

No. 627,786.

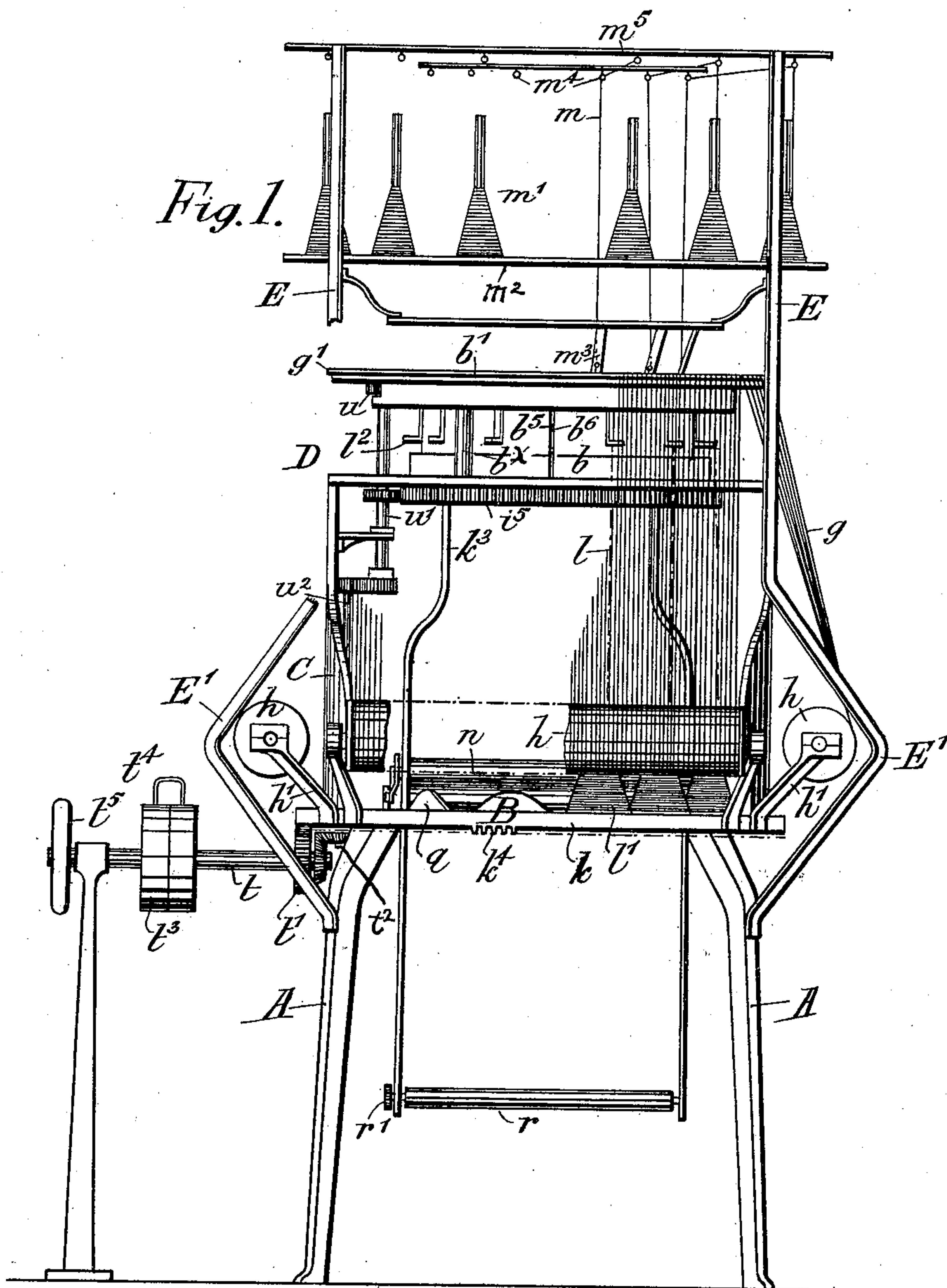
Patented June 27, 1899.

J. WATERFIELD.
KNITTING MACHINE.

(Application filed June 28, 1898.)

(No Model.)

