of the lever W′ extends to the right or on the side opposite of arm w^8. The clutch-actuating rod E is provided with a collar E^5, adjustably secured thereto by a set-screw. This collar is provided with the cam projection E^6 to engage with the arm w^{11}. When the rod is forced to the left to stop circular work and set in motion the narrowing and widening devices, this effects a lengthening of the stitch throughout the whole operation of forming the heel or toe of the stocking. The arm w^{11} is provided with a screw w^{12} and jam-nut to enable the length of stitches to be adjusted.

I employ in my present machine the same means for holding the needles in proper position as in my former patent. In this case I provide a means for holding the needles which are thrown out and into operation during the operation of narrowing and widening and which are termed "fashioning-needles" in the proper position for circular knitting during circular work—that is, securing these needles from being thrown too high or being by accident drawn upward out of working position. These needles x^2 are provided at their lower ends with a nib x^4 to be engaged by the picker for throwing them out and into operative relation with their actuating-cam. On the under side of ring $B^\times$ are pivoted two arms Z Z, (see Fig. 33,) carrying at their inner ends the retainer-bars z z, which fit against the needle-cylinder above the picker-nibs of the fashioning-needles. A spring z' z' is connected with each arm Z Z and has its other end connected with the ring $B^\times$ or with some other part of the framing and serves to hold the retainers in position against the needle-cylinder.

The fashioning-needles are operated during the operations of narrowing and widening by pickers which are of substantially the same construction and are operated by substantially the same means as in my former patent hereinbefore referred to.

The picker-carriers are each provided on their inner side with a short rib z^2, which forms a continuation of each retainer z z and holds the fashioning-needles nearest the pickers. The outer ends of these ribs are pointed or beveled at top and bottom, and the retainers are provided with a notch registering with the sharp end of the rib, so that when the picker-carriers are in position for circular work the retainers engage the ends of the ribs, and this engagement serves to additionally secure the retainers from movement during circular knitting. The arms Z Z are so placed that as the picker-carriers are advanced to bring the pickers in position under the first of the fashioning-needles the carriers engage the said arms and carry them outward against the tension of the springs z' z' and away from the needles. This outward movement is continued through the process of narrowing. The reverse movement of these arms takes place during widening, and when that operation is completed the retainers will be in proper position over the nibs x^4 of the fashioning-needles. In Fig. 33 the retainer at the left is shown in its normal position, or the position which it assumes during circular knitting, and the picker at the right is shown as thrown out to nearly the full extent of its outward movement.

The two cam-cylinders are in this case driven by two gear-wheels B^4 B^5 upon the vertical cylinder-shaft. In order that the lower cam-cylinder may not be operated during reciprocating work, the gear-wheel for actuating the same is loosely mounted upon a sleeve extending from a stationary bearing of the shaft A, so that the oscillation of the shaft will have no tendency to move the gear-wheel by friction. The gear-wheel B^5 has on its upper side the radial projection 9. Above the gear-wheel a driver-collar 10 is placed loosely upon the shaft, which has a downwardly-extending lug 11 to engage the lug 9 of the gear-wheel and an upwardly-extending lug 12. A collar 13 is adjustably secured to the upper gear-wheel B^4, and said collar is rigidly secured to the shaft. The wheel B^4 has a rectangular opening in the center, and in this opening the collar 13 is placed. Flanges 13^a on diametrically opposite sides of the shaft $A^\times$ extend beyond the walls of this opening, and set-screws 13^b pass through curved slots in said flanges into the wheel. Intermediate the flanges 13^a the collar is provided with arms 13^c 13^c. At one side these arms are shown in Fig. 42 as provided with screws 13^d 13^d, which enter threaded aper-

