

No. 654,695.

Patented July 31, 1900.

F. WILCOMB.
KNITTING MACHINE.

(Application filed Apr. 14, 1899. Renewed May 16, 1900.)

(No Model.)

10 Sheets—Sheet 1.

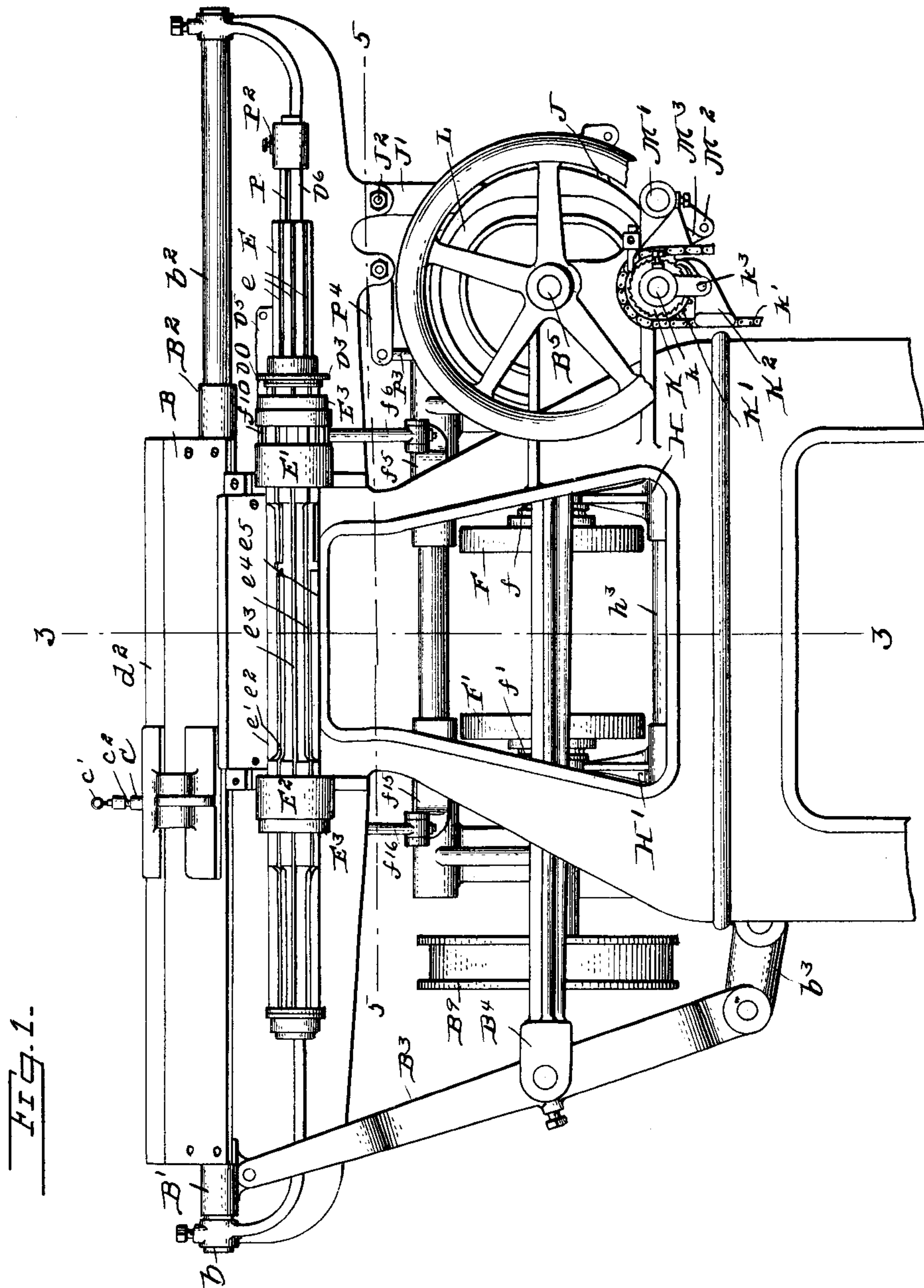


FIG. 1.

WITNESSES:
Jesse B. Heller
J. M. Shindler Jr.

INVENTOR
Frank Wilcomb
BY
Harding & Harding
ATTORNEYS

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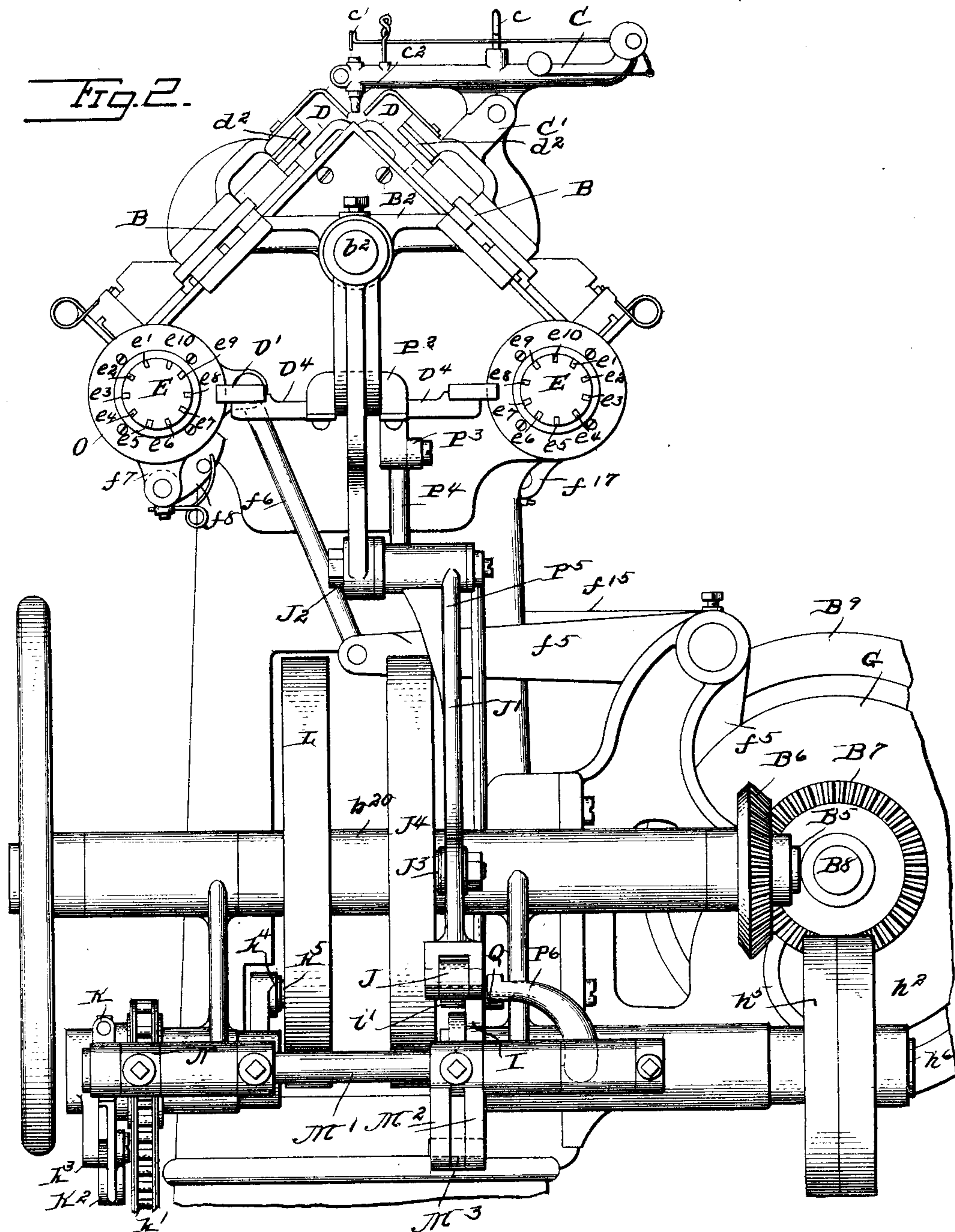
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Jesse B. Steller,
J. M. Shindler Jr.

INVENTOR

Frank Wilcomb

BY

Harding & Harding

ATTORNEYS

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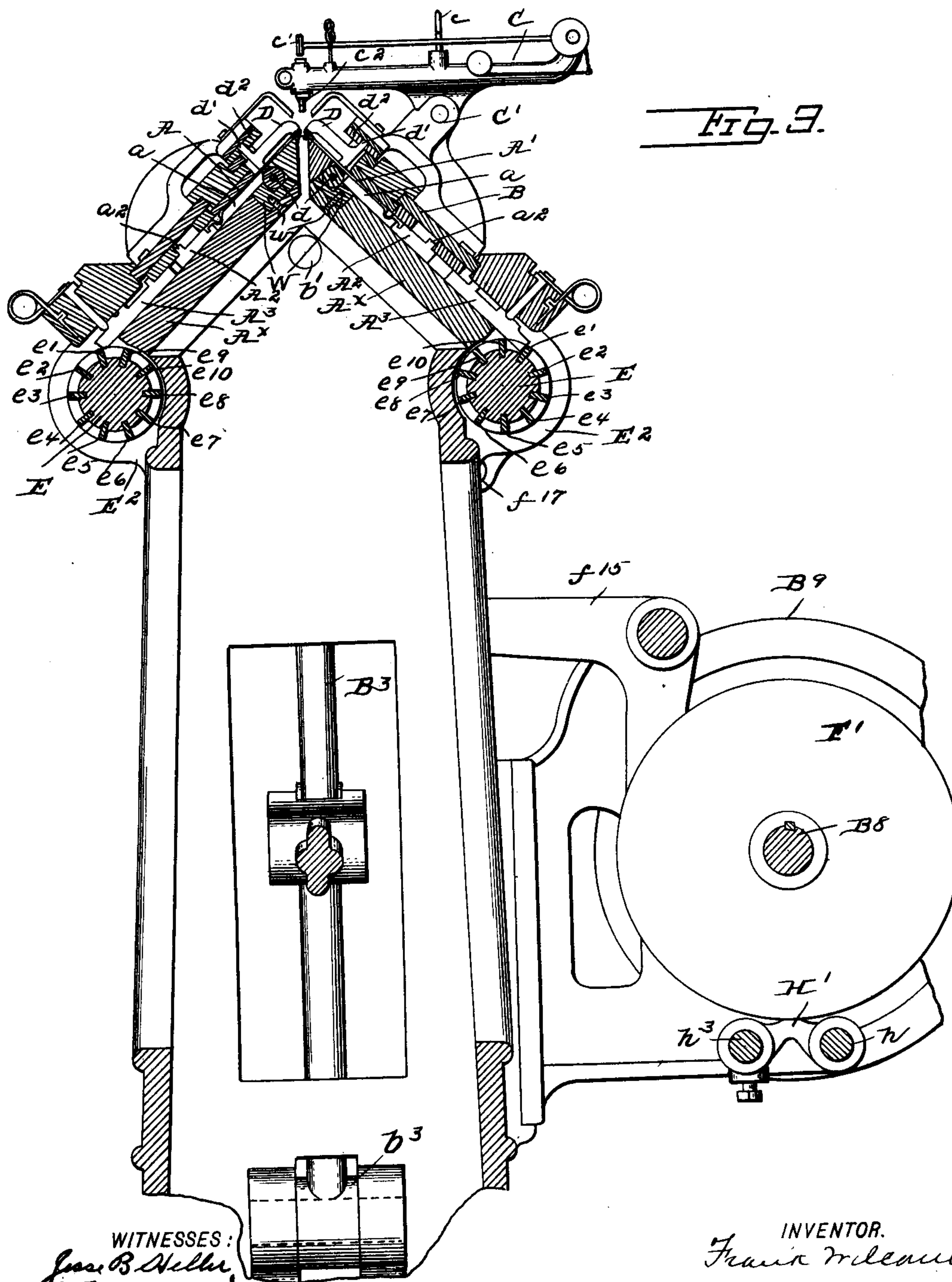


Fig. 3.

WITNESSES:
James B. Heller,
J. M. Shindler, Jr.

INVENTOR.
Frank Wilcomb
BY *Harding & Harding*
ATTORNEYS

No. 654,695.