5 Sheets—Sheet 1.



Witnesses
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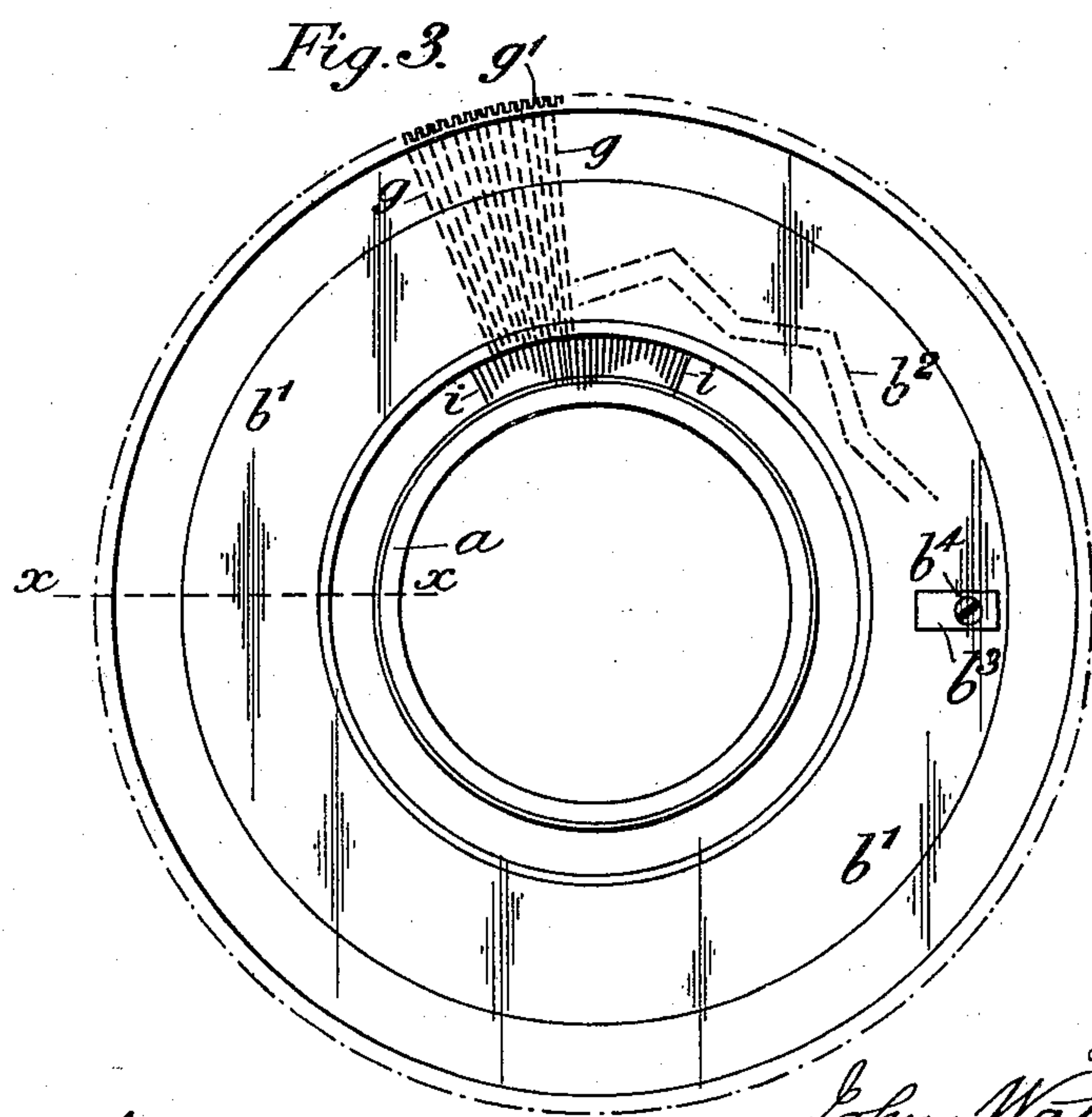
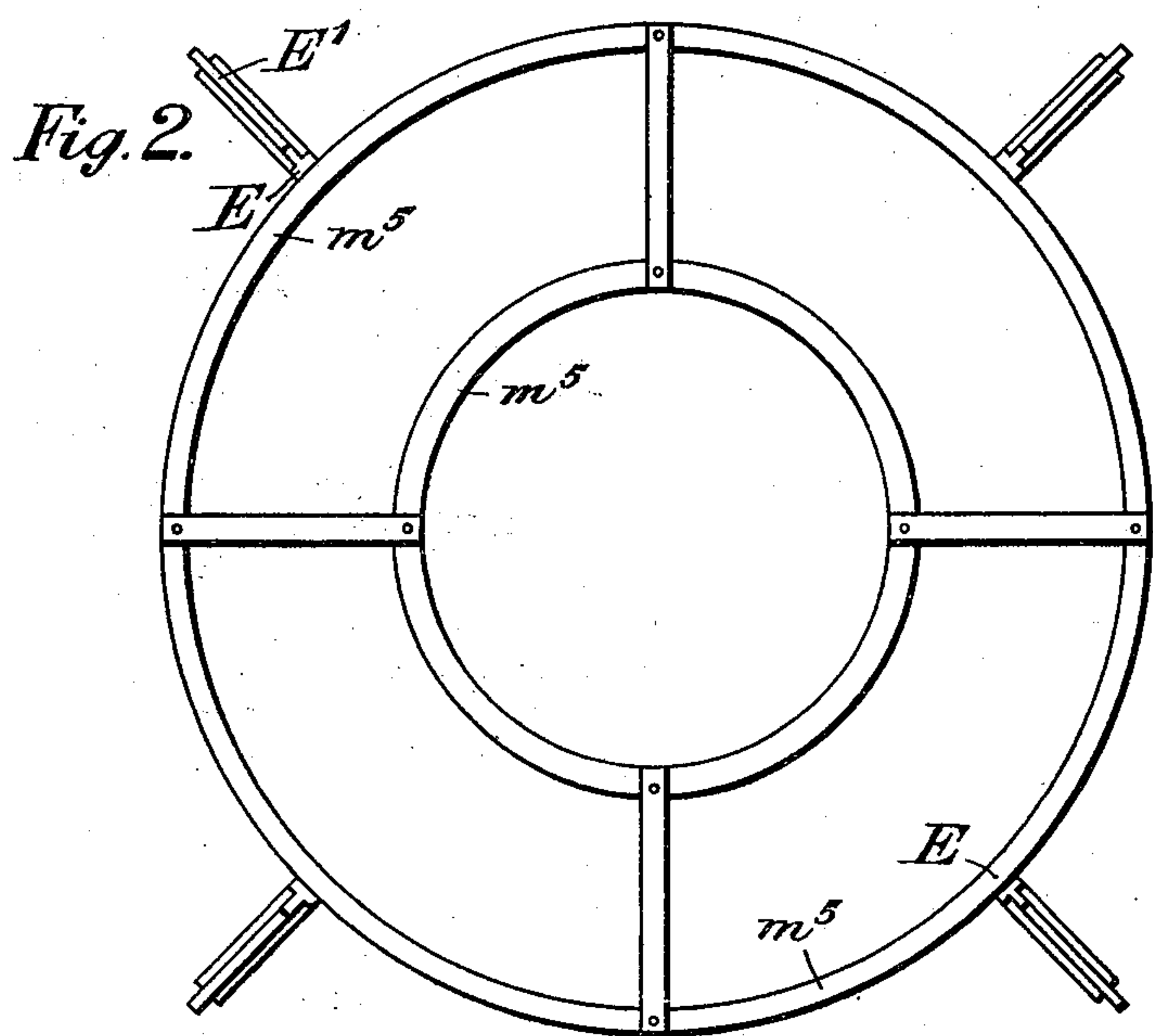
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5 Sheets—Sheet 2.