tures in the arms and have their heads bearing against lugs 13^e 13^e at the side of the central opening in the wheel. These screws may be turned in any way desired. I have here shown them provided with small openings 13^f 13^f, in which a pin may be inserted. The same construction may be and usually is employed on the opposite side of the shaft. The screws 13^d are turned to effect the proper turning between the shaft $A^\times$ and the wheel B^4, and the set-screws 13^b are then turned tightly against the flanges 13^a, holding the parts firmly together. This collar 13 has a downwardly-extending lug 14 to engage the lug 12 of the collar 10. The parts are arranged, as best shown in Fig. 42, so that on rotating the shaft in the direction of the arrow shown in that figure the lug 14 of the collar 13 will engage the lug of collar 10, and the lug 11 of the latter will engage the lug 9 of the lower gear-wheel B^5 and move that wheel in unison with the shaft and the gear-wheel B^4. When the shaft A is oscillated for reciprocating work on the movement of the shaft in the direction opposite to that of the arrow, Fig. 42, the lug 14 leaves the lug 12 and the wheel B^5 remains stationary. The gear-wheel B^4 is given more than a single revolution to effect the proper movement of the cam-cylinder; but that effects no movement of the lower gear-wheel, as the continuation of the reverse movement last referred to brings the lug 14 in contact with the opposite side of the lug 12 and moves the collar 10 with it, carrying the lug 11 away from the lug 9 of the gear-wheel B^5. Thus a movement of nearly two revolutions of the shaft A is permitted without moving the lower gear-wheel. On a resumption of circular work the parts automatically resume the position shown in Fig. 42. This construction is found very cheap and effective for the purposes desired.

In Fig. 48 I have shown a modified form of the supporting device for the nosing. Instead of the cylinder the nosing is secured to a ring 7, which is connected by rods 8 to a ring 8′ beneath the same and which ring is provided with the slot to engage the crank or eccentric on the shaft W.

Operation: The operation of the machine will be apparent, it is thought, from the foregoing description, but it is deemed best to give a description of the operations of the machine when knitting full-length hose. In doing this the pin f^{17} is removed from the mutilated wheel f^4. The arm Y has just reached the highest part of the cam-grade $f^\times$, and the lever F also has its bearing portion on the high part of the cam-grade engaged by it, and clutch c is in engagement with the gear-wheel a^2. As the shaft A is revolved the lugs 14, 12, 11, and 9 of collars 13, 10, and gear-wheel B^5 are brought into contact and the wheel B^5 is caused to rotate with the wheel B^4, giving a simultaneous rotary movement to the two cam-cylinders. The pin 4, connected with the shaft A, engages with one side of the recess in collar 5 and the shaft $A^\times$ is rotated, carrying the thread-guide M around with the cams. As the two cams are arranged one above the other and each operates on one-half of the needles the thread-guide is in position for both, and while the one cam operates first one half and the other the other half of the needles after the thread is supplied as desired and continuous circular work is produced. As the work progresses the lever Y goes slowly down the incline of the cam-grade $f^\times$ and the stitches are shortened. During this period the mutilated gears actuating the cam-wheel F^2 retard the motion of the said wheel, so that the proper length of leg is secured. As soon as the cam-wheel F^2 is moved, so that the portion f' of the lever F bearing upon the cam-wheel drops from the cam-grade f^3, the rod E is then moved to the left, as before described, and the circular work ceases. This movement of the rod E brings the cam E^6 into engagement with the arm w^{11} of the lever W′ and raises the nosing to lengthen the stitches. At the same instant the shafts A^3 and A^4 are put in motion, thereby starting the mangle-wheel d^3 and the picker-carriers. The pickers commence to move as soon as the shaft A^3 moves; but as they are not in alinement with the fashioning-needles they effect no result. As soon as the shaft A^4 begins to revolve the rack A^5 is reciprocated and the wheel a^{13} is oscillated on shaft A′. The pawl u thereupon moves the circular thread-guide into its position for reciprocating work, which is nearly centrally above the needles operated by the lower cam-cylinder. The rod T^2 is now raised and the stop-levers S^3 carried into position, releasing the reciprocating thread-guide. The arm v^3 now leaves the cam h^6 and the sleeve U is moved toward the gear-wheel a^{13}, permitting the pawl u to turn the upper cam and the thread-guide N into position to begin reciprocating work. During these operations the detent-lever e^7 has been lowered to lock the shifting-rod E and the pickers have been brought under the first of the fashioning-needles. The further movement of the shaft H^2 now carries the cam h^7 from under the tappet I^3 and the spring j^3 throws the clutch c' into engagement with the gear-wheel a^3, setting the upper cam-cylinder in motion and reciprocating work is begun. The narrowing and widening is carried on in the usual way. The previous movements of the cam-shaft H^2 have brought the arm l^2 of the shaft L^3 close to the longer cam-grade l^3 of the face-cam L^4. After two or three reciprocations of the cam-cylinder the cam l^3 begins to act upon said arm, turning the shaft L^3 slowly and gradually raising the tension-rod L′. The upper end l of this rod engages with the outside of the knitted work and pushes it upward, effecting the required tension on the needles in operation, until at the close of the operation of widening the tappet I^3 is raised