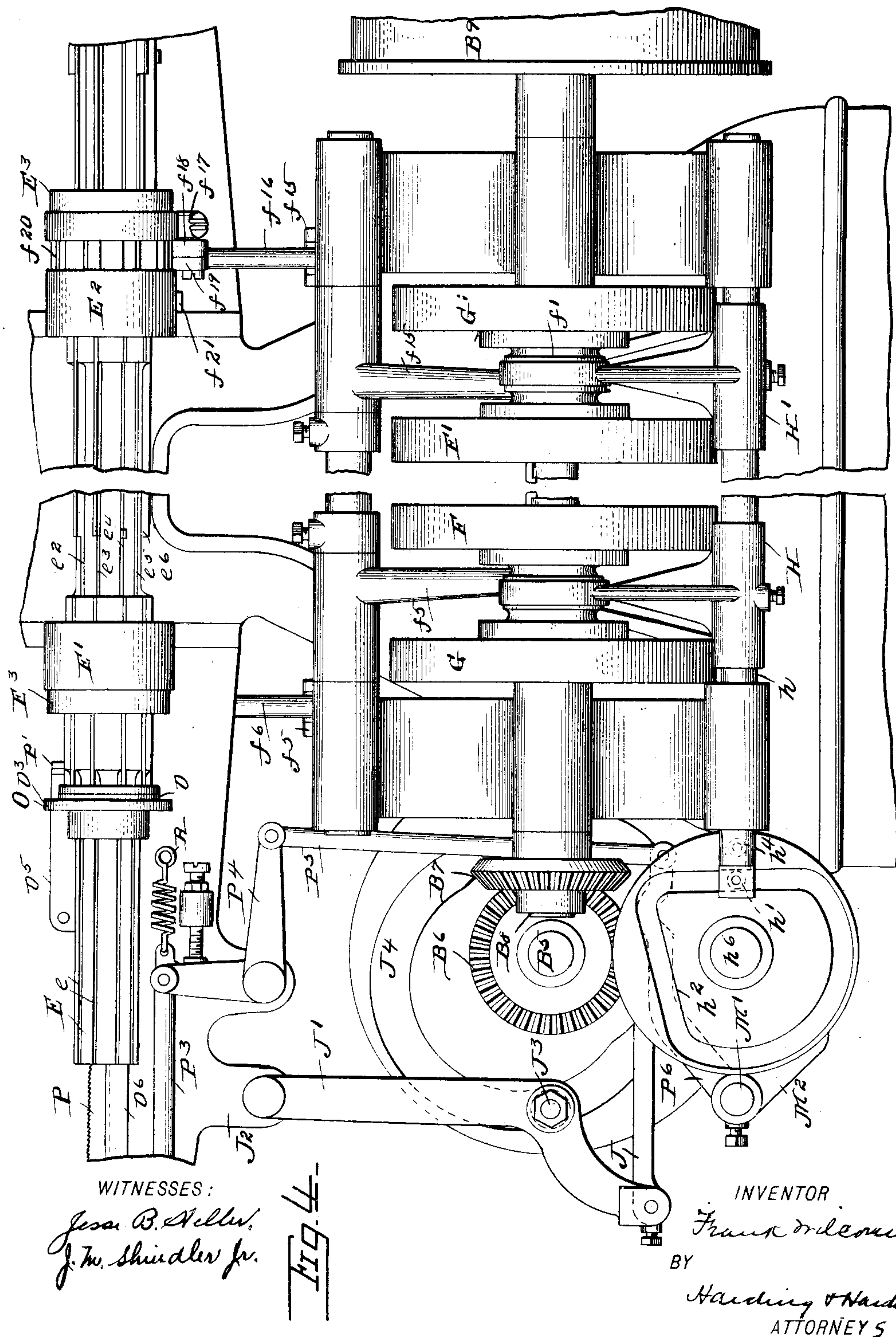
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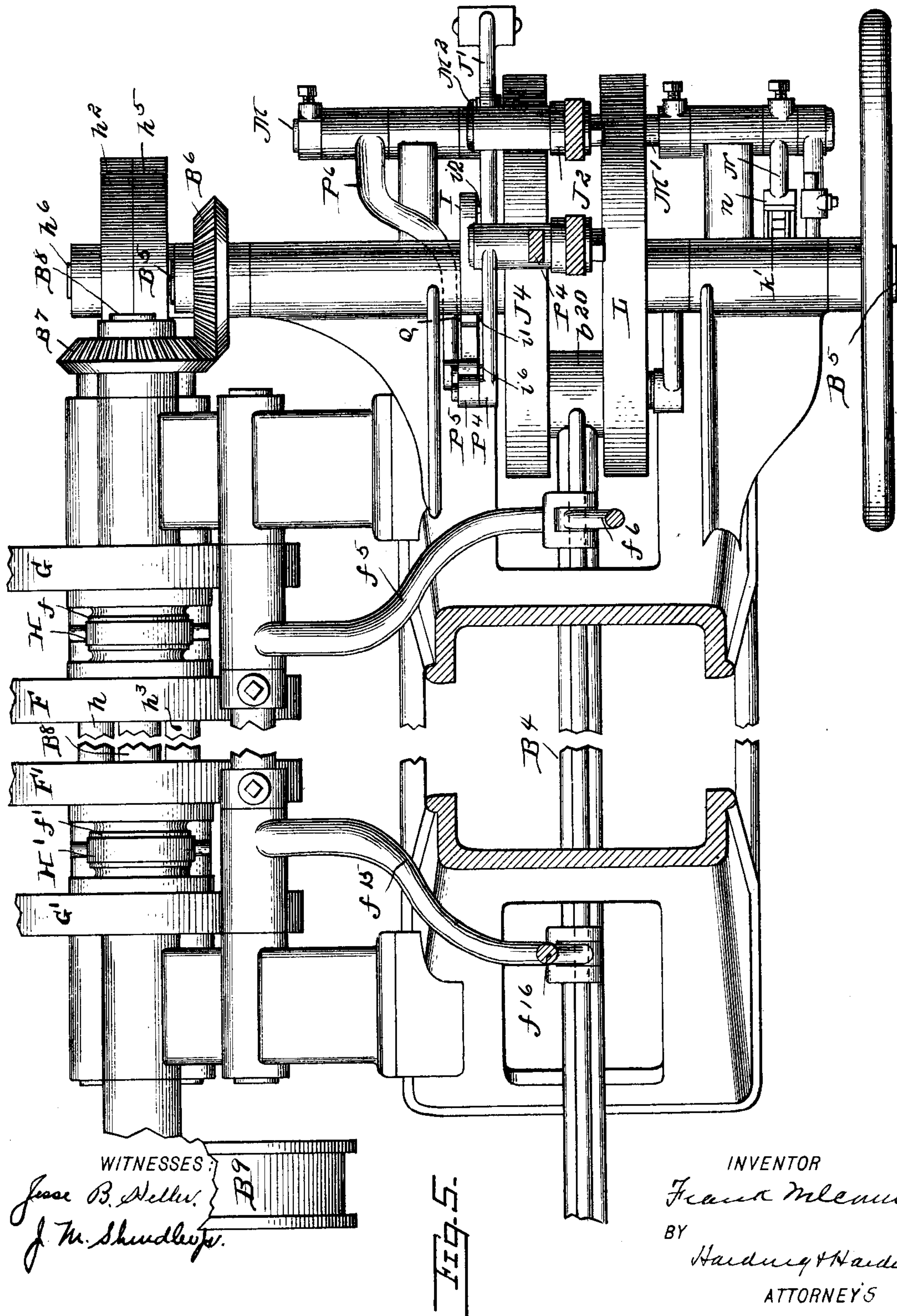
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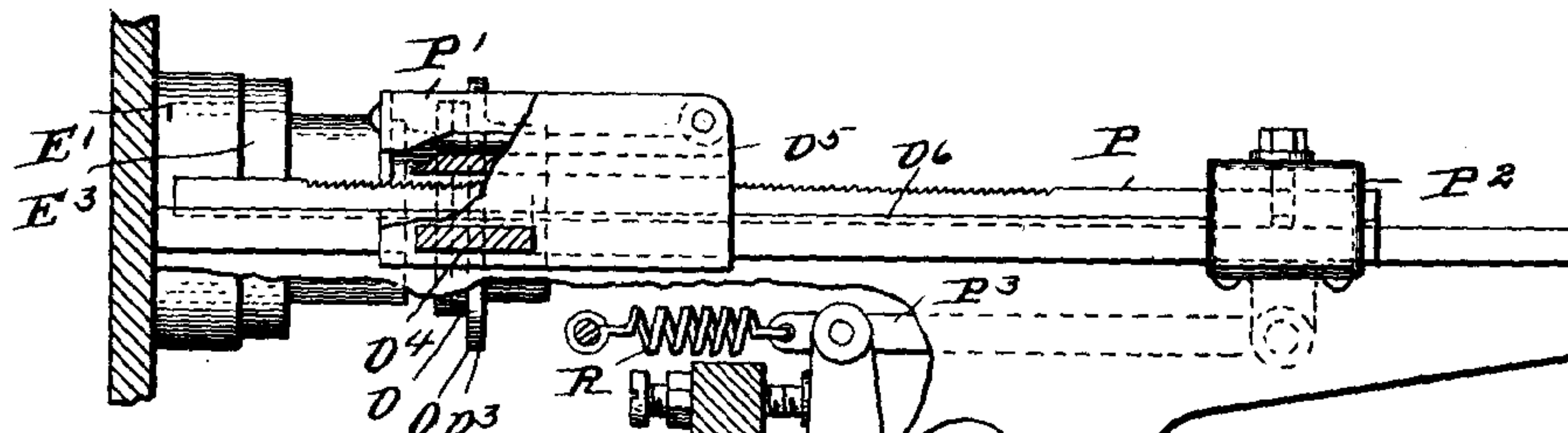


Fig. 6.

Fig. 22.

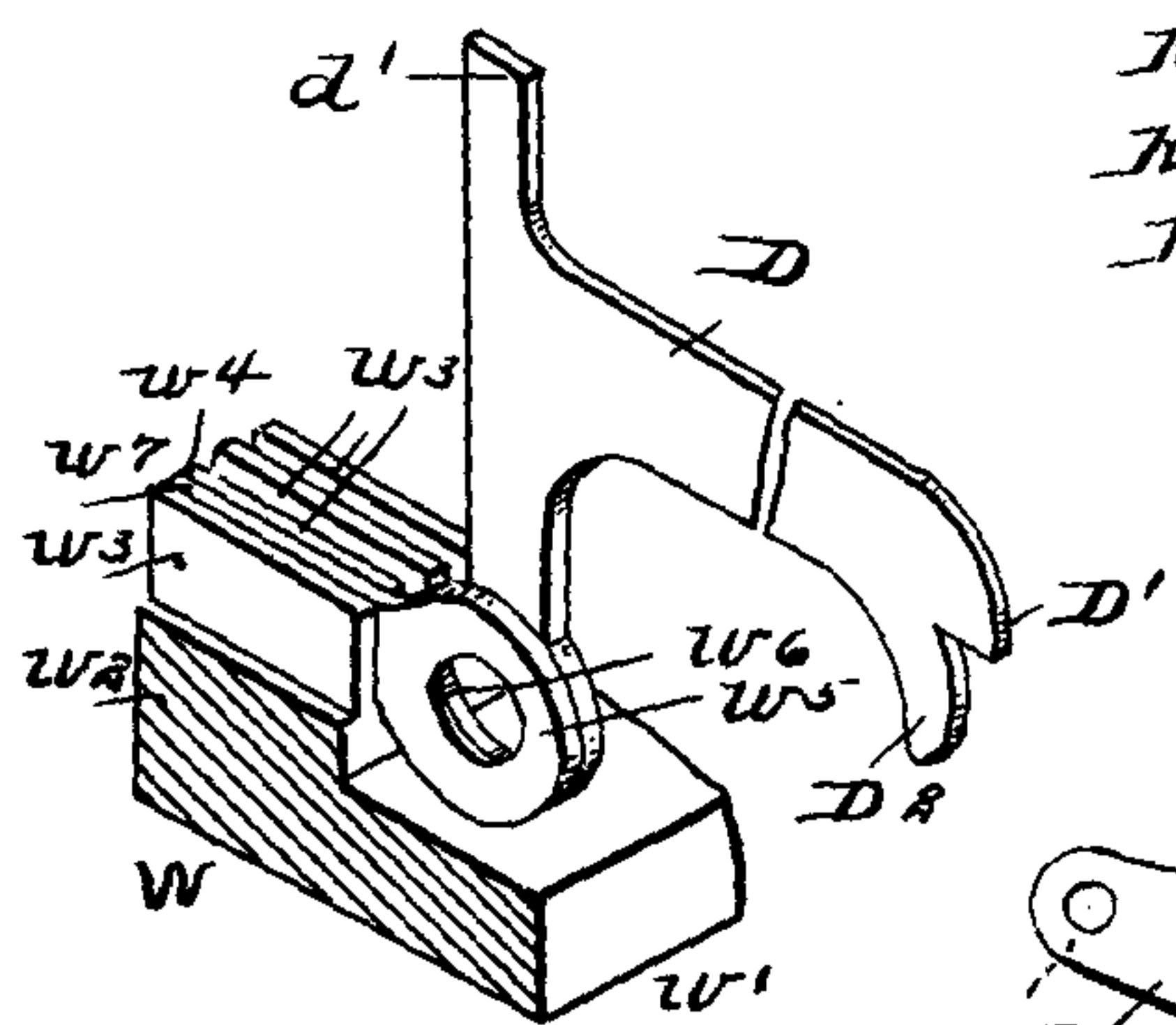
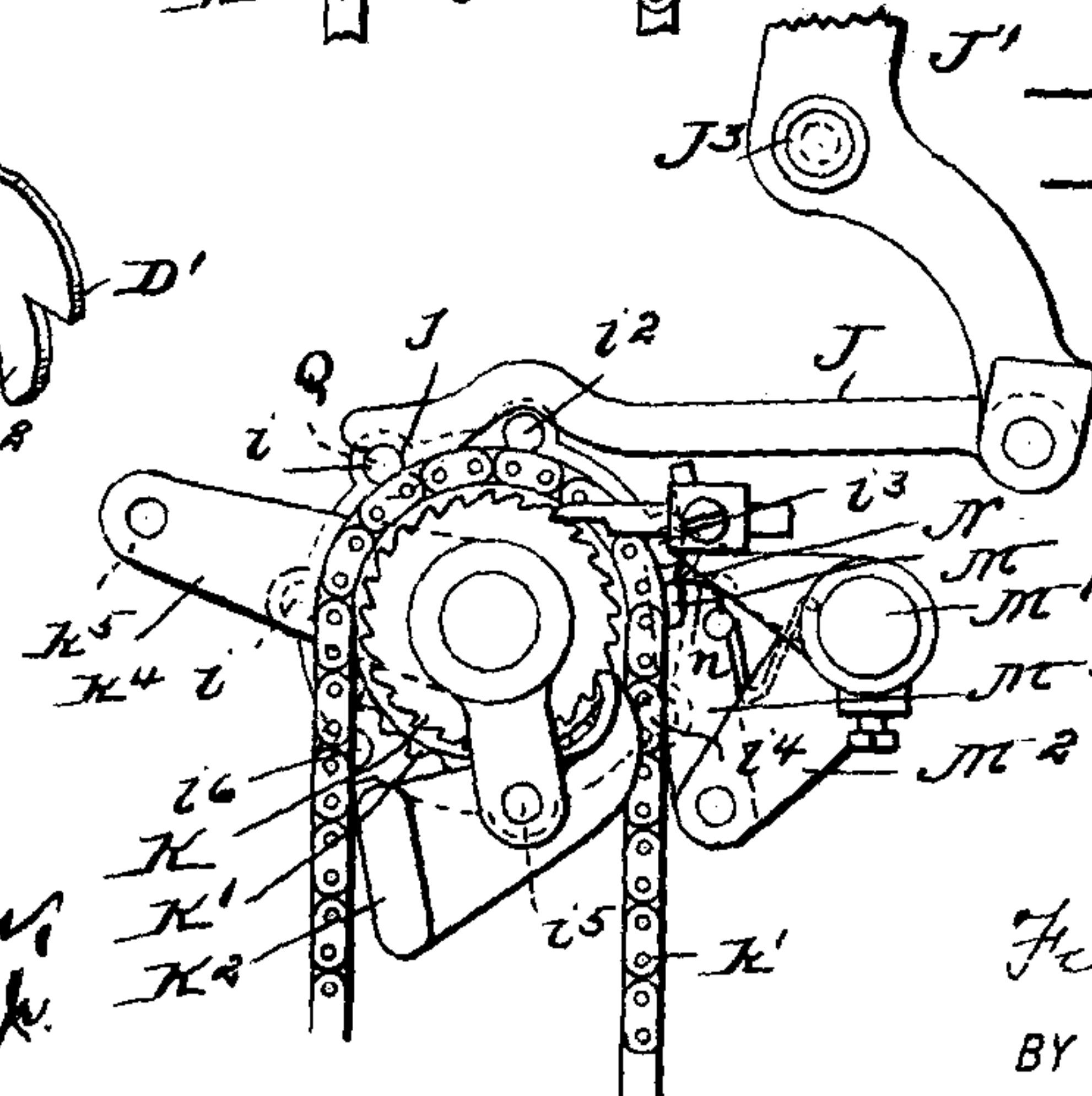


Fig. 6. w



WITNESSES:
Jesse B. Steller
J. M. Shumaker Jr.