Witnesses

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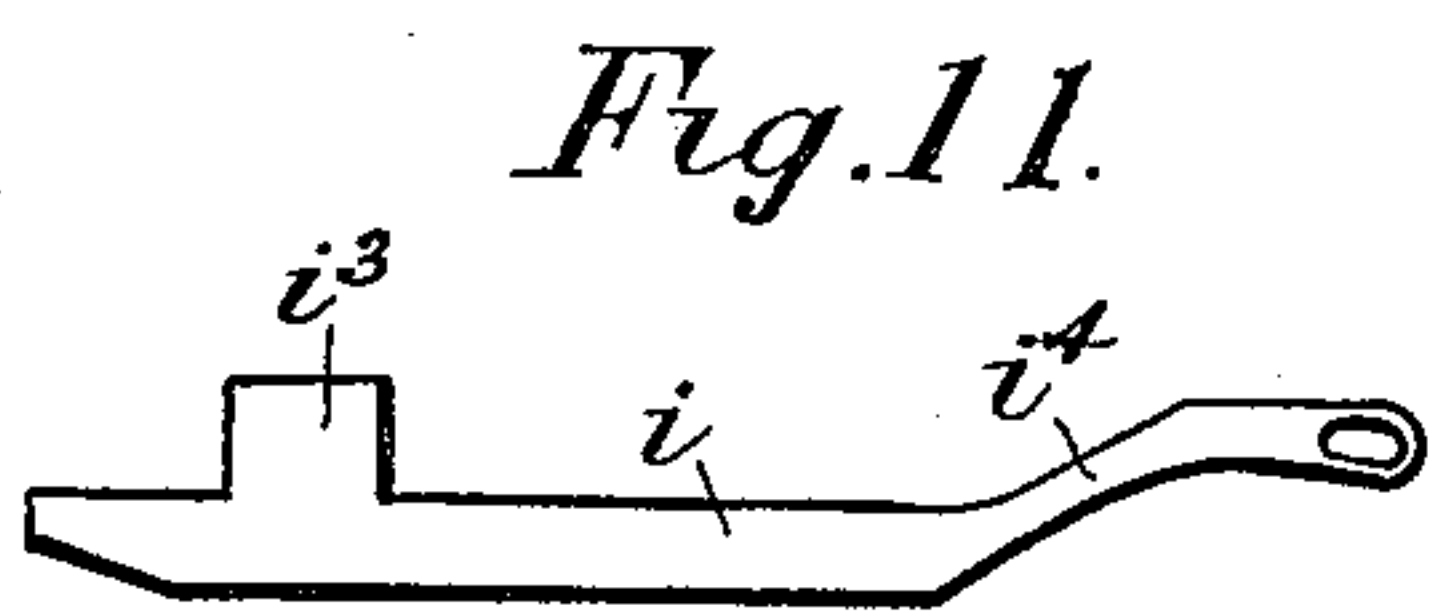
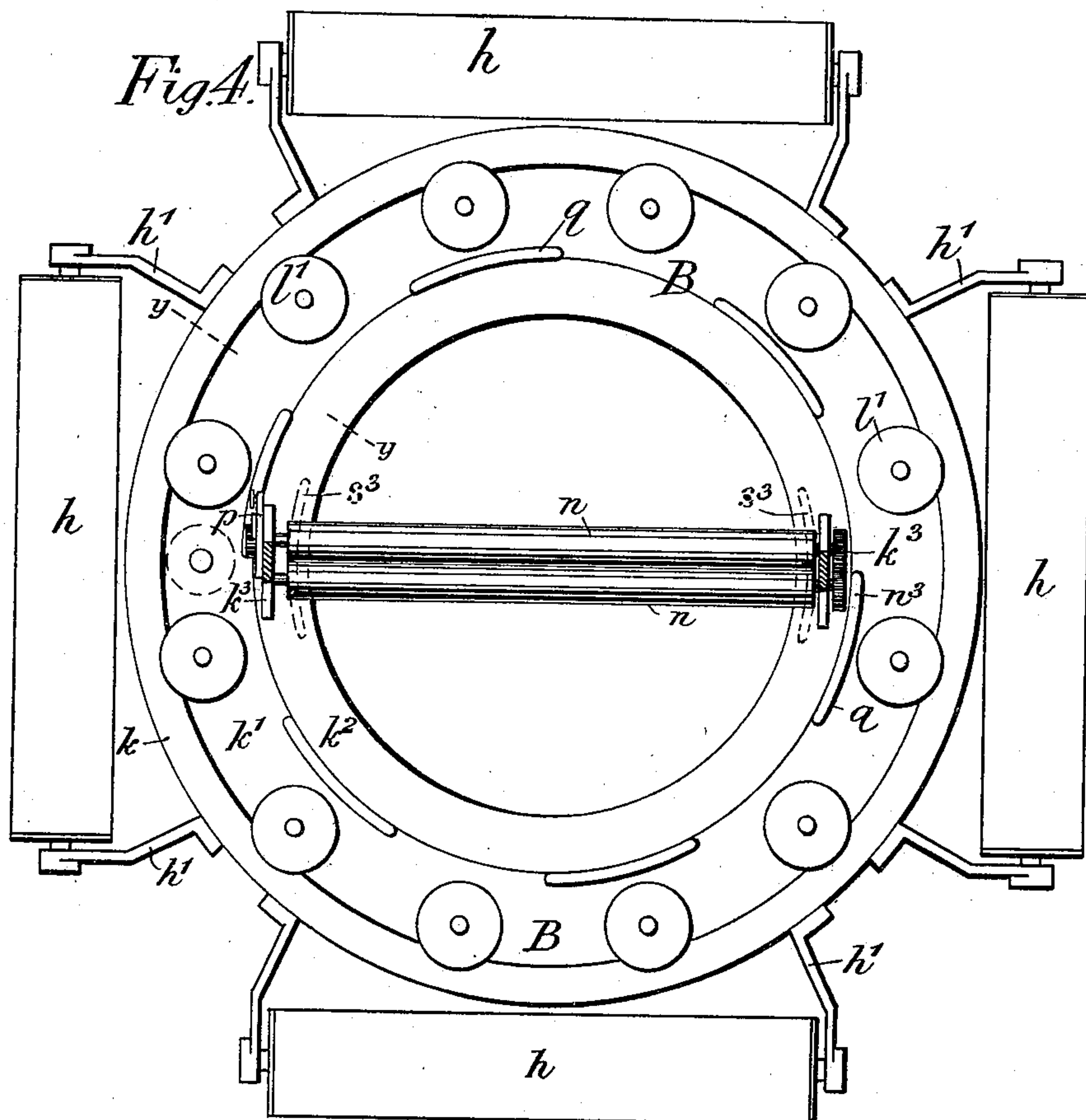
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5 Sheets—Sheet 3.



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5 Sheets—Sheet 4.