by the cam h^7, the lever I raised, and the clutch c' withdrawn from engagement with the gear-wheel a^3. This stops reciprocating work, but the shaft A^4 and the mangle-wheel continue to move. As soon as reciprocating work is stopped the arm l^2 of the shaft L^3 reaches the short cam-grade and the rod L' is lowered by one or two movements of the shaft H^2. By the continued movement of the shaft A^4 and mangle-wheel the pickers are withdrawn from beneath the fashioning-needles and the tappet d^{14} raises the detent-lever e^7. By this time the bearing f' of the lever F has been brought upon the shorter cam-grade f^2 of the cam-wheel F^2 and the spring e^5 is compressed ready to move the rod E to the right. Just before the shifting-rod E is released the rod T^2 drops into the recess h^{10} in the cam-wheel H^3 and the reciprocating thread-guide is moved outward by the arm s^6 out of the path of the circular thread-guide and where it is locked from all movement. The detent-lever e^7 is then raised and the shifting-rod E shifts clutch c to engage gear-wheel a^2 and circular work is resumed. The movement of the shifting-rod to the right releases the arm w^{11} of the lever W', causing the nosing to descend and the stitches to be again shortened. There is now no cam-grade to act on the lever Y, and the foot of the stocking is knitted with short stitches. As soon as the cam-grade f^2 has been moved from under the bearing f' of the lever F the same operations are repeated, except that as the tappet I^3 has now been moved onto the cam h^6 a greater period of time elapses between the moving of the shifting-rod E and the moving of the clutch c' to engage the gear-wheel a^3. During this period the narrowing mechanism has been at work and one or more of the fashioning-needles, as found most desirable, have been thrown up on each side. The reciprocating work is then commenced to form the toe of the stocking. In this case as the operation of widening approaches its close the tappet I engages the cam h^6 earlier than it previously engaged the cam h^7. The stopping of reciprocating work occurs while there are still two or three of the fashioning-needles in a raised position; but as circular work cannot be resumed until the mangle-wheel has returned to its normal position and as the narrowing and widening mechanism continues to move as long as the mangle-wheel moves these needles are all depressed before the detent-lever is raised to release the shifter-rod E. As the mangle-wheel approaches the position in which the tappet d^{14} connected to and moving therewith will raise the detent-lever e^7 the bearing f' of the lever F will have been brought upon the highest part of the cam-grade f^3 and the spring e^5 again compressed. As the mangle-wheel and the narrowing and widening devices approach their positions of rest the tappet d^{14} again raises the detent-lever e^7 and circular work is again commenced on the upper end of the leg of another stocking.

Of course it will be understood that the cam-wheel F^2 and its driving mechanism and the other coacting parts can be so arranged as to knit the toe first, then the foot and heel and the leg, as well as to knit them in the order narrated.