INVENTOR
Frank Wilcomb
BY
Harding & Harding
ATTORNEYS

No. 654,695.

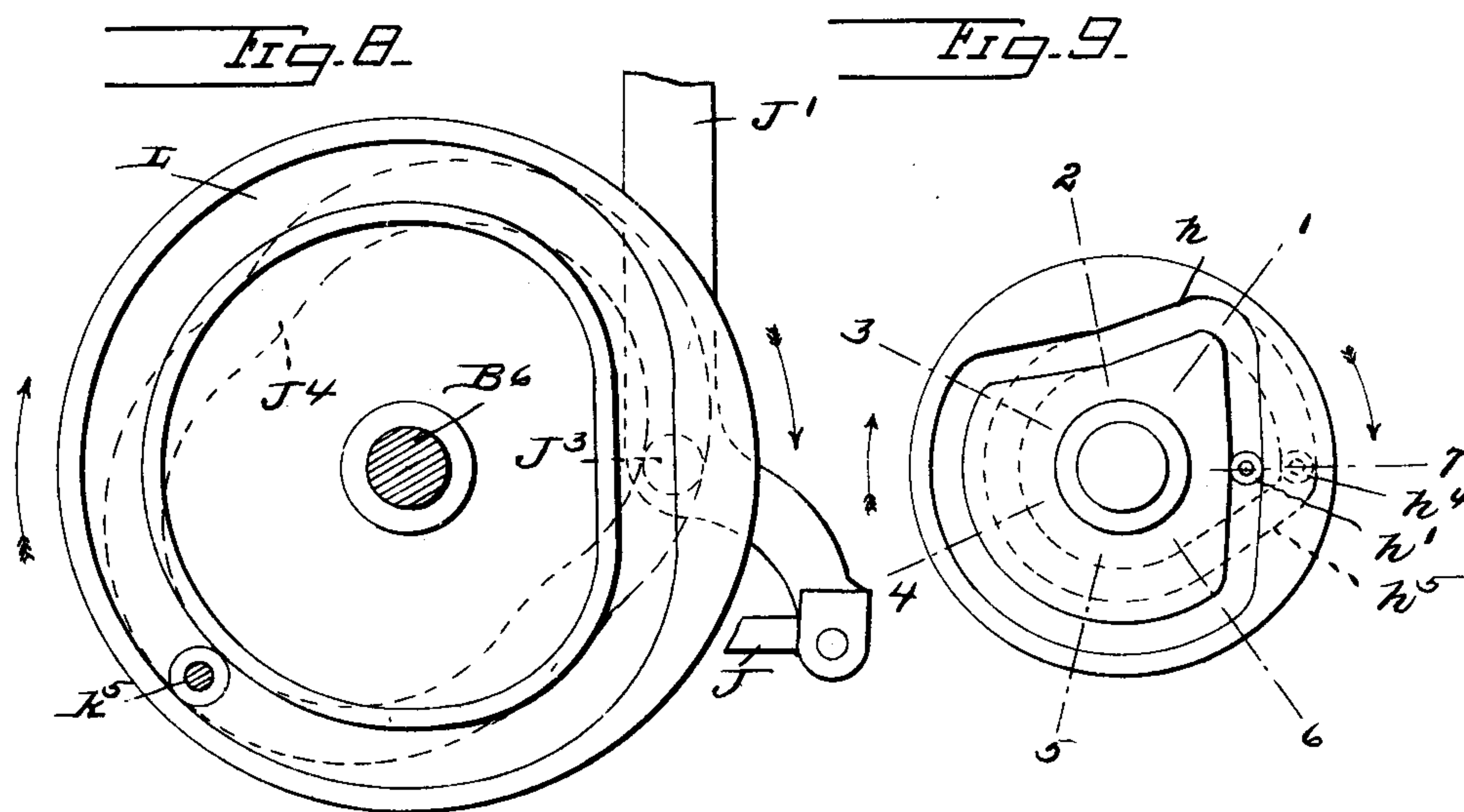
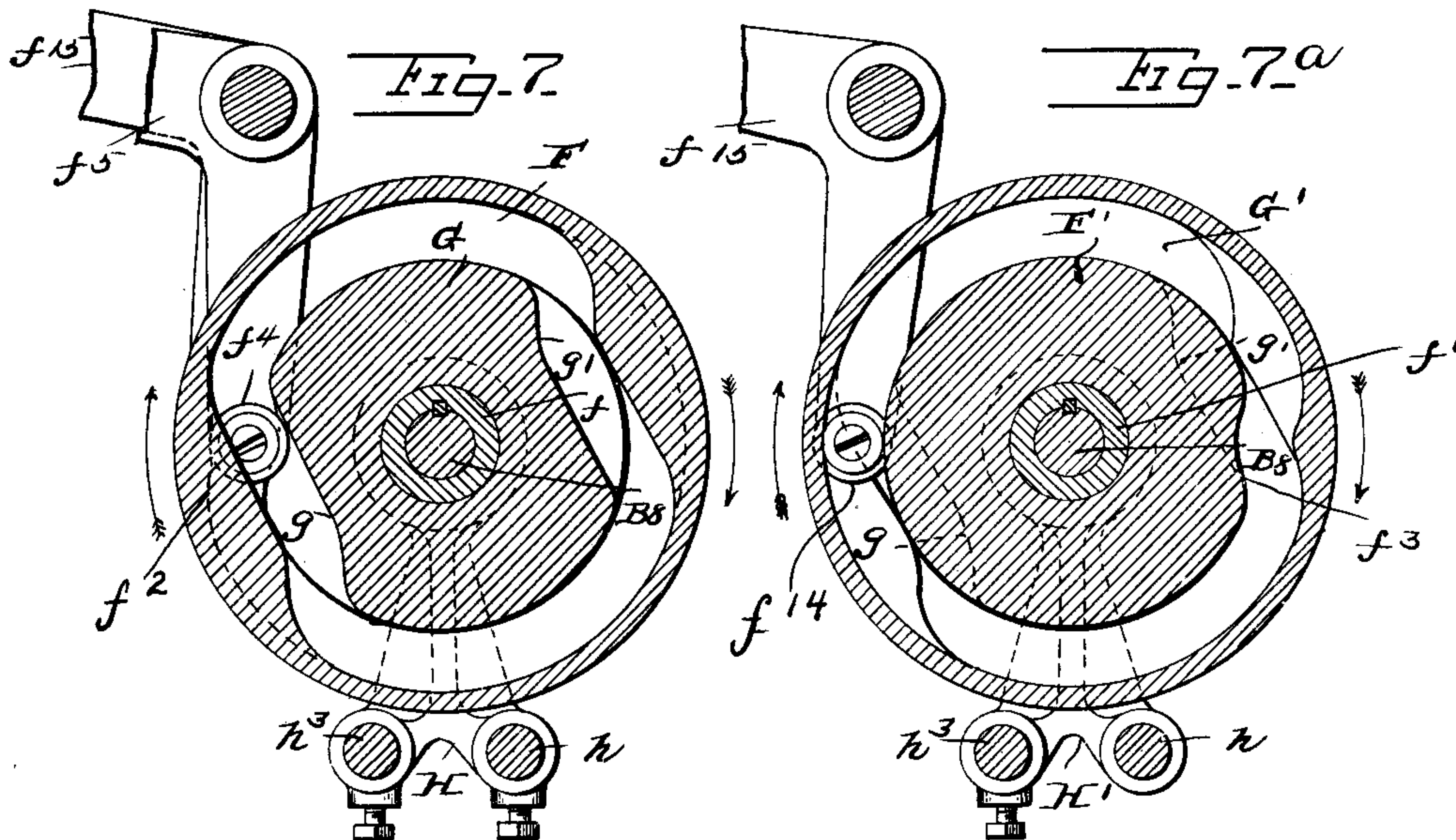
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WITNESSES:

Jesse B. Steller,
J. W. Shunder Jr.

INVENTOR .

Frank Wilcomb

BY

Harding & Harding
ATTORNEYS

No. 654,695.