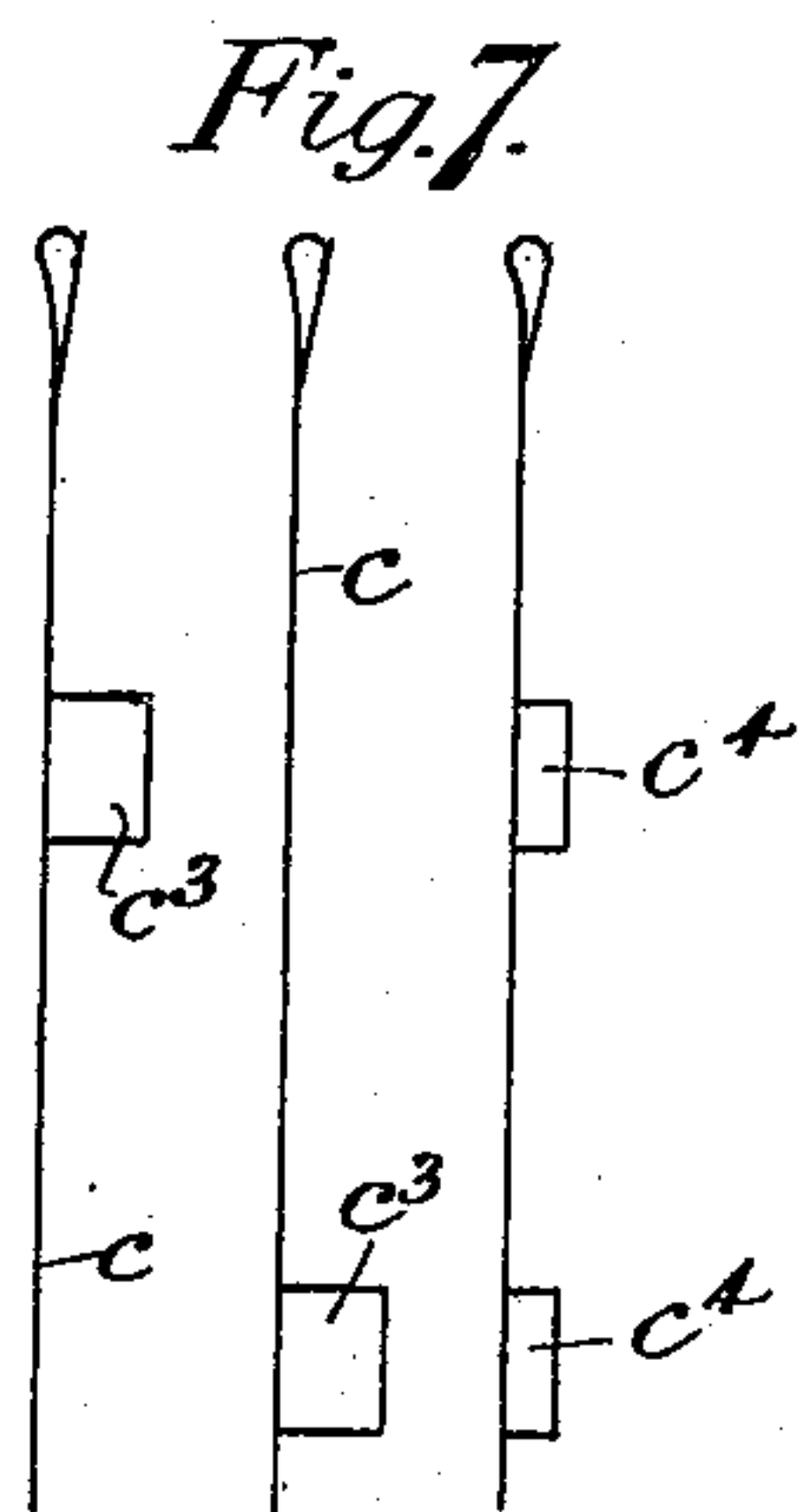
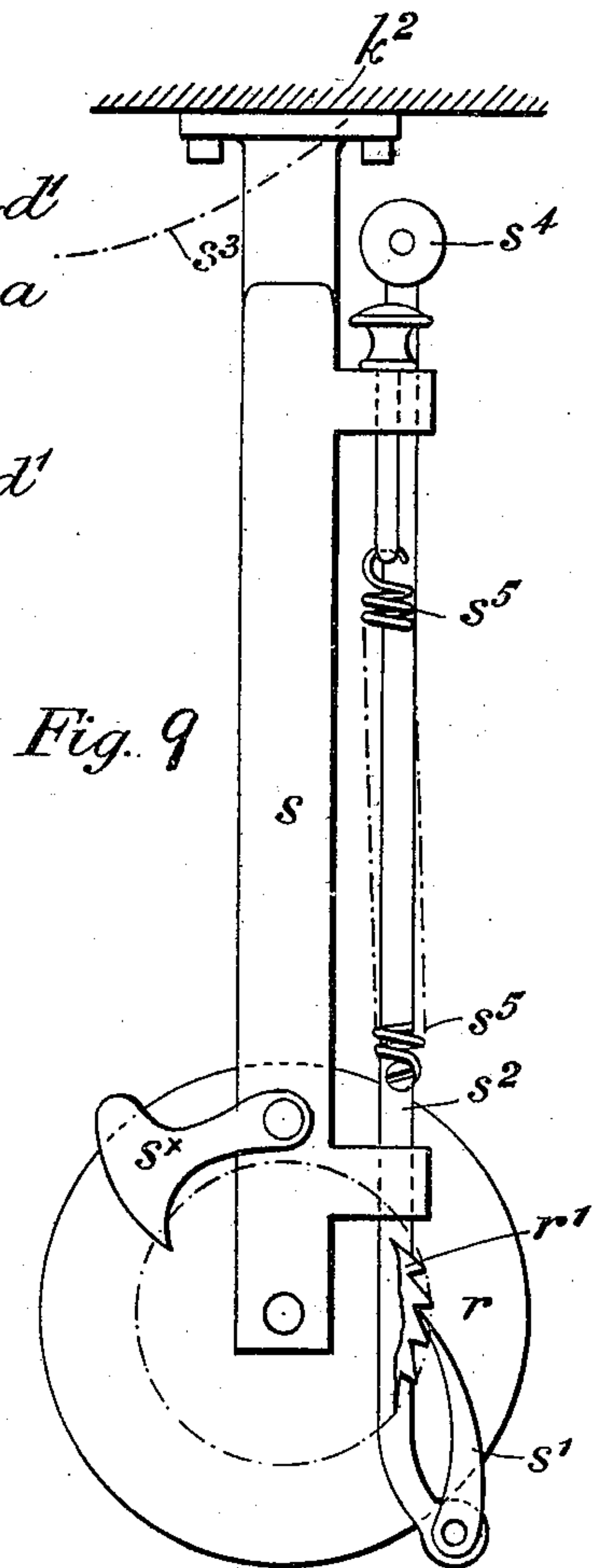