What I claim, and desire to secure by Letters Patent, is—

1. A circular-knitting machine organized for circular and reciprocating work and having narrowing and widening devices, said machine having mechanism for automatically stopping circular work and starting the narrowing and widening devices, and means for thereafter automatically starting reciprocating work, substantially as described.

2. In a circular-knitting machine the combination with the stitch-forming mechanism and narrowing and widening devices, of means for automatically stopping circular work and starting the narrowing and widening devices, mechanism for thereafter automatically bringing the stitch-forming devices to the proper position for reciprocating work and automatic devices for thereafter starting reciprocating work, substantially as described.

3. In a circular-knitting machine organized for circular and reciprocating work, the combination with the stitch-forming mechanism and narrowing and widening devices of automatic means for simultaneously stopping circular work and starting the narrowing and widening devices, automatic mechanism for bringing the stitch-forming devices to the proper position to begin reciprocating work and like devices for starting reciprocating work, substantially as described.

4. A circular-knitting machine organized for circular and reciprocating work and provided with mechanism for stopping and starting circular work and mechanism for starting and stopping reciprocating work, the said mechanism controlling reciprocating work having provisions for starting reciprocating work a greater and a less time after the stopping of circular work and for stopping reciprocating work a greater or less time before the starting of circular work.

5. In a knitting-machine the combination with a clutch of a shifter-rod connected with said clutch, two springs of unequal strength mounted on said rod, and mechanism for compressing and releasing the stronger spring whereby said rod is moved longitudinally, in one direction from the compression of the spring and in the opposite direction by the release of the said spring, substantially as described.

6. In a knitting-machine the combination with the clutch, of the shifter-rod connected therewith and its springs, of the spring-compressing lever and cam actuating said lever, substantially as described.

7. In a knitting-machine the combination

with a clutch, of a shifter-rod for said clutch, two springs of unequal strength mounted on said rod, means for compressing the stronger spring, detent mechanism holding the shifter-rod against movement during the compression of said spring and means for releasing the said shifter-rod to permit the stronger spring to move the clutch and compress the weaker spring, substantially as described.

8. In a knitting-machine, the combination with a clutch, of a shifter-rod for said clutch, two springs of unequal strength upon said rod, means for compressing the stronger spring, detent mechanism for holding the rod against movement during the compressing of the spring, means for releasing said detent mechanism to permit the stronger spring to move the clutch and compress the weaker spring, and mechanism for releasing the stronger spring from pressure to permit the weaker spring to move the clutch in a reverse direction, substantially as described.

9. In a knitting-machine organized for circular and reciprocating work, the combination with a clutch controlling circular knitting, of a shifter-rod for said clutch, two springs of unequal strength upon said rod, means for compressing the stronger spring, detent mechanism for holding the rod against movement during such compression and means connected with the parts active during reciprocating work to release said detent mechanism at the end of reciprocating work to permit the stronger spring to move the shifter-rod and clutch to start circular knitting and to compress the weaker spring, substantially as described.

10. In a knitting-machine the combination with shifter-rod and a spring mounted on the same, of the lever for compressing said spring and the cam-wheel provided with cam-grades having adjustable parts, substantially as described.

11. In a knitting-machine the combination with the shifter-rod and springs, of the lever and cam for compressing a shifter-rod spring and driving mechanism for said cam including among its members two mutilated gear-wheels on the cam-shaft and a pinion engaging said gear-wheels and operative connections between the said gear-wheels, substantially as described.

12. A circular-knitting machine, organized for circular and reciprocating work, having a heel and toe tension yieldingly engaging the outside of the fabric, substantially as described.

13. In a circular-knitting machine organized for circular and reciprocating work, the combination of a heel and toe tension, yieldingly engaging the outside of the fabric adjacent to the needles between the fashioning-needles and means for gradually increasing the power of the tension device, substantially as described.

14. In a circular-knitting machine organized for circular and reciprocating work the combination with the heel and toe tension yieldingly engaging the outside of the fabric, the cam for raising said tension and means for intermittently operating said cam, substantially as described.