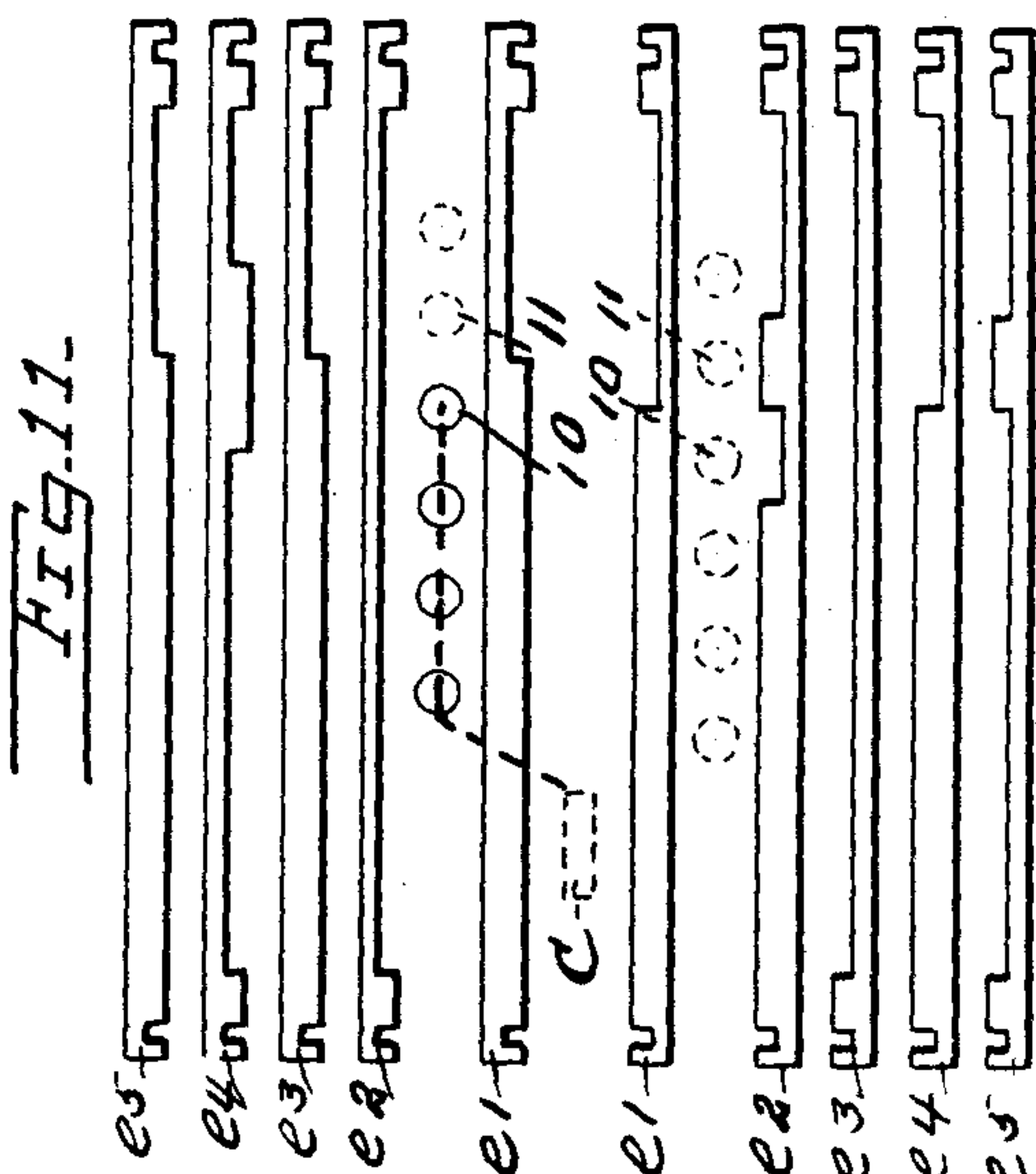
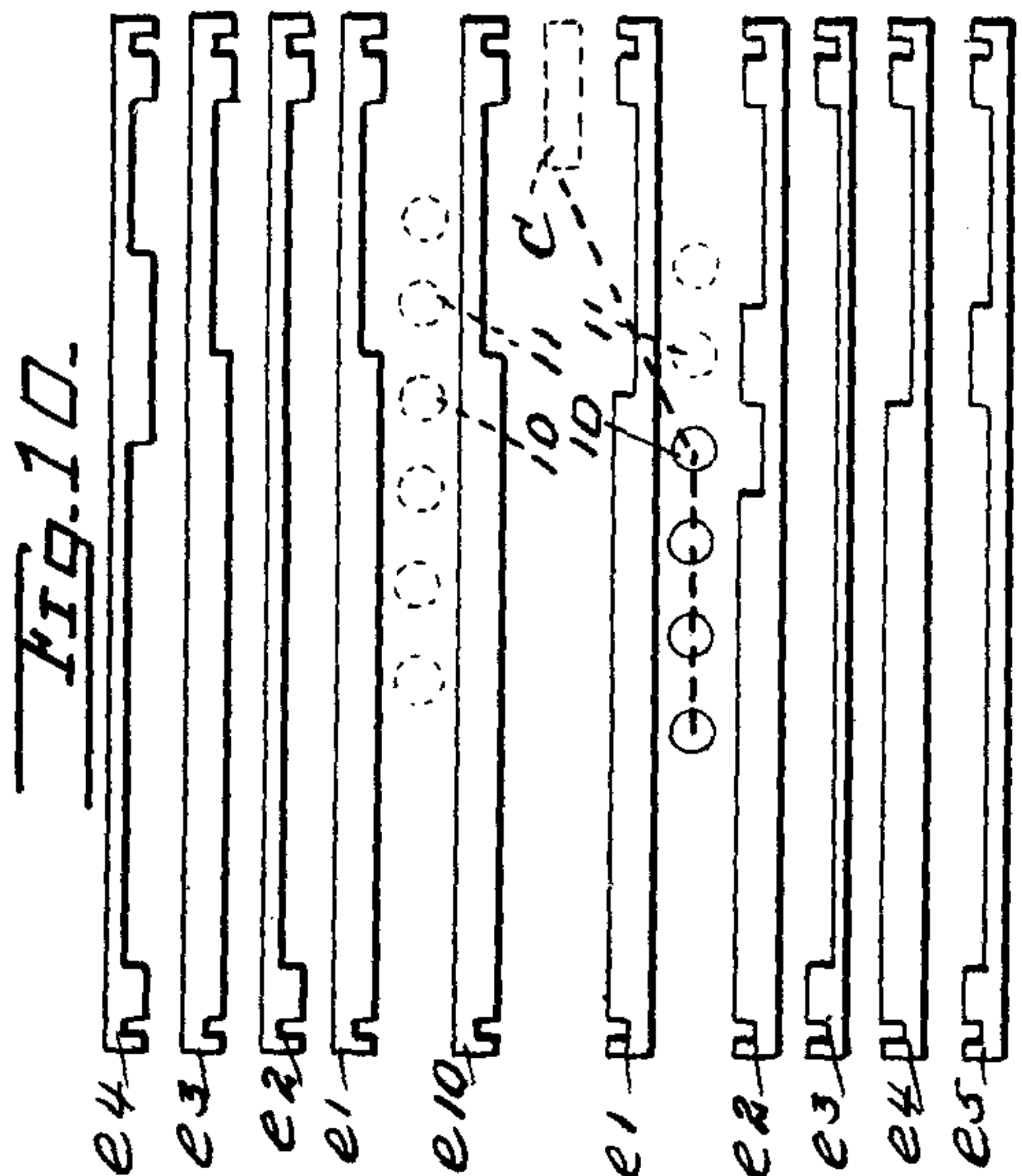
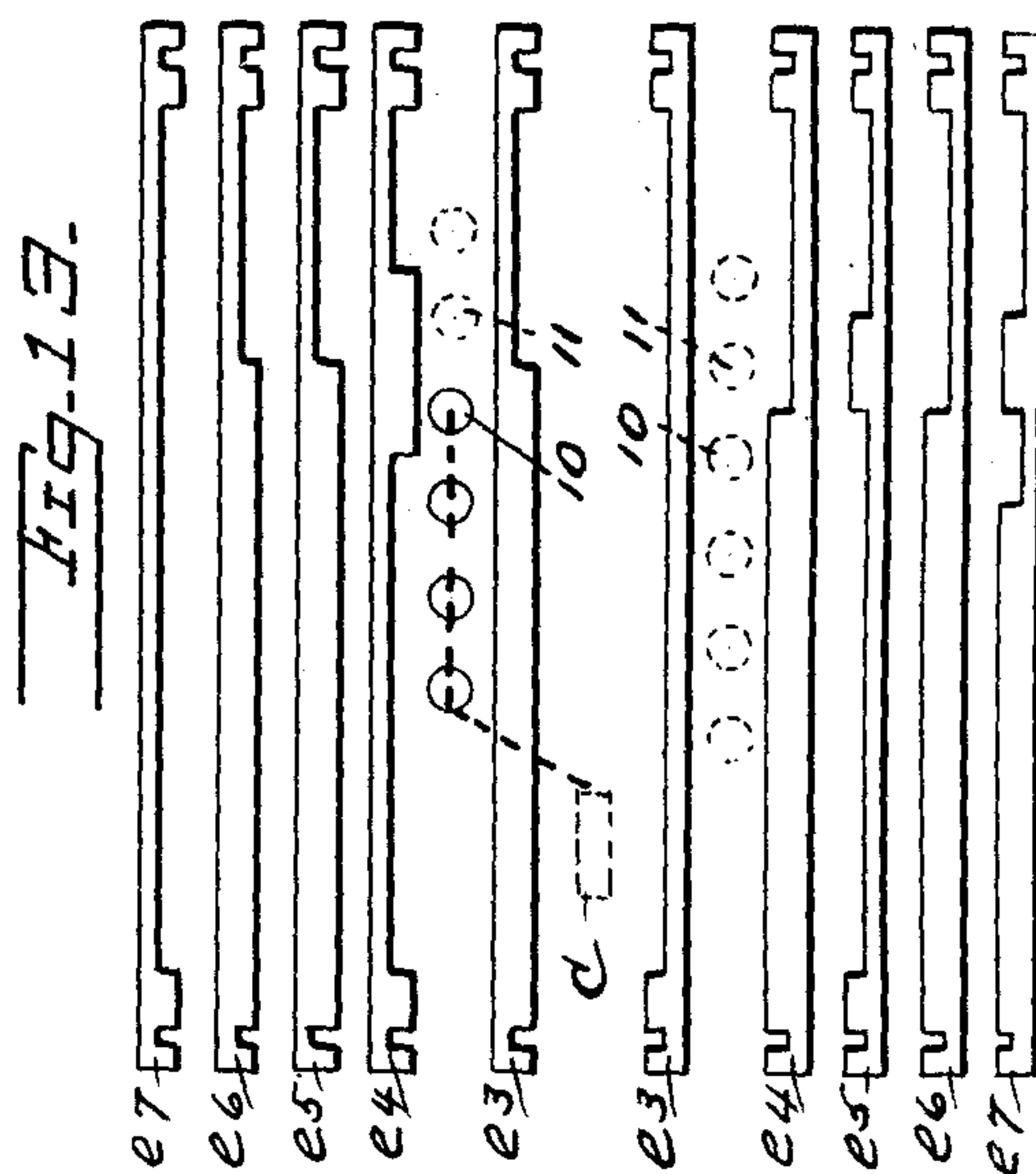
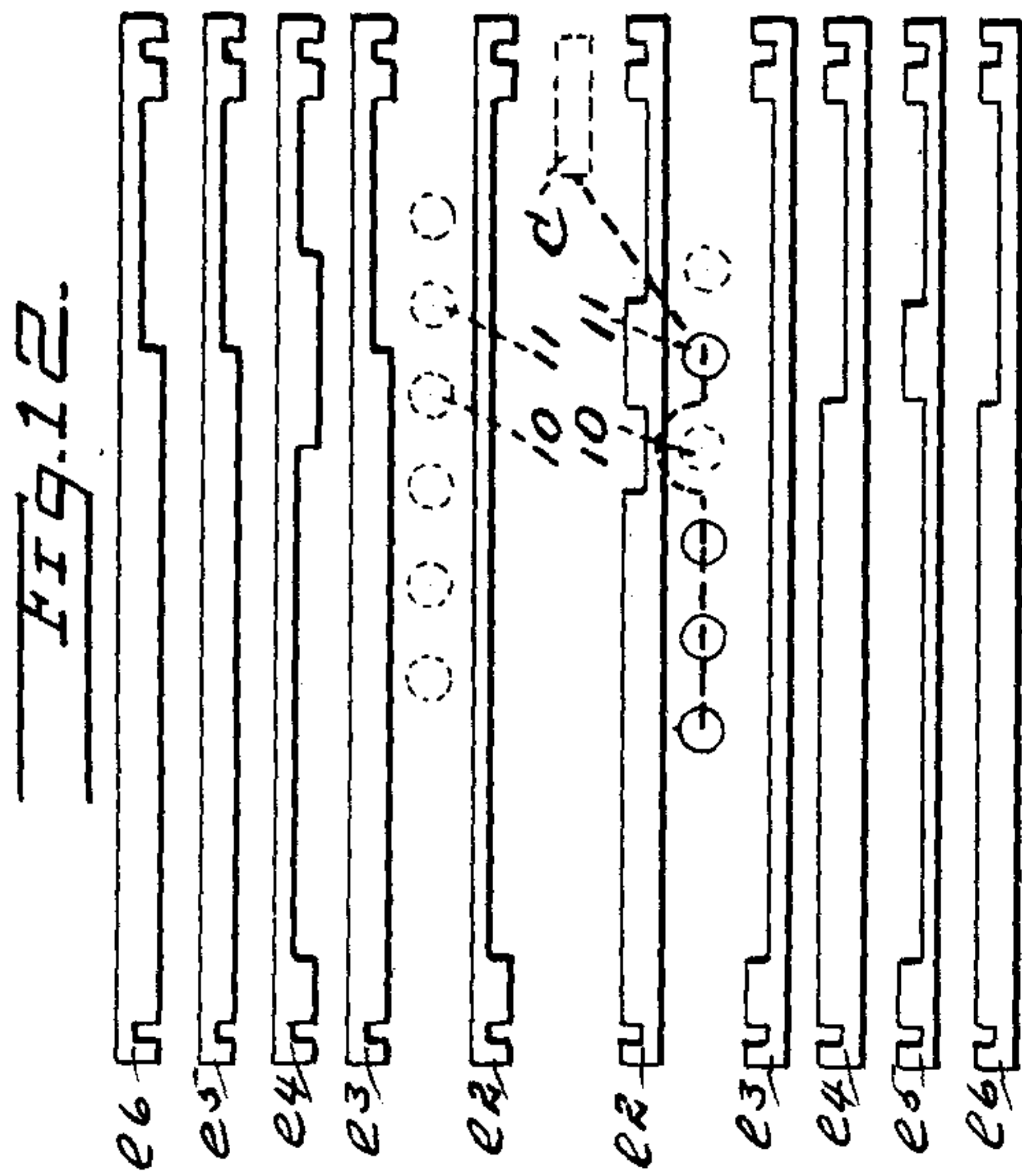
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WITNESSES:
James B. Heller
J. M. Shindler Jr.

INVENTOR.
Frank Wilcomb
BY
Harding & Harding
ATTORNEYS

No. 654,695.