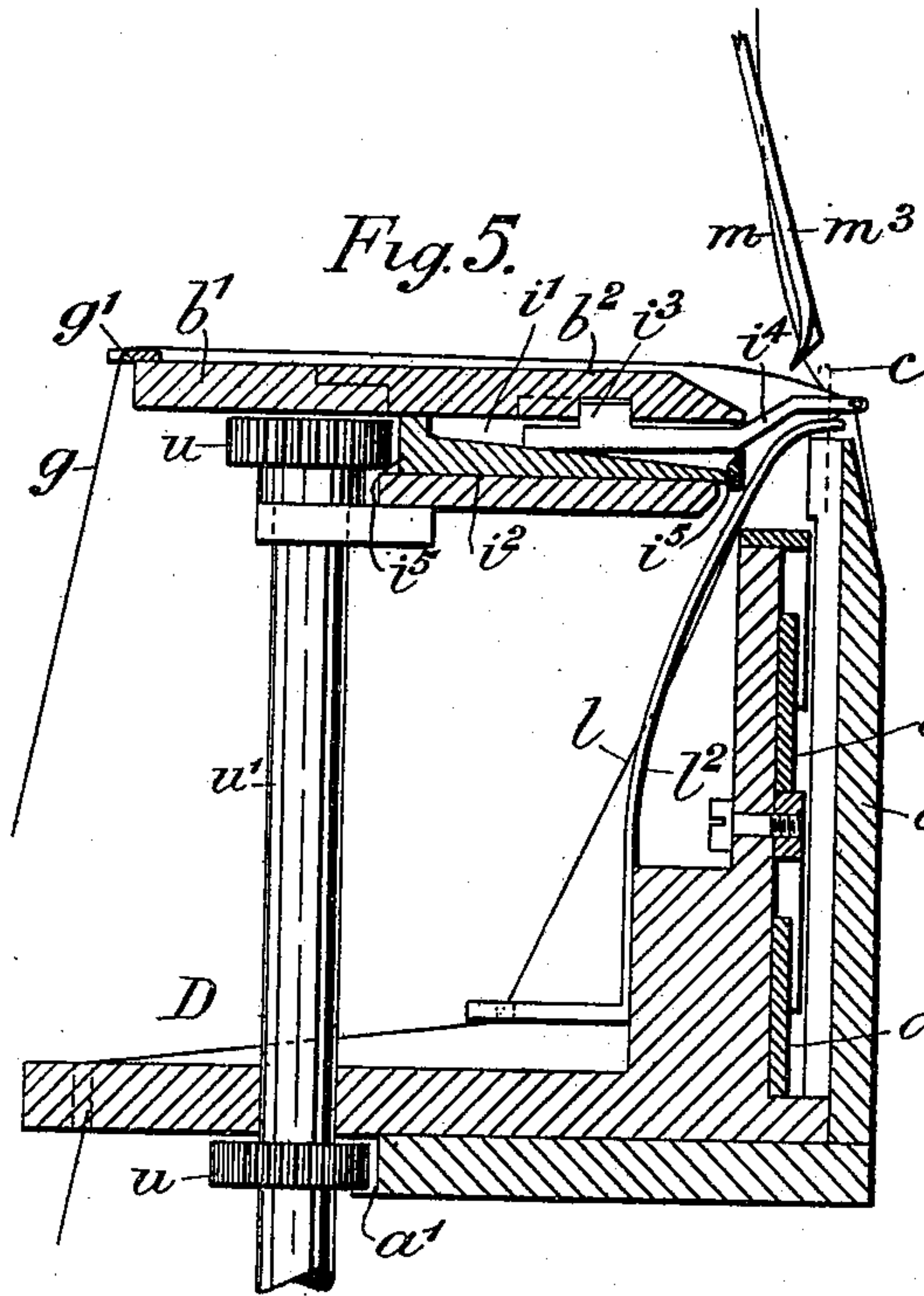
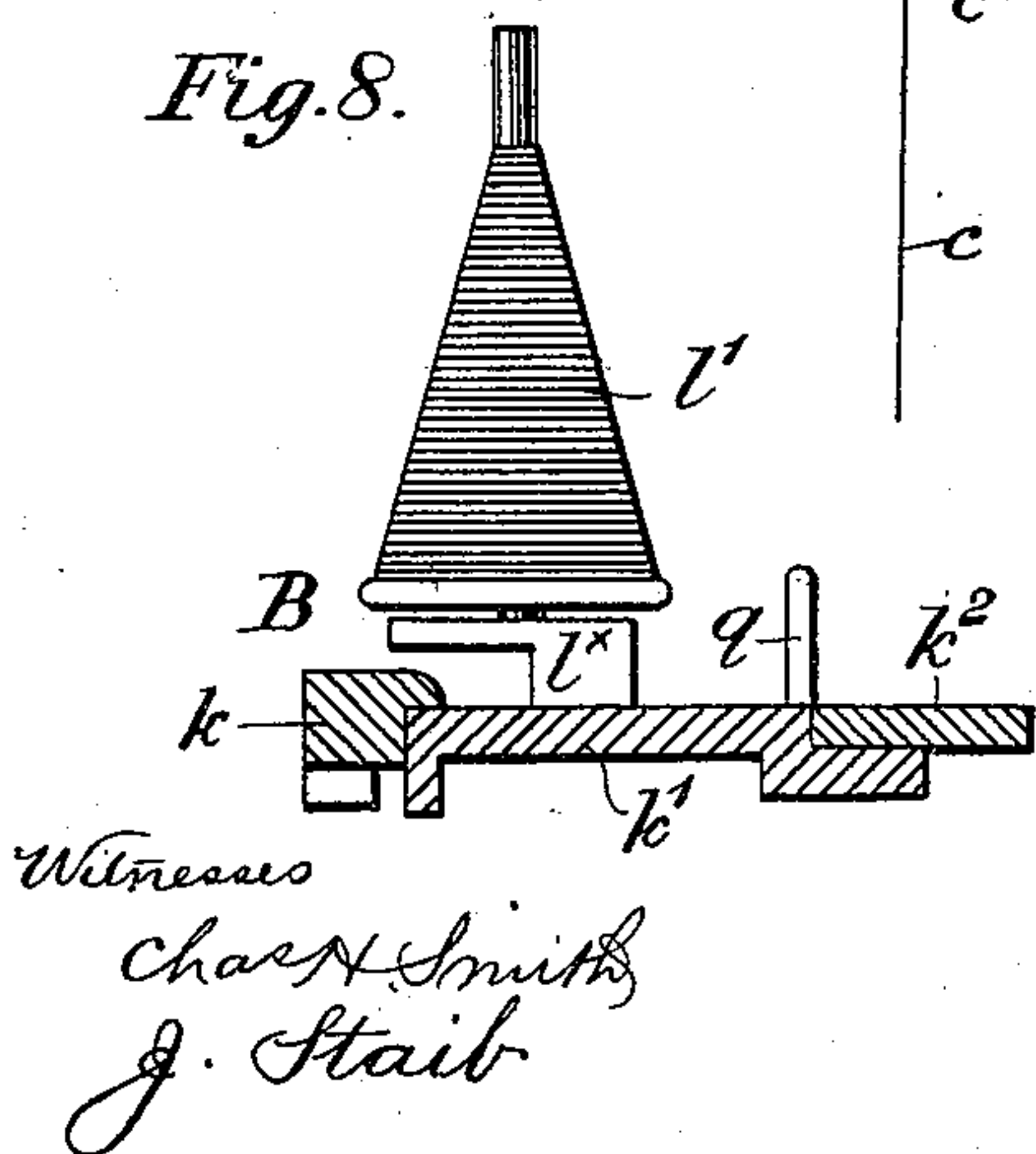