15. In a circular-knitting machine organized for circular and reciprocating work, the combination with a cam operative during reciprocating work and narrowing and widening devices, of a cam stationary during reciprocating work, means for stopping circular work, mechanism actuated independently of said stopping means for bringing the said stationary cam to a predetermined position of rest, and means for thereafter starting reciprocating work, substantially as described.

16. In a circular-knitting machine organized for circular and reciprocating work having a cam operative during circular and stationary during reciprocating work, the combination with said cam of means for stopping circular work, independently-actuated means for bringing the said cam to a predetermined idle position for reciprocating work, and means for thereafter starting reciprocating work, substantially as described.

17. In a circular-knitting machine organized for circular and reciprocating work, the combination with a cam operative during reciprocating work and narrowing and widening devices coöperating therewith, of means for simultaneously stopping circular work and starting the narrowing and widening devices, means for bringing the said cam to the proper position to begin reciprocating work and means for thereafter starting reciprocating work, substantially as described.

18. In a circular-knitting machine organized for circular and reciprocating work, the combination with two cams operative during circular work, one of which is stationary during reciprocating work, of means for stopping both cams to stop circular work, independent means for bringing the cam stationary during reciprocating work to the proper position of rest, means for bringing the other cam into the proper position to commence reciprocating work and means for thereafter starting reciprocating work, substantially as described.

19. The combination with the main operating-shaft, of the double-faced pawl journaled to a part loosely mounted on the said shaft, means for oscillating the pawl about the shaft and the placing-sleeve, substantially as described.

20. The combination with the main operating-shaft, of a double-faced pawl journaled to a part loosely mounted on the said shaft, means for oscillating said pawl about the shaft, the placing-sleeve having two parts to engage said pawl and means for moving said placing-sleeve, substantially as described.

21. The combination with the main operating-shaft, of a gear-wheel loosely mounted on said shaft, a double-faced pawl journaled on said wheel, a rack engaging said wheel, the

placing-sleeve and a cam for moving said sleeve, substantially as described.

22. In a circular-knitting machine organized for circular and reciprocating work, the combination with two cams in different planes to stop and start reciprocating work, of a tappet to engage the said cams, the said cams and tappet being, the one movable in respect to the other to cause the tappet to be engaged by either of said cams, substantially as described.

23. In a circular-knitting machine organized for circular and reciprocating work, the combination with two cams in different vertical planes, said cams being of different lengths, of a tappet to engage said cams and mechanism to shift the tappet from the plane of the one to the plane of the other, substantially as described.

24. The combination with the tappet-lever and the cam-wheel operating the same, having different cam-grades to engage the said tappet, of the tappet movably connected with the tappet-lever and tappet shifter-cam operatively connected with said tappet, substantially as described.

25. The combination with the tappet-lever and its movable tappet, of the cams for engaging said tappet, the tappet shifter-cam having intersecting cam-grooves and the follower engaging said grooves, substantially as described.

26. In a circular-knitting machine organized for circular work, the combination with the two cam-cylinders of the driving gear-wheels therefor having projections, one of said wheels being loose upon the shaft, of the driver-collar mounted loosely upon said shaft between the two wheels and adapted on the rotation of the shaft in one direction, to engage with the projections of said wheels, substantially as described.

27. The combination with the vertical cylinder-shaft, of the cylinder gear-wheels, the one of which is fast and the other loose on the shaft and the driving-collar between the two and having a loose engagement with both, substantially as described.

28. The combination with the vertical cylinder-shaft, of the cylinder gear-wheels, one of which is fast upon the shaft, the two wheels each having a projection extending toward the other, of the driving-collar between the wheels having projections extending toward each gear-wheel, substantially as described.

29. The combination with the vertical cylinder-shaft of an extension-shaft in line therewith, the circular thread-guide, a wheel loosely mounted on said extension-shaft operatively connected with the thread-guide, said wheel having a projection engaged by a projection on the said shaft and provision for lost motion between the shafts on oscillating the vertical cylinder-shaft, substantially as described.