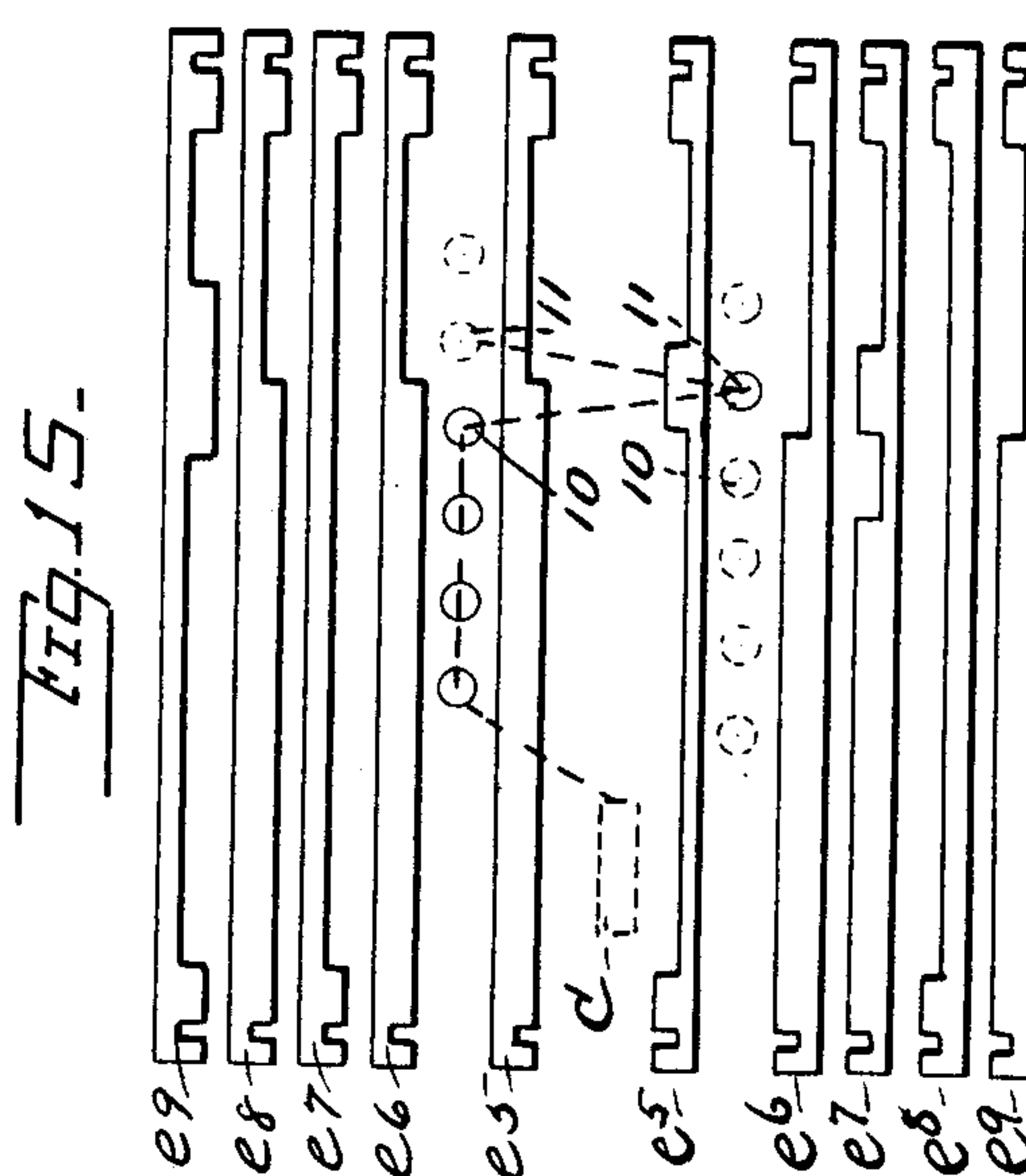
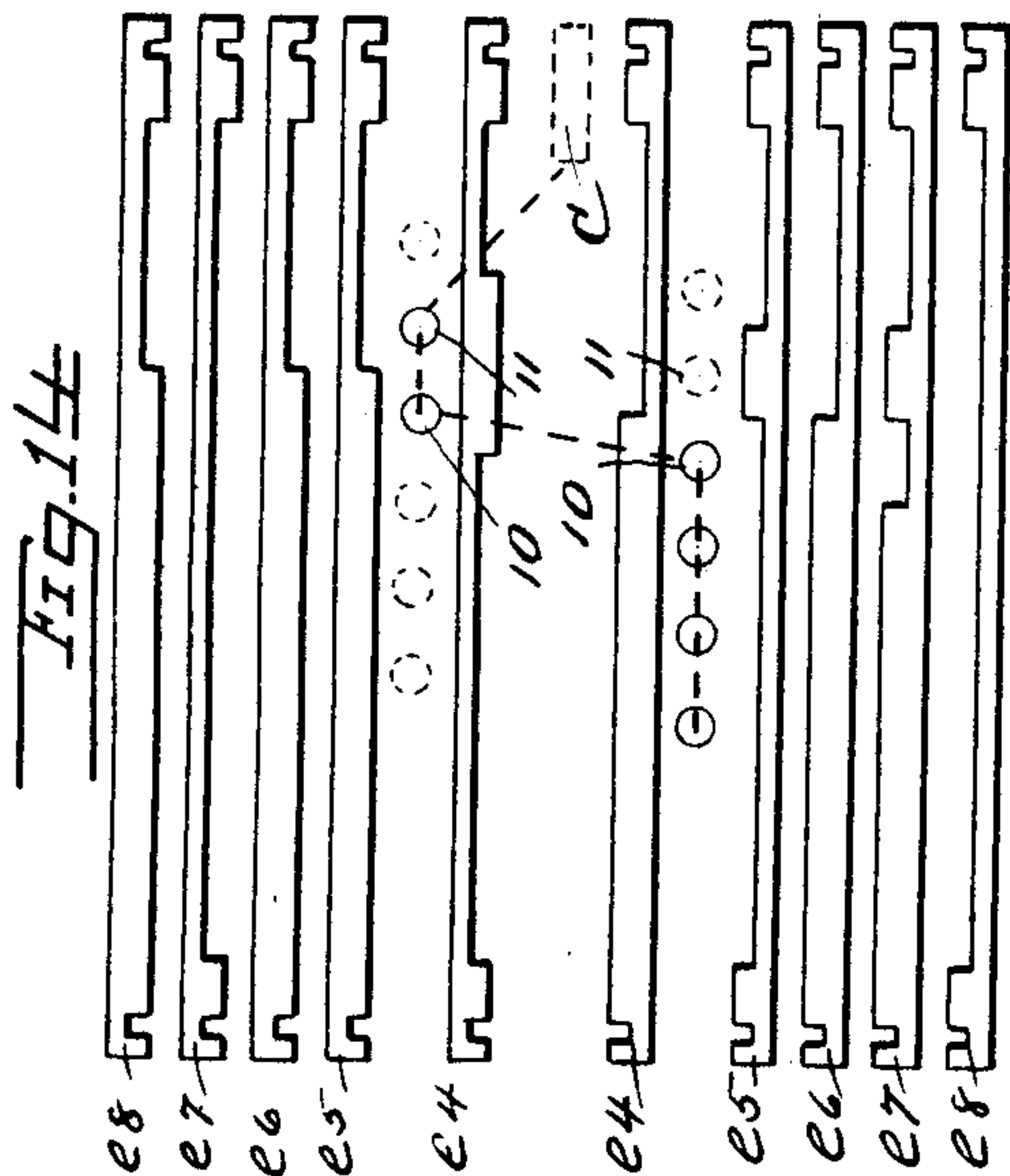
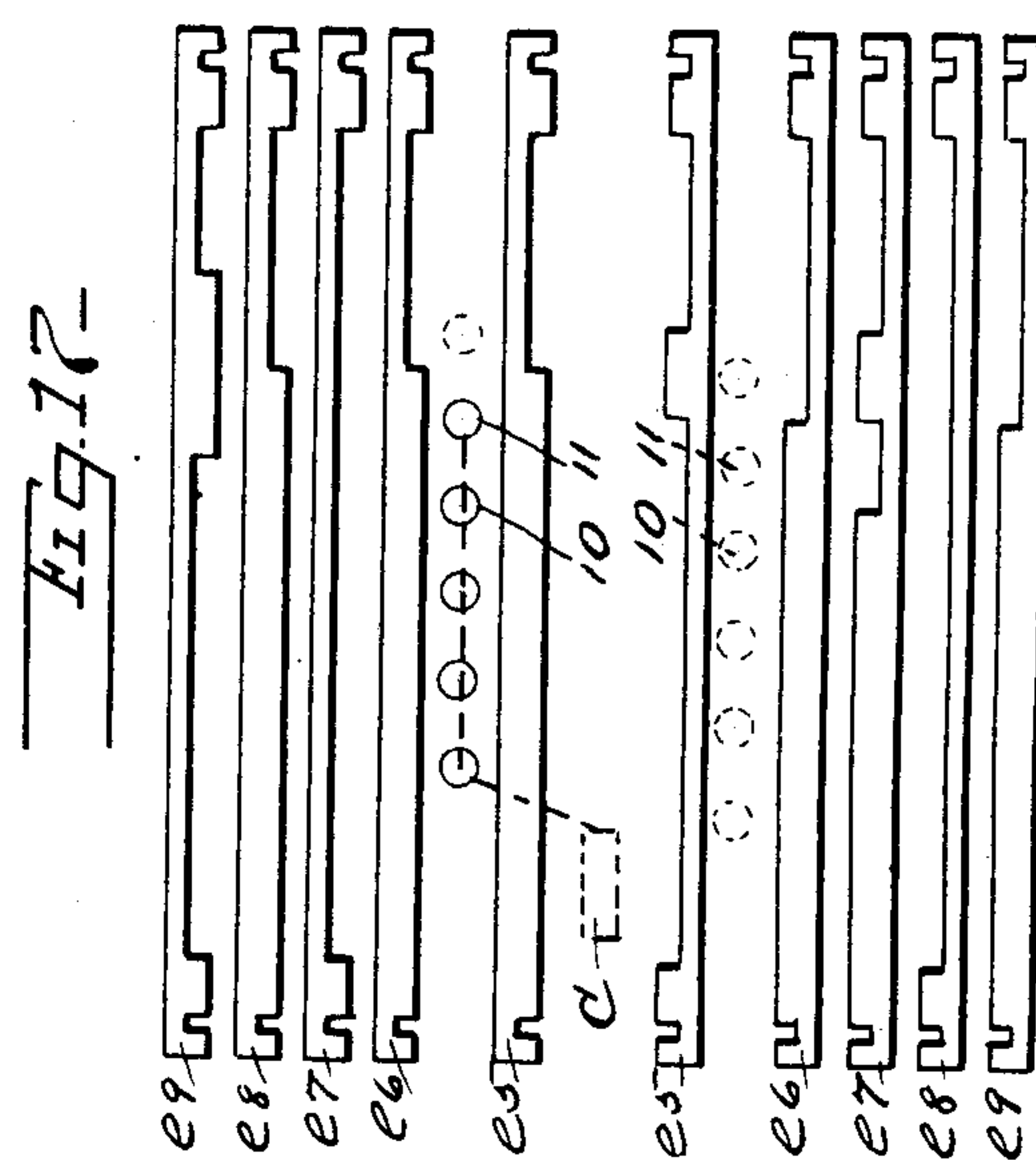
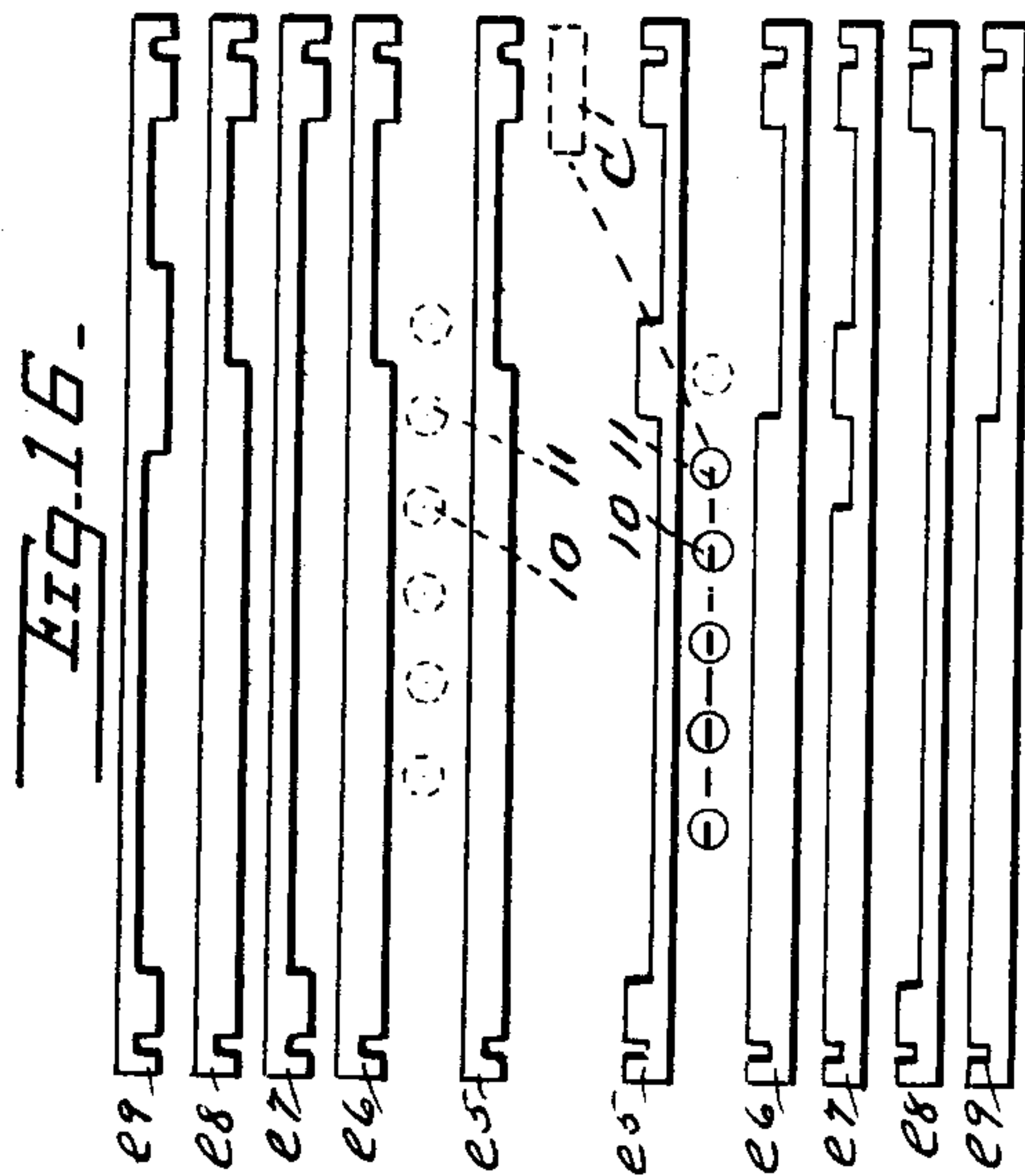
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WITNESSES:

James B. Steller
J. W. Shindler Jr.

INVENTOR

Frank Wilcomb

BY

Harding & Harding

ATTORNEYS

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Fig. 18.

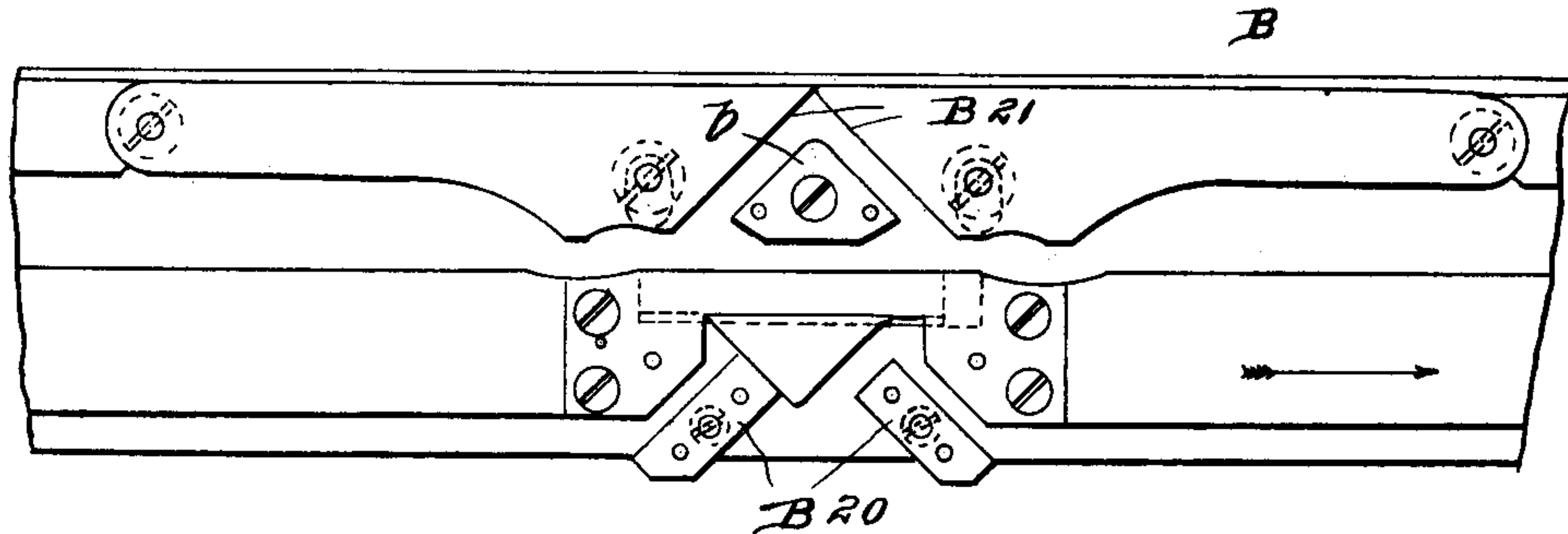


Fig. 19.

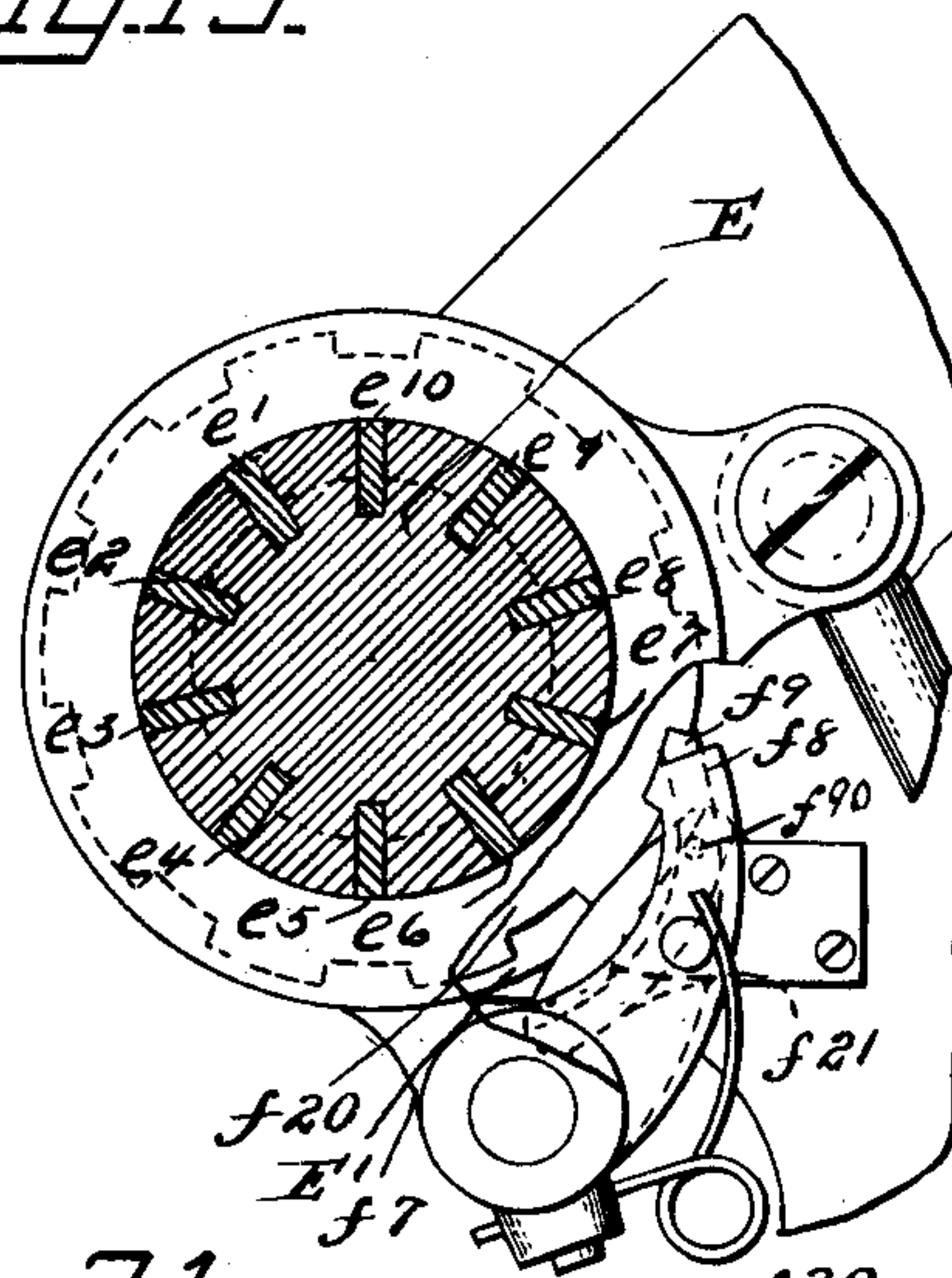


Fig. 20.