Fig. 8.



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5 Sheets—Sheet 5.

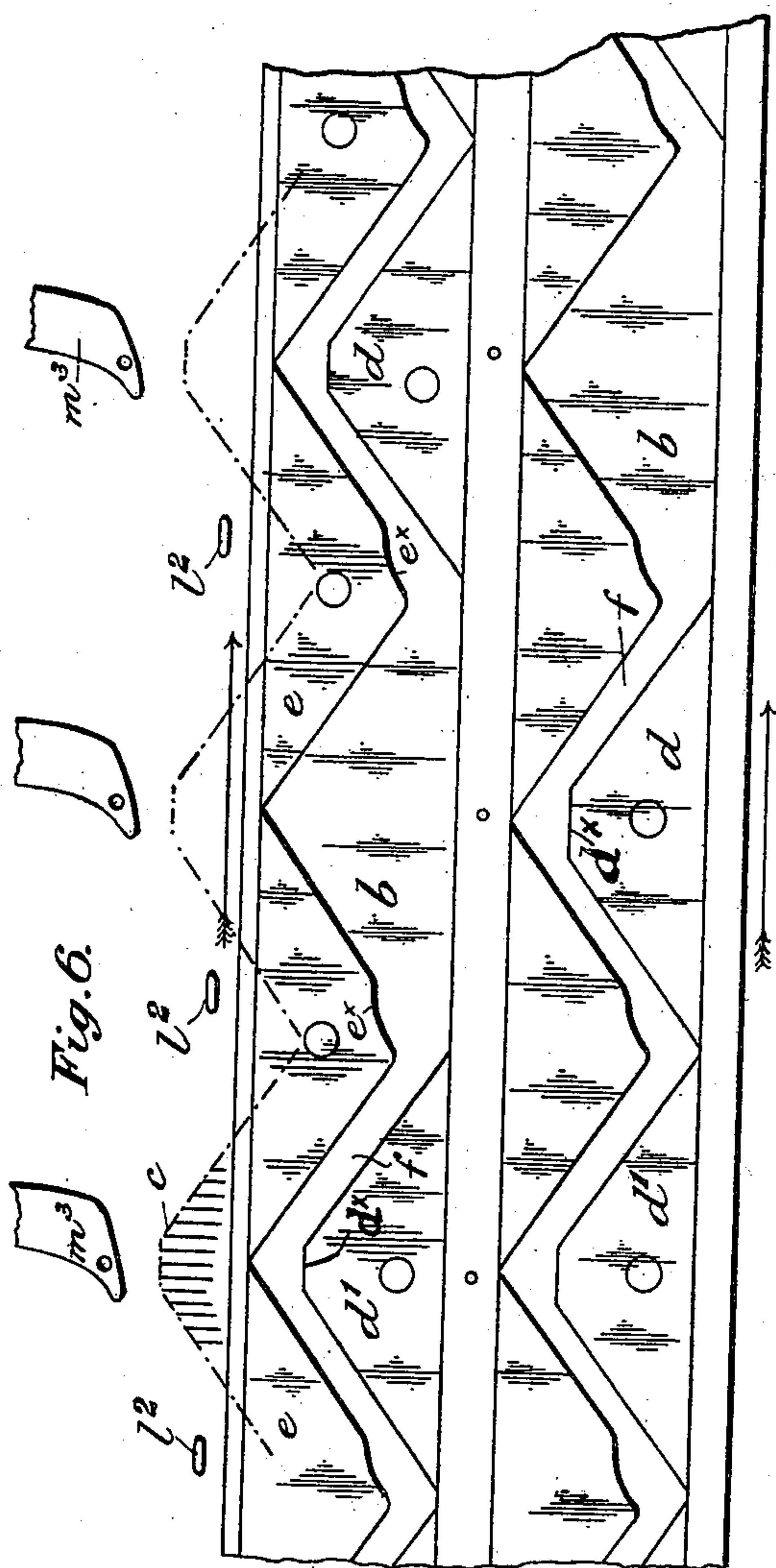
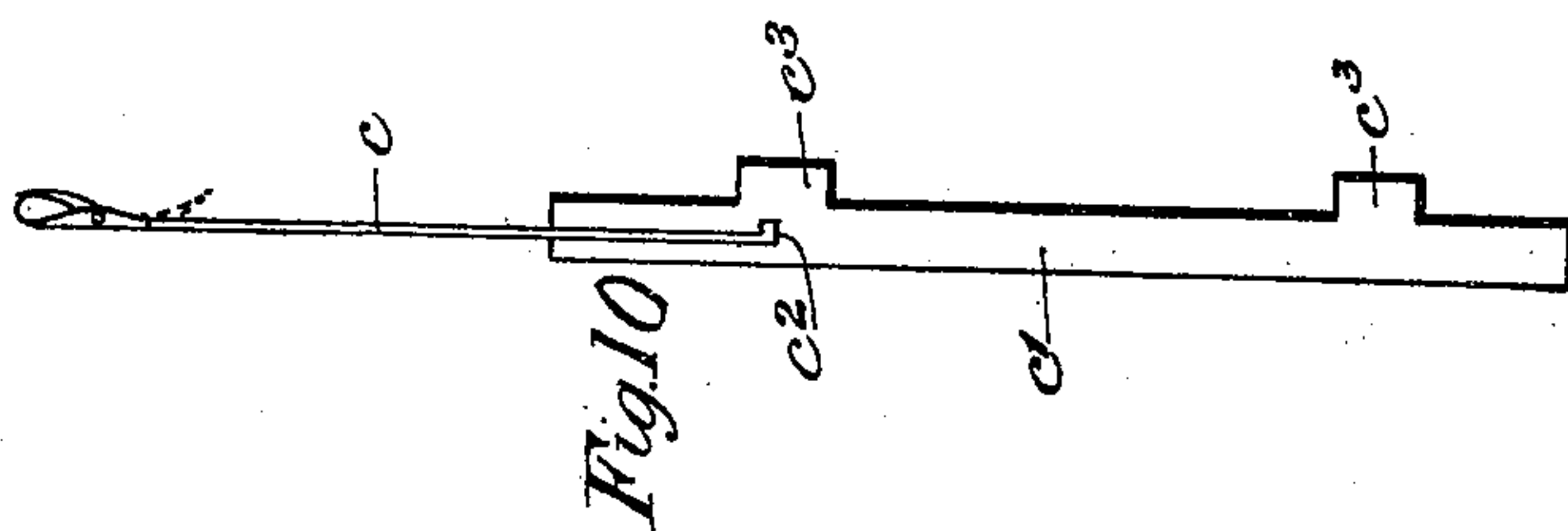
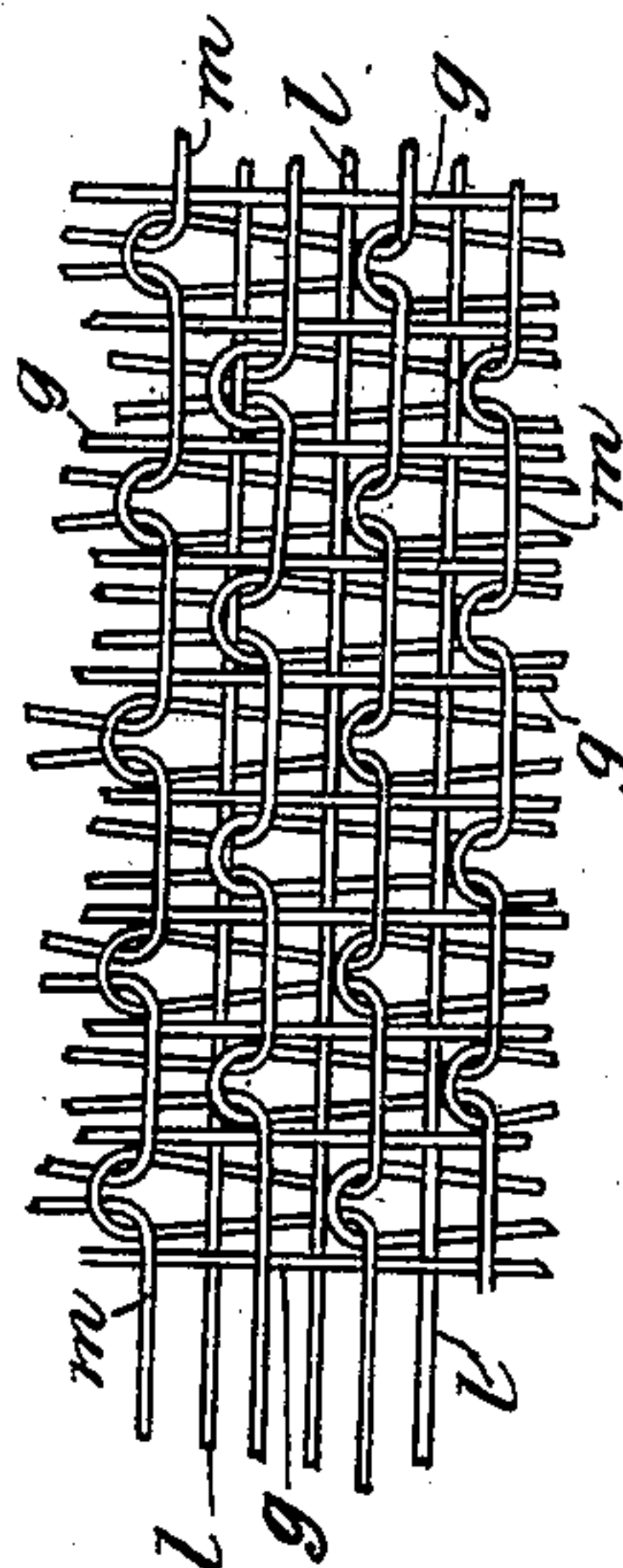


Fig. 12



Witnesses

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UNITED STATES PATENT OFFICE.

JOHN WATERFIELD, OF LONDON, ENGLAND, ASSIGNOR OF TWO-THIRDS TO
WILLIAM BADCOCK AND HENRY BALDWIN EDWARDS, OF SAME PLACE.

KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 627,786, dated June 27, 1899.

Application filed June 28, 1898. Serial No. 684,686. (No model.)

To all whom it may concern:

Be it known that I, JOHN WATERFIELD, a citizen of the United States of America, residing at London, England, have invented certain new and useful Improvements in Knitting-Machines, of which the following is a specification.

This invention has reference more particularly to knitting-machines of the kind known as "knitting-loom" for producing fabrics analogous to woven fabrics.

The main object of the said invention is to provide a machine of a simple and reliable character which shall be capable of producing a very great variety of fabrics, including cloths resembling the well-known diagonals.

One important point of this invention consists in so constructing the machine or loom as to cause the loops of the knitting-thread to miss or skip certain of the warp-threads, so that, for example, if a diagonal cloth be required the loops in one row are produced between alternate warp-threads, while those in the next row are produced between intervening threads.

A further important feature of the invention consists in constructing the machine somewhat after the manner of a circular-knitting machine and in such a way that both sets of weft-threads remain stationary and only the warp-threads revolve.

A convenient means for obtaining the desired distribution of the loops is to provide the needles with butts of different sizes and to arrange certain of the cams for operating the needles so as to miss the shorter butts, and thus produce the variation in stitch.