30. In a circular-knitting machine organized for circular and reciprocating work, the combination with two cams operative during circular work one of which is stationary during reciprocating work, of two thread-guides, one operative with the two cams during circular work, the other operative with the cam operating during reciprocating work, automatic means for stopping circular work and the circular thread-guide and independent means for starting reciprocating work and putting the reciprocating thread-guide into action, substantially as described.

31. In a circular-knitting machine organized for circular and reciprocating work, the combination with two cam-cylinders operative during circular work, of a thread-guide coacting therewith, a thread-guide operative during reciprocating work, and automatic means for throwing the one thread-guide out of and the other into operation, substantially as described.

32. In a circular-knitting machine the combination with a standard extending upward from the bed-plate of the machine, a plate adjustably mounted on said standard, a thread-guide-supporting bracket supported by said plate and adjustable thereon, substantially as described.

33. The combination with the standard, of the thread-guide-supporting plate, a thread-guide supported thereby and the rib and screw constructed for fine adjustment interposed between the two and the clamping-bolt, substantially as described.

34. The combination with the circular thread-guide of the pivoted reciprocating thread-guide, the stop-lever provided with an arm extending on the inside of the reciprocating thread-guide and means for moving said stop-lever outwardly to move the reciprocating thread-guide out of the path of the circular thread-guide, substantially as described.

35. The combination with the reciprocating thread-guide, of the stop-lever having an arm extending inside of the thread-guide, means for throwing the stop-lever into and out of operative position and the locking-plate, substantially as described.

36. The combination with the circular thread-guide of the hollow shaft secured thereto, the bearing for said shaft and a reciprocating thread-guide movably mounted on said hollow shaft, substantially as described.

37. In a circular-knitting machine the combination with the circular thread-guide and the hollow shaft to which it is secured, of a reciprocating thread-guide movably mounted on said hollow shaft means for rotating the circular guide and means for reciprocating the reciprocating thread-guide, substantially as described.

38. In a circular-knitting machine organized for circular and reciprocating work, the combination with the knitting-cylinder and its needles, of a circular thread-guide following one undeviating path around said cylinder and a reciprocating thread-guide for mov-

ing in alternate directions less than entirely around the needle-cylinder, means for moving the said circular guide out of the path of the reciprocating guide and means for moving the reciprocating guide out of the path of the circular guide, substantially as described.

39. The combination with the stationary needle-cylinder, of the movable nosing, the lever operatively connected with the said nosing, the cam, an independently-movable lever for engaging said cam adapted to engage an arm of the nosing-actuating lever, substantially as described.

40. In a circular-knitting machine organized for circular and reciprocating work including fashioning-needles, having nibs for engagement with the pickers of the narrowing and widening devices, narrowing and widening devices including pickers, and retainers for said fashioning-needles above said nibs, substantially as described.

41. In a circular-knitting machine organized for circular and reciprocating work including fashioning-needles and narrowing and widening devices, the combination with the said fashioning-needles, of the picker-carriers and the pivoted retainers for the said needles, substantially as described.

42. The combination with the needle-cylinder and fashioning-needles, of the picker-carriers having a rib forming a retainer for the fashioning-needles opposite the same, of pivoted retainers engaging and forming a continuation of said rib, substantially as described.

43. The combination with the stop-levers, of the rock-shaft having an arm for engaging and controlling said stop-levers, and an adjusting-arm, of a rod for engaging the actuating-arm, and a cam for actuating the rod, substantially as described.

44. The combination with a cam-cylinder operative during circular and reciprocating work, of the thread-guide for reciprocating work and the cam projection operatively connected with said cylinder for moving the thread-guide and throwing it out of its operative position, substantially as described.

45. The combination with the mutilated pattern-gears and their shaft, their actuating-pinion and an elastic bearing for the shaft of said pattern-gears, substantially as described.