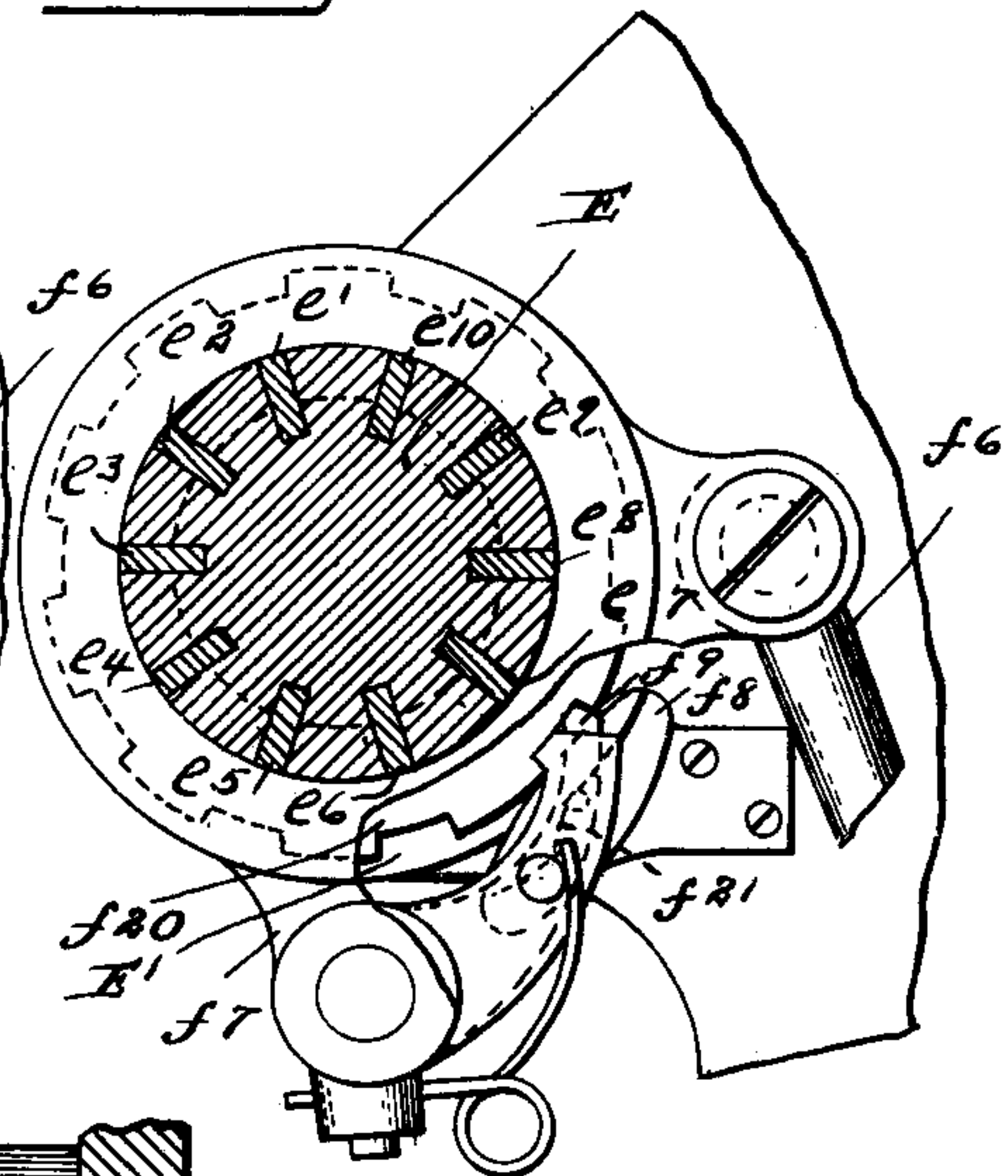
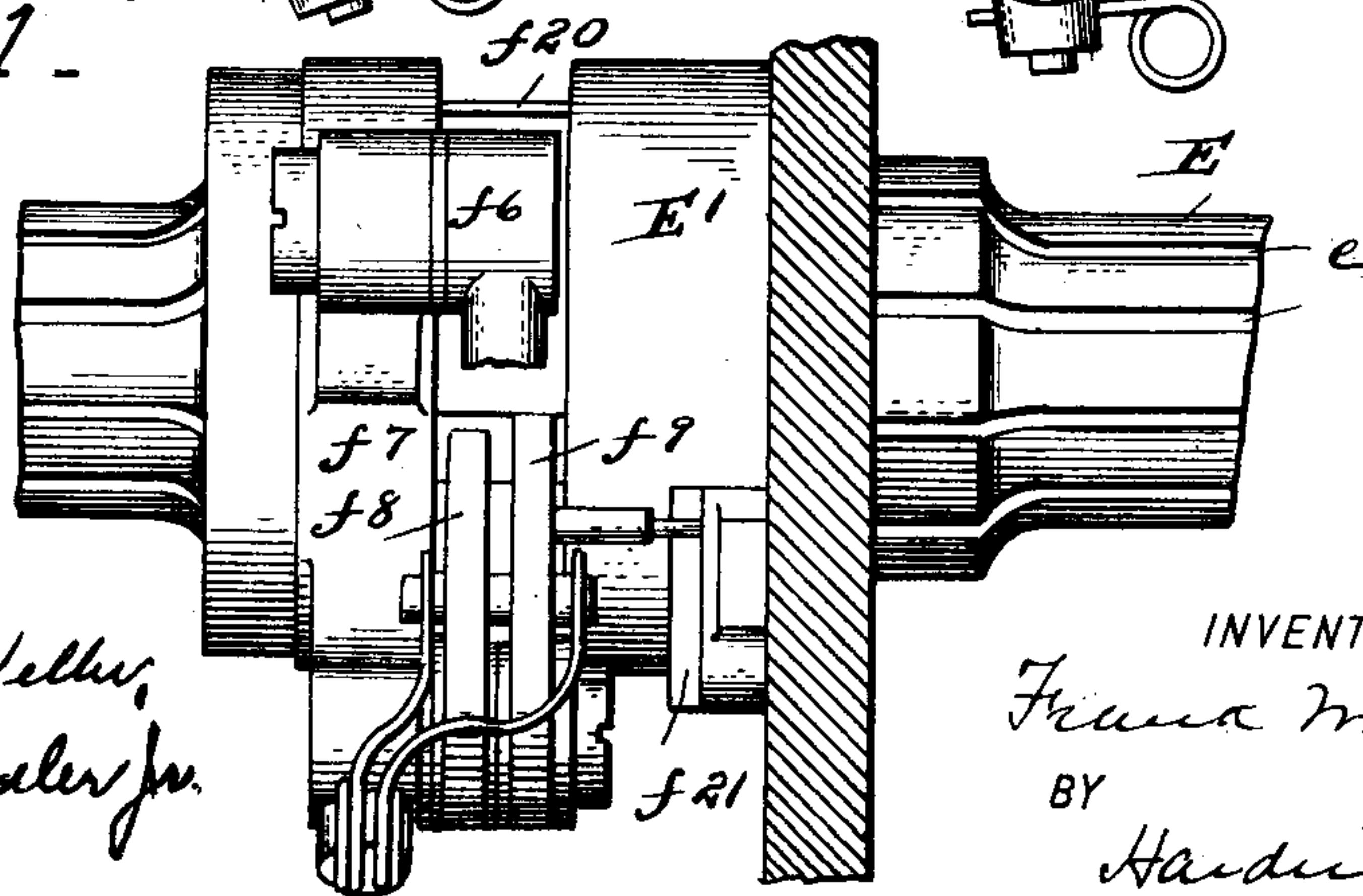


Fig. 21.



WITNESSES:

Jesse B. Heller,
J. M. Shindler, Jr.

INVENTOR.

F. Wilcomb

BY

Harding & Harding
ATTORNEYS

UNITED STATES PATENT OFFICE.

FRANK WILCOMB, OF PAWTUCKET, RHODE ISLAND, ASSIGNOR TO THE
STANDARD MACHINE COMPANY, OF PENNSYLVANIA.

KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 654,695, dated July 31, 1900.

Application filed April 14, 1899. Renewed May 16, 1900. Serial No. 16,918. (No model.)

To all whom it may concern:

Be it known that I, FRANK WILCOMB, a citizen of the United States, residing at Pawtucket, county of Providence, and State of Rhode Island, have invented a new and useful Improvement in Knitting-Machines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which form a part of this specification.

My invention relates to an improvement in that class of knitting-machines known as "straight-knitting" machines of the class generally known as the "Lamb" or "double-needle bank" type, and among other things to cause it to automatically widen the goods in a particular manner.

In the straight-knitting machines there are two banks of needles, one forming the front bank and the other the rear bank, between which banks of needles the thread-carrier reciprocates and in its movement in one direction, in the ordinary operation of such machines when making tubular goods, operates with one of the banks of needles—say the front bank—and on its return operates upon the other bank—say the rear bank. This continues until it is desired to widen the fabric. This is done on the machine in the following manner: Where an additional needle is to be thrown into action at that point in the forward throw of the thread-carrier, the additional needle in the front bank is drawn into action, but the needle preceding it is thrown out of action, said needle still holding a loop. On the return of the carrier the additional needle of the rear bank is not brought into action, the knitting being upon the other needles used in the previous course of said bank. On the next round of knitting on the forward movement of the thread-carrier the additional needle on the front bank, thrown into action on the previous round and supplied with thread, is made inoperative, the remainder of the needles preceding this being in action, and in this movement of the carrier the additional needle in the rear bank and the needle preceding it are thrown into action and take the thread. On the return movement of the thread-carrier the additional needle in the front bank is thrown into action and the

thread fed to it and to all the needles of the rear bank, except the additional needle, so that on this round of the thread-carrier the stitch is first formed on the additional front needle and then on the remainder of the rear needles, except the additional rear needle. Thereafter the rounds, until additional needles are again to be thrown into action, are formed by knitting on all the needles of one bank brought into action up to this point and then crossing over and knitting on all the needles of the other bank brought into action up to this point in the usual manner. My improved mechanism at the point of widening acts automatically to control the needles, so as to form the stitches in the manner just described, and after the change has been made acts to control the needles to operate in the ordinary manner for making tubular goods on this class of machines. The mechanism is also applicable to machines where fancy patterns may be made, as by the novel devices used any of the needles of a bank may be operated upon according to the arrangement of the pattern-strips in the cylinder, as will hereinafter appear.

I will first describe the machine illustrated in the accompanying drawings, which discloses a machine for carrying out my invention, and then specifically point out the invention in the claims.

In the drawings, Figure 1 is a front view of the machine. Fig. 2 is an end view of the machine. Fig. 3 is a section on line 3 3, Fig. 1. Fig. 4 is a partial rear view of the machine. Fig. 5 is a sectional plan on line 5 5, Fig. 1. Figs. 6 and 6^a are detail front views of mechanism for controlling the needle-operating devices. Figs. 7 and 7^a are detail sectional views of cams for oscillating and rotating the needle-operating cylinder. Fig. 8 is a side elevation of cams for operating pattern-chain and needle-operating mechanism. Fig. 9 is a side elevation of cams and cam-grooves for controlling the cams which operate the needle-operating devices. Figs. 10 to 17 are diagrammatical views showing courses of tubular knitting and the stitches formed at the point where additional needles are brought into action and the pattern-bars which are in action when these needles are

introduced. Fig. 18 is a front view of the cam-plate with its cams. Fig. 19 is a sectional view showing the needle-operating cylinder and the pawls for operating the same. Fig. 20 is a similar view of the pawls in their retracted position. Fig. 21 is a side elevation of the same. Fig. 22 is a perspective view of the sinker-block.

A represents the front bank of needles, and A' the rear bank of needles. Each groove a in the needle-bed A^x has a needle A or A' and also a jack A^2 . This jack A^2 has a nib a^2 , which rests in a groove in the cam-plate B. In line with each needle-jack A^2 is a lifting-jack A^3 . This cam-plate B carries the lifting-cam b . There is one cam-plate for the front needles and one for the rear.

B' B² are two cross-heads on opposite ends of the needle-space, the cross-head B' working on the guide b' and the cross-head B² working on the guide b^2 . Connected to one side of the cross-heads B' and B² is one of the cam-plates, and to the other side of the cross-heads B' and B² is connected the other cam-plate. These cross-heads are given a reciprocating movement across the needle-bed by the following means: B³ is a lever pivotally attached to the cross-head B' and at the other end, by means of the link b^3 , is pivotally attached to the frame of the machine. Between the pivotal points of the lever B³ is the link B⁴, which link has a crank connection b^{20} with the shaft B⁵. The shaft B⁵ has at one end the bevel-gear B⁶, which meshes with the bevel-gear B⁷ on the main driving-shaft B⁸, operated by the driving-pulley B⁹, so that as the driving-pulley is rotated through the medium of the mechanism just described the cam-plates are given a reciprocating motion across the needle-bed.

Ordinarily the needle-jack A^2 is in such position that the nib a^2 rests in the groove in the cam-plate B out of alinement with the lifting-cam b . The needle-jack is thrown into operative alinement with the lifting-cam by mechanism acting upon the rear end of the lifting-jack A^3 , which will hereinafter be more fully described.

C is the thread-carrier, having the eyes c c' and the thread-spindle c^2 , which spindle c^2 is central between the banks of the needles. This thread-carrier C is connected to one of the cam-plates by the frame C', so that in the reciprocation of the cam-plates B the thread-carrier is reciprocated so that the spindle c^2 , carrying the thread, is brought between the banks of needles in the movement of the thread-carrier in each direction.