Referring to the drawings, Figure 1 is an elevation of so much of the new circular-knitting machine or loom as is necessary to explain the invention. Figs. 2, 3, and 4 are plans of certain portions of the machine hereinafter referred to. Fig. 5 is an enlarged section on the line *x x*, Fig. 3, showing the construction of that part of the machine in which the knitting is actually effected. Fig. 6 shows a development of one portion of the cylinder which carries the cams for operating the needles. Fig. 7 shows, diagrammatically, the order in which the needles are arranged to suit the cams shown in Fig. 6. Fig. 8 is a

detail section on the line *y y*, Fig. 4, showing a portion of the machine hereinafter referred to. Fig. 9 shows a convenient device for actuating the roller on which the fabric is wound. Fig. 10 shows one of the needles which are employed in the said machine. Fig. 11 shows one of the warp-guides. Fig. 12 is an enlarged view or draft of one of the fabrics made according to this invention.

The body of the machine is supported on legs A and comprises a lower platform B, built up of concentric rings, as shown in Fig. 8, and to the inner or stationary ring *k'* of which the said legs A are connected.

C C are uprights extending from this stationary part and carrying an upper annular platform D, which supports the knitting mechanism.

E E are side bars or uprights for carrying the upper bobbins and thread-guides. These side bars are bent or cranked, as at *E'*, in order to permit of the warp-rollers hereinafter described revolving freely within them.

The knitting mechanism proper comprises a needle-cylinder *a*, arranged to revolve within a stationary cam-cylinder *b*, which rests upon or is formed integrally with the upper platform D.

c c are the needles, which are of the ordinary latched kind and are carried in tricks or grooves in the usual way. They are secured in their holders *c'* by means of solder or otherwise, and their lower ends are each bent to form a heel *c²*, which takes into a corresponding recess in the holder.

c³ c⁴, Fig. 7, are respectively the wide and narrow butts with which the needle-holders are provided near their upper and lower ends.

d d' are the cams which raise the needles into their highest position and are hereinafter termed "lifting-cams." Of these cams those marked *d* are considerably thicker than those marked *d'*, the purpose of this being to obtain the varied distribution of the loops in the manner above referred to.

e e are cams which are of the same thickness as the cams *d* and move the needles downward after they have been raised by the lifting-cams.

Both kinds of cams consist of interchangeable triangular blocks secured to the cam-cyl-

inder by screws and are so arranged that a cam groove or path f is formed between them for the butts of the needles to enter.

The points of the cams e are shaped as at 5 e^x to enable the butts of the needles to pass them more easily. The points d^x of the cams d d' are also removed to prevent the needles being thrown too high.

The revolution of the needle-cylinder carries the needles past the cams in the direction of the arrow, Fig. 6, with the result that while the thick lifting-cams d act on both the wide and the narrow butts c^3 c^4 the thin cams d' only act on the wide butts c^3 .

15 g are the warp-threads, which are wound upon warp beams or rollers h and are led to the warp-guides i over a cover-plate b' , supported on short pillars b^x , fixed to the upper platform D.

26 The warp-beams h are mounted in brackets h' , secured to a ring k , which is provided with teeth on its under side and forms the outer part of the lower platform B. This latter is built up of three concentric rings k k' k^2 , Fig. 8, the second, k' , of which is stationary, while 25 the outer and inner ones revolve with the needle-cylinder, so that the warp-beams also travel around therewith.

To prevent the warp-threads becoming entangled, they are passed through notches in 30 the edge of a loose ring or band g' , which is connected with the ring k by light metal strips (not shown) or otherwise, so as to revolve therewith.

35 The warp-guides are arranged approximately at right angles to the needles in radial tricks or grooves i' in a revolving flat ring i^2 , situated above the cam-cylinder. The said guides are provided with butts i^3 , which project into a cam-groove b^2 (see Figs. 3 and 5) 40 on the under side of the cover-plate b' , so that as they travel around they are moved longitudinally in and out by the cam-groove. At the same time they receive a rising-and-falling motion, which is due to an inclined portion i^4 on each guide working in and out of 45 the tricks or grooves, the mouths of which latter are partially closed by a circular band or strip i^5 , secured inside the ring i^2 . The purpose of the rising movement of the warp-guides is to enable their points to clear the tops of the filling-guides as they travel around, whereas the purpose of the falling movement is to cause the warp-thread to rest 50 solid or direct on the top of the needle-cylinder at the moment the loop is being made. This is an important feature, because if the guide were kept always raised the warp-threads would be inclined when the loops 60 were formed, and consequently the loops would be of different sizes, according to the tension on the thread, and the cloth would have an uneven appearance.

65 l are the filling-threads, which are carried by bobbins l' , mounted on brackets l^x on the stationary inner part or ring k' of the lower platform. From the bobbins the filling-

threads are conducted upward by guides l^2 and delivered just below the points of the warp-guides. These guides l^2 are secured 70 outside the cam-cylinder opposite those places where the needles descend to their lowest positions. The filling-threads are drawn from the guides l^2 by the revolution of the needle-cylinder and the warp-threads and are caused 75 to stretch themselves across the outside of these latter threads.

m are the knitting-threads, which correspond in number to the filling-threads. They are wound upon bobbins m' , supported on a 80 ring m^2 , and are conducted to the guides m^3 , in the manner shown in Fig. 1, through eyes m^4 on rings m^5 . The guides m^3 serve to deliver them at the points where the needles complete their upward movements, so that 85 when the said needles descend they knit the threads into the fabric. It will be seen from Fig. 5 that the said knitting-threads are delivered onto the opposite side of the warp-threads to that on which the filling-threads 90 are delivered; but by the knitting operation their loops are caused to pass through the fabric and around the filling-threads, so tying the latter in place.

The needles and thread-guides coöperate 95 in the following manner: When the needles rise into their highest position, as indicated in dotted lines, Fig. 5, the warp-guides are thrust in between them, and as they revolve the knitting-threads are drawn from the guides m^3 100 and are stretched along the upper sides of the warp-threads below the hooks of the needles, the needle-latches being at this time open. Previously, however, the filling-threads were drawn from their guides along the under 105 sides of the warp-threads, so that as the needles ascended the said filling-threads were situated between the backs of the needles and the warp-threads. When, therefore, the needles descend, they draw the knitting- 110 thread down in loops across the filling-threads, so that the latter are firmly locked in position against the warp-threads. A little before the needles descend the warp-guides retire and pass clear of the filling-guides as 115 they travel around with the needles. It will be seen from Figs. 3 and 6 that the warp-guides i and the needles c are caused by the shapes of their operating-cams to follow a regular wave-like path as they travel around 120 the machine.