46. In a circular-knitting machine having needle-actuating means adapted to rotate and reciprocate, the combination of two yarn-guides, a support for said guides independent of said needle-actuating means, means to rotate one of said guides with the said actuating means when the said means is rotated, and other means reciprocating the other of the said guides with the needle-actuating means when said means is reciprocated, substantially as described.

47. A knitting-machine containing the following instrumentalities: a needle-cylinder to contain a series of needles, a cam-cylinder having suitable cams to actuate said needles, two independent detached thread-carriers, one to provide the said needles with thread for circular knitting, and the other to provide them with thread for reciprocating knitting, an independent actuating means for said carriers, each moving in unison with the cam-cylinder, a means to render one and then the other of said actuating means effective in moving its own thread-carrier and then leave it at rest while the other thread-carrier is operated, substantially as described.

48. A knitting-machine containing the following instrumentalities: the needle-cylinder to contain a series of needles, a cam-cylinder having suitable cams to actuate said needles; a thread-carrier support and thread-carrier to supply thread to said needles while circular knitting is being done, means to rotate said thread-carrier on said support for circular knitting, and to stop the operation of the said thread-carrier and leave it at rest during reciprocating knitting, substantially as described.

49. A knitting-machine containing the following instrumentalities: a needle-cylinder to contain a series of needles, a cam-cylinder having a cam to actuate said needles, two independent detached thread-carriers, one to provide the said needles with thread for circular knitting, and the other to provide them with thread for reciprocating knitting, an actuating means for said carriers whereby they are moved in unison with the cam-cylinder, and means to move them independently of each other, substantially as described.

50. In a circular-knitting machine, the combination with needle-actuating mechanism, of two thread or yarn guides detached from the needle-actuating devices, a support for said guides, means for rotating one of said guides to deliver thread to the needles when the said needle-actuating mechanism is rotated, and means for reciprocating the other of said guides when the needle-actuating mechanism is reciprocated, substantially as described.

51. In a circular-knitting machine, the combination of the following instrumentalities; a needle-cylinder to contain a series of needles, needle-actuating devices, two detached thread-guides, one for circular knitting and one for reciprocating knitting, actuating mechanism to move one to supply thread to the needles during circular knitting and actuating mechanism to move the other to supply thread to the needles during reciprocating knitting and means to render the said actuating mechanism of the said guides effective to move one thread-guide to deliver thread to the needles for circular work, and then to leave this guide at rest and to move the other guide to supply thread to the needles for reciprocating knitting, substantially as described.

52. A circular-knitting machine containing the following instrumentalities; a needle-cyl-

inder to contain a series of needles, needle-actuating devices, two independent thread-guides one for circular knitting and one for reciprocating knitting, independent actuating mechanisms for said guides, means for maintaining one guide and its actuating mechanism at rest while the other guide and its actuating mechanism are in operation, and for throwing the operative guide out of operation and putting the other in operation, substantially as described.

53. A knitting-machine containing the following instrumentalities; a needle-cylinder to contain a series of needles, needle-actuating mechanism, a thread guide or carrier support, and a thread-carrier operatively carried by said support, means to rotate said guide or carrier to supply thread to the needles during circular knitting and to stop said guide or carrier and leave it at rest during reciprocating knitting, substantially as described.

54. A circular-knitting machine containing the following instrumentalities; a needle-cylinder to contain a series of needles, needle-actuating devices, a thread-guide support and a thread-guide movably supported thereon, devices to actuate said thread-guide on said support and to stop said guide independently of the said needle-actuating devices and to hold it out of operation during circular knitting, substantially as described.

55. A circular-knitting machine containing the following instrumentalities; a needle-cylinder to contain a circular series of needles, needle-actuating devices, two independent detached thread guides or carriers, actuating means to move said guides independently of each other to cause one to supply thread to the needles during circular knitting and the other to supply thread to the needles during reciprocating knitting, substantially as described.

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

EDWARD E. KILBOURN.

Witnesses:

CHAS. W. KILBOURN,

W. N. LINCH.