D is the sinker or web-holder, which consists of the hook D' and the tailpiece D². The tailpiece in the machine is below the plane of the needle. The sinker is pivoted at d to the machine. This pivotal point, as may be seen, is below the needle. The surface of the tailpiece D² is curved, and its curvature is eccentric to the pivotal point of the sinker, and thus is curved eccentric to

the plane of the needle. This construction is very desirable in that in the movement of the sinker upon its pivot the hook may move approximately across the path of the needle. The thread in the knitting is laid across the hook D', and the movement of the sinker from its pivotal point below the plane of the needle causes the sinker in its rising movement to move away from the loop, and thus release the loop without putting any strain on it, and in its downward movement the tailpiece has a tendency to push the fabric away from the end of the needle assisting in the casting off. Heretofore it has been difficult, especially in fine-gage machines, to employ web-holders successfully on straight machines having two banks of needles. By this construction as perfect results as could be desired can be obtained.

The use of a rocking sinker or web-holder instead of one sliding in the usual way and the arrangement of the parts and their operation enable the sinker when tilted to release the hook from the fabric and maintain contact between the tailpiece and the fabric and to do this without interfering in any way with the operation of the needle. The sinker has the nib or projection d' , operated upon by the sinker-cam d^2 , which is connected with the cam-plate, and in the reciprocation of the cam-plate strikes the projection d' , tilting the sinker so as to bring the hook out of engagement with the fabric, so as to maintain contact between the tailpiece and the fabric, so that at the time that the needle is drawing down the thread the sinker or web-holder corresponding to that needle is moved back, allowing the new loop to be formed under the hook, holding the fabric from being carried forward when the needles are advanced again. The tailpiece being practically in contact with the fabric all the time serves to hold the fabric while the needles are drawing the thread through the old loops.

W is a sinker or web-holder block detachably connected by means of the screws w with the needle-bed, there being one of these blocks W on each side of the machine. This block W has a lower portion w' and a higher portion w^2 . The portion w^2 and the vertical wall connecting the parts w^2 and w' are provided with a series of slots w^3 , equal in number to the needle-bed slots. In each of these slots are placed the sinker-holders w^4 . These holders are provided with a head w^5 , in which there is an orifice w^6 and the tailpiece w^7 , which is inserted in the slots. Between the pairs of these sinker-holders w^4 are placed the sinkers, the pivotal orifice or point of the sinker registering with the orifice w^6 , and a bar or rod passes through the orifice w^6 and the orifice in the sinker, forming the pivotal point for the sinker.

In the ordinary knitting of straight tubular work when the thread-carrier is moving in one direction—say from left to right of the

machine—the mechanism is operated so as to throw out of action or to leave out of action all the needles in the rear bank, and when the thread-carrier is moved from right to left the mechanism is so operated as to throw or leave out of action all of the needles in the front bank. This is accomplished in the following manner: The front and rear banks of needles, respectively, are provided with a needle-bar cylinder E. This cylinder is provided on its surface with slots e , of any number desired, (as shown in the drawings there are ten slots,) the purpose of which will be more fully hereinafter described. The cylinder on each side of the machine extends across its corresponding needle-bed and beyond the same, passing loosely through orifices or bearings E' E^2 on the frame of the machine. Upon each of the cylinders E are collars E^3 of such size as to abut against the inner edges of the bearings E' E^2 , so that while the cylinders E are free to rotate they are held from lateral movement in either direction by the collars E^3 abutting against the surfaces of the bearings E' E^2 . In the slots e are placed the lifting-jack-operating bars e' e^2 to e^{10} . In the front cylinders are the bars corresponding in number to those in the rear cylinder, although, as will hereinafter be shown, the shape of the bars in this machine is slightly different in the rear from that of the front set of bars. Of course as the effect to be produced is varied the shape and construction of the pattern-bars, front and rear, will be varied accordingly.

The cylinders, by mechanism hereinafter to be more fully described, are, when straight tubular work is being made by the machine, given an oscillating movement, so that the projecting surfaces of the bars force the lifting-jacks into alinement with the cams B^{20} for operating the lifting-jacks against the needle-jacks, forcing the needle-jacks into such position as to bring the nib a^2 into alinement with the lifting-cam b . Speaking generally, these bars are cut away opposite the needle or needles which are to remain inactive, leaving a projecting surface opposite the needles desired to be thrown into operative position at any one traverse of the thread-carrier, the portion of the bar being cut away opposite to and corresponding to any needle desired to be left out of action in any one traverse of the thread-carrier. In operating the machine for straight tubular work the bar e' or its corresponding bar e^6 on the front and rear cylinders are used and the cylinders are alternately oscillated, so that just before the thread-carrier moves from left to right the front cylinder is oscillated and just before the thread-carrier moves from right to left the rear cylinder is oscillated, it being understood that all the needles of both banks are always inoperative except when the jacks A^3 are forced into alinement with the cam B^{20} by the aforesaid strips in the cyl-

inder. This is accomplished in the following manner:

F and F' are two cams secured, respectively, to the bushings f and f' , which bushings are feathered loosely upon the main driving-shaft, so that they rotate with and are susceptible of a lateral movement upon the main driving-shaft. These cams, as may be seen in Fig. 7, are smooth-faced cams having at one point a depression, the depression in the cam F being denoted by f^2 and the depression in the cam F' being denoted by the letter f^3 . As may be seen, while these cams are similarly formed, the depression f^2 is at a distance of one hundred and eighty degrees from the depression f^3 , so that as the main driving-shaft moves the thread-carrier across the depressions f^2 and f^3 assume corresponding positions at opposite ends of the throw of the thread-carrier. Coöperating with the cam F is the roller f^4 , which is connected with the bell-crank f^5 , which is connected by means of a link f^6 to a pawl-holder f^7 , which pawl-holder carries two pawls f^8 f^9 , which work in a ratchet-wheel connected to the front needle-bar cylinder. As may be seen, the pawl f^8 is so constructed that it acts in one direction on the ratchet-wheel, while the pawl f^9 acts in the other direction on the ratchet-wheel, so that when the roller f^4 strikes the surface f^2 the pawl-holder f^7 is rocked so that the first movement of the pawl f^8 will turn the cylinder to bring the bar e' against the lifting-jacks, throwing the needles corresponding to the jacks struck into operation and the pawl-holder rocks back. The pawl f^9 acts to return the cylinder to its original position. In this operation the pawl-engaging pin f^{10} on pawl f^9 slides back and forth along the concentric portion of cam-surface f^{21} on the frame of the machine, so that the pawls are not drawn out of engagement with the ratchet. Coöperating with the cam F' is a corresponding roller f^{14} , connected to a bell-crank f^{15} , which bell-crank f^{15} , by the link f^{16} , is connected to the corresponding pawl-holder f^{17} on the rear of the machine, coöperating with the pawls f^{18} and f^{19} , meshing with the ratchet f^{20} , connected to the rear needle-bar cylinder. This being the case, as the main driving-shaft is rotated alternately the cam F and the cam F' operate upon their corresponding rollers f^4 and f^{14} and through the medium of the mechanism just described alternately cause the bar e' of the front and rear needle-bar cylinders to strike the lifting-jacks and throw the needles of the front and rear banks alternately in action. Thus in the reciprocation of the thread-carrier the knitting in one direction is performed on the front bank of the needles and in the other direction on the rear bank of the needles, forming ordinary tubular fabric. Of course it is immaterial, so far as the operation of the machine is concerned, whether the front or the rear bank of needles act upon either throw of the thread-carrier. Thus the rear

bank of needles might be active through the movement of the thread-carrier from left to right and the front bank from right to left. In this case it would merely necessitate the reversal of the position of the cams with relation to each other. So much as has heretofore been described in reference to this machine relates to tubular work, where a constant number of needles are in action throughout the courses.

10 In Figs. 10 to 17 I have shown the form of the bars e' to e^{10} , heretofore described, as being in the needle-bar cylinders front and back, and, as before described, the bars from e^6 to e^{10} are a duplication of the bars from e' to e^5 —that is, e' corresponding to e^6 , e^2 to e^7 , e^3 to e^8 , e^4 to e^9 , and e^5 to e^{10} . When it is desired to add additional needles, by my method it is necessary during this change that the needle-bar cylinder, both rear and front, should at some point in the change be oscillated at each end of the movement of the thread-carrier. The change, or adding an additional needle, is commenced at the time when the thread-carrier is moving from left to right, and let us suppose, as in the ordinary knitting, it will then knit upon the front bank of needles, (and I will now describe the operation as if done by hand.) In that case instead of the front bar e' being used to operate the jacks both front and back cylinders have been simultaneously turned and the front jacks operated by the front bar e^2 , and the rear bar e^2 is brought into position. As may be seen, the construction of this front bar e^2 is such, let us suppose there being ten needles used in the straight work, as to be inactive with reference to lifting needle-jack 10 and to bring into action an additional needle to needle No. 10—let us say needle No. 11. The consequence is that in the movement of the thread-carrier in this direction no stitch is made on needle No. 10 while the thread is laid on needle No. 11. The construction of the rear bar e^2 is such as to have no effect upon the rear jacks. On the return movement of the thread-carrier both cylinders are again simultaneously turned, so that bar e^3 is moved toward the lifting-jacks; but being entirely cut away it has no effect upon them while the bar e^3 on the rear cylinder operates upon its jacks. This rear bar e^3 may be readily seen by Fig. 13 to be of the same construction as the rear bar e' . As a consequence in the return movement of the thread-carrier stitches are formed upon the ten rear needles, which are the same ten needles upon which stitches were formed in the straight tubular goods. In the next movement of the thread-carrier from left to right both cylinders are again simultaneously turned, and the bar e^4 on the front is brought into action, and the bar e^4 on the rear is brought into action. As may be seen, the bar e^4 on the front is the same as the bar e' front, and as a consequence ten needles on the front (the same ten needles used in forming tubular work) are knitted upon, while in this movement of the thread-carrier, as may be seen from the construction of the rear bar e^4 , the rear needles 10 and 11 are knitted upon in the rear bank. (See Fig. 14.) On the return movement of the thread-carrier from right to left both cylinders are simultaneously turned, the front bar e^5 is in action, and the rear bar e^5 . As may be seen from the construction of these bars, in this movement of the thread-carrier a stitch is formed upon the eleventh needle of the front bank and upon ten needles in the rear bank, the additional needle in the rear bank not being knitted on. (See Fig. 15.) In the next forward movement of the thread-carrier the front cylinder only is actuated and the front bar e^6 is brought into action, which is the same as bar e' , but is shifted forward the distance of one needle. This throws into operation the whole eleven front needles. During this movement the rear needle-bar cylinder is inactive. (See Fig. 16.) On the return of the carrier from right to left the rear cylinder only is actuated and the rear bar e^6 is operated, which throws into action the whole eleven needles on the rear bank. During this movement the front needle-bar cylinder is inactive. (See Fig. 17.) From this on, so long as no further additional needles are added, the operation is the same as in the original straight work—that is, alternately bar e^6 front and bar e^6 rear are thrown into action to strike the lifting-jacks. In the first movement from left to right a needle is skipped and an additional needle knitted upon. In return from right to left the additional needle on the rear is not included. In the next movement from left to right the additional needle on the front is not knitted on, while the additional needle on the rear is knitted on. On the return movement of this course from right to left the additional needle on the front bank is knitted on and the additional needle or rear bank is not knitted on, and subsequently thereafter so long as no further additional needles are thrown in action alternately the full number of needles, including the additional needles on the front and rear, are knitted on, so as to form tubular fabric, including the additional needle. By this, as may be seen, there is no open space at the point of adding additional needles.

In my machine I provide mechanism for automatically operating the bars, and I further provide means at the end of the widening action to shift the bars laterally, so as to increase their effective surface by the extent of the additional needles, so that when subsequent additional needles are added the bars will be in position to repeat the operation just described.

Upon the main driving-shaft and connected to the bushing f and f' are the cams G and G' . These cams are shown in Figs. 7 and 7^a and are somewhat similar to the cams F and F' , except there are two depressions g and g' , in corresponding parts of each cam, and these two depressions are somewhat deeper than

the depressions f^2 and f^3 . When the additional stitches are to be added, the cams F G and F' G' are shifted, so that the roller f^4 operates on the cam G instead of the cam F, while the roller f^{14} operates with the cam G' instead of with the cam F', and when either of these rollers reaches the portions g and g' of the respective cams the operation upon the corresponding bell-cranks is such as to increase the throw of the bell-cranks f^5 and f^{15} and the corresponding pawl-holders f^7 and f^{17} , so that the pawls f^8 and f^{18} will operate upon their corresponding ratchets, so as to turn their corresponding needle-bar cylinders in a position to cause the bar to strike and pass beyond the lifting-jack and bring the next succeeding bar into operative position. This forward movement is of such length as to cause the pawls f^9 and f^{19} to strike the raised portion of the cam-surface f^{21} , which tilts them so as to throw them out of connection with the ratchet, so that on the return movement of the corresponding levers f^5 and f^{15} no action will take place on the cylinder. To make these cams operate properly upon their corresponding levers to produce the desired result, I use the following mechanism: Encircling the bushing f is a clutch-fork H and encircling the bushing f' is a clutch-fork H'. The clutch-fork H, by means of a rod h , is connected to a roller h' , working on a cam h^2 , while the clutch-fork H', by means of a rod h^3 , is connected to a roller h^4 , working on the cam h^5 . These cams h^2 and h^5 are secured to a shaft h^6 , so that when said shaft is revolved the cams are revolved with it. In Fig. 9 is shown the position of the rollers h' and h^4 upon the cams h^2 and h^5 during the straight knitting, the cams during the straight knitting not revolving, but being at rest. It is by the movement of these cams that the mechanism whereby the needle-bar cylinders are automatically operated during the addition of the additional needles is brought into operation and retired. So that this may be understood independent of the mechanism which operates it, we will revolve the cams by hand. Revolving the cams in the direction of the arrow, the rollers h^4 and h' will move from position 7 to position 1. So far as the roller h^4 is concerned, it moving in a concentric circle during that movement will have no effect upon its corresponding fork. As a consequence the cams G' and F' will not be affected and the roller f^{14} will still remain in contact with the cam F'. As a consequence during this movement of the cam (supposing the thread-carrier to be at the position to move from left to right) no effect will be had upon the rear needle-bar cylinder. However, the roller h' has been moved outward, which will move the cams G and F so as to throw the roller f^4 out of engagement with the cam F and into engagement with the cam G. This operates the bar e' against the lifting-jack of the front set of needles and moves it beyond the lifting-jack