With the arrangement of cams and needles shown in Figs. 6 and 7 the operations are as follows: On passing the cams d' the first and second needles (counting from the left, Fig. 7) 125 rise and descend, forming a loop, while the third needle remains idle, as the cams d' being thin do not project far enough to engage the short butts of the third needle. On passing the next cam—viz., d in the bottom row— 130 the second and third needles operate, as this cam is a thick one and engages both the wide butts c^3 and the narrow butts c^4 . At the same time the first needle remains idle, as there

is no cam in the upper row to engage its butt c^3 . In the next stage there is a thick cam d in the upper row, but none in the bottom row. Hence the first and third needles are operated; but the second one remains idle. These various operations are repeated continuously as the needles travel around, there being as many sets of cams as there are knitting and filling threads. The relative positions of the guides m^3 and l^2 of these latter threads can be clearly seen in Fig. 6, as can also the path followed by the points of the needle c , which is indicated by the dotted lines. The fabric as produced is drawn down through the needle-cylinder a by means of tension-rollers n , mounted in brackets k^3 , secured to the revolving ring k^2 and the needle-cylinder, so that the said tension-rollers are carried around with the latter. These rollers may be operated in any convenient manner. The finished fabric is finally wound upon a roller r , carried by a pair of brackets s , extending down from the inner revolving ring k^2 of the lower platform, so that the roller q revolves with the tension-rollers. The said roller may be operated in any convenient manner—say, for example, by the device shown in Fig. 10, wherein a pawl s' on a vertical sliding rod s^2 is adapted to act on a ratchet-wheel r' on the roller-spindle. The necessary movement of the rod s^2 is produced by a pair of cams s^3 , Fig. 4, situated opposite one another on the under side of the stationary platform-ring k' . These cams act on a roller s^4 on the upper end of the rod s^2 and depress the latter, after which a spring s^5 tends to raise it into its highest position again and at the same time causes the pawl s' to rotate the ratchet-wheel r' , backward rotation of the said ratchet-wheel being prevented by a retaining-pawl s^x . Owing to this arrangement undue strain on the fabric can be avoided by regulating the tension of the spring so that it will not be strong enough to operate the pawl and ratchet if the fabric be already tight.

The various revolving parts of the machine are driven from a main shaft t in the following manner: The ring k , carrying the warp-beams, is provided with teeth k^4 , which gear with a pinion t' on the shaft t . The needle-cylinder a and the ring i^2 , carrying the warp-guides, are provided with teeth a' and i^5 , respectively, which engage a pair of pinions u on a vertical spindle u' , in gear with a spindle u^2 , driven by bevel-gear t^2 from the main shaft t , which is itself actuated by means of a belt and fast and loose pulleys t^3 . A spring-actuated fork t^4 may be provided to enable the belt to be thrown onto the loose pulley instantly, if necessary. A hand-wheel t^5 is arranged at the extremity of the main shaft to enable the machine to be rotated by hand when necessary—as, for instance, if it be required to take out a needle or a warp-guide. Suitable means are provided to permit of these

latter operations without it being necessary to take the machine to pieces. To this end, for the purpose of taking out the warp-guides, the cover-plate b' is fitted with a removable fillet b^3 , let into it flush and held in position by a screw b^4 . This fillet serves to close an aperture in the cover-plate, which opens into the cam-groove b^2 . Consequently when the fillet is removed the warp-guides lying under the same can be taken hold of with a suitable tool and removed one by one. Similarly, the wall of the cam-cylinder has a vertical slot or opening b^5 beneath the fillet b^3 , through which access can be had to the needles in the needle-cylinder. The continuity of the cam-grooves is, however, preserved by small studs b^6 , which are inserted in the slot b^5 and act as bridging-pieces.

Referring now to Fig. 12, this shows the arrangement of the various threads and loops in the finished diagonal fabric, g being, as before, the warp-threads, l the filling weft-threads, and m the knitting weft-threads.

Up to the present it has not been possible to produce diagonal patterns in knitted fabrics; but according to the present invention this result is obtained by arranging the loops of the knitting weft-threads m so that those in one row alternate or break joint with those in the adjacent rows, as shown more clearly in the back view in Fig. 14. This can be readily done by the means hereinbefore described, whereby certain of the needles are caused to miss a loop while the others are rising and falling and are forming loops. In practice the weft-threads lie close together in the fabric; but in the drawings they are separated somewhat for the sake of clearness. It should be understood, however, that a machine of the kind herein referred to is not restricted to any particular pattern of cloth, as such pattern is simply a question of the particular arrangement of the cams and needles. The machine can therefore be employed for producing all the ordinary patterns that have been usually produced on the so-called "knitting-loom," but in addition it can also be employed for producing diagonals in the manner described.

Having now described my said invention, I claim—

1. In a knitting-loom, the combination of a needle-cylinder and means for revolving it, a circular series of needles, a stationary cam-cylinder inside which said needles travel, radially-arranged warp-guides revolving with said needles, and means for operating said warp-guides, substantially as described.

2. In a knitting-loom, the combination of a needle-cylinder and means for revolving it, a circular series of needles, a stationary cam-cylinder inside which said needles travel, warp-guides revolving with said needles, and means for operating said guides and for operating certain of the needles independently of the others, substantially as described.

3. In a knitting-loom, the combination of a needle-cylinder and means for revolving it, a circular series of needles, a cam-ring inside which said needles travel, stationary guides
5 for knitting and filling threads and means for insuring the warp-threads traveling with the needles and clearing said stationary guides, substantially as described.

4. In a knitting-loom, the combination of a
10 needle-cylinder and means for revolving it, a revolving circular series of needles, warp-guides revolving with said needles, stationary knitting-thread guides arranged above said warp-guides, stationary filling-thread guides
15 alternating with said knitting-thread guides, and means for operating said needle and warp guides, substantially as described.

5. In a knitting-loom, the combination of a circular series of needles, a revolving needle-
20 cylinder carrying the same, a stationary cam-cylinder inside which said needles revolve, warp-guides arranged above said cam-cylinder radially thereof, means revolving said warp-guides with the needles, stationary knit-
25 ting-thread guides above said warp-guides and stationary filling-thread guides projecting between the top edge of the cam-cylinder and the warp-guides, substantially as described.

6. In a knitting-loom, the combination of a
30 needle-cylinder and means for revolving it, a circular series of needles, a circular series of warp-guides arranged approximately at right angles to said needles, means for revolving said guides with said needle-cylinder, a sta-
35 tionary cam for moving said warp-guides in and out and means for causing their inner ends to rise and fall, substantially as and for the purpose described.

7. In a knitting-loom, the combination of a
40 circular series of warp-guides, each provided with an inclined inner end, a flat revolving ring having tricks to receive said guides, a stationary cover-plate provided with cams above said trick-ring, a partially-closed mouth
45 to each trick whereby the inclined portion on each guide imparts a rising movement to the

warp-guides as they move inward, substantially as described.

8. In a knitting-loom, the combination of a needle-cylinder and means for revolving it, a
50 revolving circular series of needles, a circular series of warp-guides, a flat revolving ring having tricks to receive said guides, a cam-ring inside of which said needles work, two superposed series of cams in said ring, and
55 means for causing some of the needles to be worked by the upper series of cams and others by the lower series, substantially as described.

9. In a knitting-loom, the combination of a needle-cylinder and means for revolving the
60 same, a circular series of warp-guides, a flat revolving ring having tricks to receive said guides, a revolving series of needles composed of groups having butts of different width, a cam-cylinder surrounding said needles, two
65 superposed series of cams carried by said cylinder, thick cams at the bottom of each series for raising all the needles, narrow cams also at the bottom of each series to miss the narrow butts of the needles, and wide cams
70 at the top of each series for depressing all the needles, substantially as described.

10. In a knitting-loom, the combination of a revolving series of needles divided into groups
75 of which each has its butts different from the others, guides for the latter revolving with the needles, means for moving said guides in and out and up and down, a stationary cam-ring surrounding said needle, filling-thread guides secured to said cam-ring and leading
80 to a point below the ends of the warp-guides, stationary knitting-thread guides above said warp-guides, and means for taking up the fabric as produced, substantially as described.

In testimony whereof I have hereunto set
85 my hand in presence of two subscribing witnesses.

JOHN WATERFIELD.

Witnesses:

GEORGE ERNEST MINTERN,
WALTER J. SKERTEN.