and brings the bar e^2 into operative position. This may be seen in Fig. 10, which is the condition after the stroke has been made from left to right of the thread-carrier. Fig. 10 shows the operation of bar e' front, the stitch, and the shift to front bar e^2 . The next movement of the cams h^2 and h^5 to right brings the two rollers h^4 and h' from position 1 to position 2. This, so far as the roller h' is concerned, moves the cams F and G in the reverse direction, so as to throw the roller f^4 into engagement with the cam F, and as a consequence there is no action upon the corresponding front needle-bar cylinder. The operation upon the roller h^4 in this movement is such as to shift the cams F' and G' to bring the roller f^{14} into engagement with the cam G', as a consequence its corresponding rear needle-bar cylinder operating the bar e' upon the tails of the lifting-jack and moving the bar e' out of operative position and bringing the rear bar e^2 into operative position. Fig. 11 shows the operation of the rear bar e' , the stitch, and the shift to rear bar e^2 . The next movement of the cams causes the rollers h^4 and h' to move from the position 2 to the position 3. In this movement the roller h^4 travels concentric and the roller h' travels toward the circumference. This disengages the roller f^4 from the cam F and brings it into engagement with the cam G. The concentric travel of the roller h^4 causes the roller f^{14} to remain in engagement with the cam G'. As a consequence the effect upon the front cylinder is to cause the front bar e^2 and the rear bar e^2 to operate upon the lifting-jacks and move said bars beyond the lifting-jacks and move the bars e^3 , front and rear, into operative position. Fig. 12 shows the action of front and rear bars e^2 , the stitch, and the shift to front and rear bars e^3 . In the next movement of the cam from position 3 to position 4 the form of the cam is such that the roller h' still holds the roller f^4 in connection with the cam G and the roller h^4 still holds the roller f^{14} in engagement with the cam G'. The consequence is that in this position the bars e^3 , front and rear, are brought against the jacks and moved beyond and the bars e^4 , front and rear, are brought into operative position. Fig. 13 shows the action of bars e^3 , front and rear, and the shift to bars e^4 , front and rear. The next movement of the cam moves the rollers from the position 4 to the position 5. These passages, being concentric with the previous position of the rollers, maintain contact between the roller f^4 and the cam G and the roller f^{14} and the cam G'. As a consequence both bars e^4 rear and e^4 front simultaneously operate upon their respective jacks and the bars are moved beyond operative position and the bars e^5 rear and e^5 front are brought into operative position. Fig. 14 shows the action of the bars e^4 , front and rear, and the shift to bar e^5 , front and rear. In the next movement of the cams from position 5 to position 6 the rollers h' and h^4 move concentric,

maintaining the contact between the roller f^4 and the cam G and the roller f^{14} and the cam G', causing the bars e^5 , front and rear, to operate upon the lifting-jacks and move 5 beyond the lifting-jacks, bringing the bars e^6 , front and rear, into operative position. Fig. 15 shows the action of bars e^5 , front and rear, and the shift to bars e^6 , front and rear. In the next movement of the cams, the rollers 10 h' and h^4 travel from the position 6 to the position 7, which is the initial position. In this position the roller h' travels toward the center and the roller h^4 toward the periphery. This shifts the rollers f^4 and f^{14} from cams 15 G G' to cams F and F'. As a consequence the front bar e^6 will operate under the influence of cam F. The cam F' being at its inactive point will not affect bar e^6 rear. The action of bar e^6 is shown in Fig. 16. In the 20 next movement of the thread-carrier the cam F' is active and cam F inactive, and thus rear bar e^6 operates and front bar e^6 is inoperative. (See Fig. 17.) Alternately front bar e^6 and rear bar e^6 are operated until it is again 25 desired to add additional needles.

The mechanism by which the cams h^2 and h^5 are operated and the means by which they are automatically thrown in and out of operation are as follows: Upon the shaft h^6 , upon 30 which are the cams h^2 and h^5 , is the wheel I, having projections i to i^6 . These projections are equally spaced on the wheel, with the exception that the distance between the space i and i' is slightly greater than the distance 35 between the remainder of the projections. J is a lever having a notch j at its end. The lever J is connected to a lever J', which lever J' is pivotally connected to the frame of the machine at J². Upon the lever J' is the roller 40 J³. This roller rests upon the surface of the cam J⁴ upon the driving-shaft of the machine. The surface of this cam, as may be seen, Fig. 8, is such as to give a reciprocating motion to the lever J, it having two motions 45 to one rotation of the driving-shaft, so that it (the lever J) moves forward when the thread-carrier is moving in each direction of movement. The notch j of the lever J plays normally between the projection i and the 50 projection i' , the lateral movement of the lever being equal to the distance between the teeth i' and i^2 or i^2 and i^3 —in fact, the distance between all of the projections except that of i and i' . As a consequence in the normal 55 positions of the machine this lever J plays between the projections i and i' . K is a ratchet-wheel upon the shaft k . Upon the same shaft and connected with the ratchet-wheel K is the sprocket-wheel K', having upon it 60 the pattern-chain k' . K² is a pawl operating in the ratchet-wheel K. This pawl is connected by means of a crank k^3 with the shaft k . k^4 is a crank connected to the shaft k and having at its outer end a roller k^5 , which 65 works on cam L on the main driving-shaft. The surface of this cam is such that in the major portion of its surface it has no effect

upon the roller k^5 , but has a cam-surface at one point which vibrates the shaft, operating the pawl and moving the ratchet and with 70 it the pattern-chain the distance of one tooth at each rotation of the shaft. Upon this pattern-chain is, at the desired point, the projection or lug M. In line with said lug or projection M is the crank N, having the pro- 75 jection n in alinement with said projection M. Connected to the shaft M' is the crank M², having at its free end the lever M³. The lever M³ has a bifurcated end which rests normally against the tooth i^2 of the wheel I. 80 When the projection M strikes the projection n , the shaft M' is rocked, rocking the lever M² and the lever M³, and causes it to act upon the tooth i^2 and move the wheel I a distance sufficient to bring the projection i' in the line 85 of movement of the lever J, so that when the lever J next moves forward it strikes the projection i' , and in its forward movement successively strikes the projections i' , i^2 , i^3 , i^4 , i^5 , i^6 , and i^7 , thus moving the cams h^2 and h^5 and 90 causing them automatically to move to bring the rollers h' and h^4 successively from the positions 1 to 2, to 3, to 4, to 5, to 6, and to 7. After the lever J has acted upon the projection i it cannot move sufficient to bring the projec- 95 tion i' in line of engaging with the shoulder of the lever J, and as a consequence the wheel I and the cams h^2 h^5 are no longer moved until a succeeding lug on the pattern-chain again throws the mechanism into operation. 100

By this construction the mechanism is automatically operated to move the cams h^2 and h^5 to control the stitch mechanism when additional needles are to be thrown into action and held in action during the necessary period 105 to form widening stitches and to close the hole at the change and goes out of action and remains out of action through the predetermined period in which the additional needles are to be used without further addition for 110 straight work.

At the end of the operation of forming the stitch, at the addition of the additional needles, it is necessary to shift the needle-operating bars endwise and outward, so as to 115 make them conform to these additional needles. This is done in the following manner, (see Fig. 6:) The needle-bars rest in slots in the needle-bar cylinder, and at their ends are connected to the head O by means of the split 120 ring o , which enters notches o' in the bars. The flanges o^3 of the front and rear head O are connected by arm o^4 with the block o^5 , the connection being a slotted connection enabling the head O to revolve in its connection 125 and yet to move laterally with the block o^5 . The block o^5 travels on a guide o^6 on the frame of the machine. P is a rack with which meshes the dog P', pivotally attached to the block o^5 . The rack P extends through the 130 block o^5 and works loosely therein. To the other end of the rack P is connected the head or sliding block P², sliding on guideway o^6 . From this head P² extends link P³, connected

to the bell-crank P⁴. The bell-crank lever P⁴ is connected by the link P⁵ with a crank P⁶, loosely mounted upon the shaft M'. Upon the wheel I is a projection Q, which may be
 5 a continuation of the projection i. When the wheel I is operated by the lever J and the lever J operates upon the projection i, it pushes it so that the projection Q or extension of i will strike the crank P⁶, lifting the link P⁵,
 10 operating bell-crank lever P⁴ and the link P³, and moving the block P² to the right as it is lifted, causing the rack P to draw the block o⁵ through the medium of the pawl, the pawl being adjusted to lock the connection between
 15 the block and the rack in that movement. When the crank P⁶ drops off the projection Q by reason of said projection passing beyond it, the rack moves in the opposite direction through the medium of the spring R and
 20 slides back under the pawl. The distance of movement of this lever and its corresponding rack is the distance of one tooth or one needle, causing in the first movement the bars to be moved outward the distance of a needle
 25 and in the return movement of the rack the bars are not affected, but the pawl drops into the next tooth, ready to pull it out in the next operation the distance of another needle. By this means just after or at the point when
 30 the additional needle-knitting has been completed the bars are given the lateral movement, so as to move them into the operative position for the additional needle.

Having now fully described my invention, what I claim, and desire to protect by Letters Patent, is—

1. In a straight-knitting machine, the combination with the needles and means for supporting them normally out of operative position,
 40 of devices corresponding to the needles and each adapted in its movement to force the corresponding needle into operative position, a cylinder, bars on said cylinder having raised portions and cut-away portions, means to
 45 move said bars longitudinally to bring said raised portions into alinement with predetermined needles and means to impart to said cylinder a complete revolution after each shifting of the bars whereby the needles are
 50 moved into operation in a predetermined order.

2. In a straight-knitting machine, the combination with the needles and means for supporting them normally out of operative position,
 55 of devices corresponding to the needles and each adapted in its movement to force the corresponding needle into operative position, a cylinder, bars on said cylinder having raised portions and cut-away portions, means to
 60 move said bars longitudinally to bring said raised portions into alinement with predetermined needles and means to impart to said cylinder a complete revolution after each shifting of the bars whereby the needles are
 65 moved into operation in a predetermined order, means to oscillate said cylinder to cause a single bar to engage needles repeatedly,

whereby the needles engaged by said bar are moved into operative position a predetermined number of times, and whereby a fixed
 70 number of needles are thrown into operative position at successive rounds of knitting.

3. In a straight-knitting machine, the combination with the needles, of a support extending along the needle-bed, of bars extending
 75 longitudinally of said support having cut-away portions and needle-actuating raised portions, means enabling said raised portions to actuate needles in alinement therewith, means to move said bars longitudinally to
 80 bring said raised portions into position to actuate predetermined needles to throw them into operative position, and means to rotate said support after the shifting of said bars whereby the needles are moved into operative
 85 position in a predetermined order.

4. In a straight-knitting machine, the combination with the needles, of a support extending along the needle-bed, of bars extending
 90 longitudinally of said support having cut-away portions and needle-actuating raised portions, means enabling said raised portions to actuate needles in alinement therewith, means to move said bars longitudinally to bring said raised portions into positions to
 95 actuate predetermined needles to throw them into operative position, and means to rotate said support after the shifting of said bars whereby the needles are moved into operative position in a predetermined order, means to
 100 oscillate said support to cause the raised portion or portions of a single bar to actuate needles repeatedly whereby the needles actuated by said bar are moved into operative position
 105 a predetermined number of times and whereby a fixed number of needles are thrown into operative position at successive rounds of knitting.

5. In a straight-knitting machine, the combination with the needles, of a support extending along the needle-bed carrying a plurality of longitudinally-extending needle-actuating projections raised above the surface
 110 of said support out of alinement with each other and extending longitudinally of said support and having cut-away portions, means enabling said projections to actuate needles in alinement therewith, means whereby said
 115 needle-actuating projections are shifted longitudinally to bring them into position to actuate predetermined needles to throw them into operative position, and means to rotate said support whereby the needles are thrown into operative position in a predetermined order.
 120
 125

6. In a straight-knitting machine, the combination with the needles, of a support extending along the needle-bed carrying a plurality of longitudinally-extending needle-actuating projections raised above the surface
 130 of said support out of alinement with each other and extending longitudinally of said support and having cut-away portions, means enabling said projections to actuate needles

in alinement therewith, means whereby said needle-actuating projections are shifted longitudinally to bring them into position to actuate predetermined needles to throw them
 5 into operative position, means to rotate said support whereby the needles are thrown into operative position in a predetermined order, and means to oscillate said support to cause a single needle-actuating projection to actuate
 10 needles repeatedly whereby the needles actuated by said projection are moved into operative position a predetermined number of times and whereby a fixed number of needles are thrown into operation at successive rounds
 15 of knitting.

7. In a straight-knitting machine, the combination with the front and rear banks of needles and means for supporting them normally out of operative position, of needle-lifting
 20 vices for each bank, cylinders adjacent respectively to the front and rear needles, bars on said cylinders having raised portions and cut-away portions, means to move said bars longitudinally to bring said raised portions
 25 into alinement with predetermined needles, and means to impart to said cylinders a simultaneous movement of rotation after each shifting of the bars, whereby the needles of both banks are moved into operation in a prede-
 30 termined order.

8. In a straight-knitting machine, the combination with the front and rear banks of needles and means for supporting them normally out of operative position, of needle-
 35 lifting devices for each bank, cylinders adjacent respectively to the front and rear needles, bars on said cylinders having raised portions and cut-away portions, means to move said bars longitudinally to bring said
 40 raised portions into alinement with predetermined needles, means to impart to said cylinders a simultaneous movement of rotation after each shifting of the bars, whereby the needles of both banks are moved into op-
 45 eration in a predetermined order, and means to oscillate said cylinders to cause a single bar of each cylinder to engage needles of the corresponding bank repeatedly whereby the needles engaged by said bars are moved into
 50 operative position a predetermined number of times and whereby a fixed number of needles in each bank are moved into operative position at successive rounds of knitting.

9. In a straight-knitting machine, the combination with the front and rear banks of
 55 needles, of supports adjacent respectively to the front and rear needles, bars extending longitudinally of each of said supports having cut-away portions and needle-actuating
 60 raised portions, means enabling said raised portions to actuate needles in alinement therewith, means to move said bars longitudinally to bring said raised portions into position to actuate predetermined needles to
 65 throw them into operative position, and means to impart to said supports a simultaneous movement of rotation after each shift-

ing of the bars, whereby the needles of both banks are moved into operative position in a predetermined order. 70

10. In a straight-knitting machine, the combination with the front and rear banks of needles, of supports adjacent respectively to the front and rear needles, bars extending longi-
 75 tudinally of each of said supports having cut-away portions and needle-actuating raised portions, means enabling said raised portions to actuate needles in alinement therewith, means to move said bars longitudinally to bring said raised portions into position to ac-
 80 tuate predetermined needles to throw them into operative position, means to impart to said supports a simultaneous movement of rotation after each shifting of the bars, whereby the needles of both banks are moved into
 85 operative position in a predetermined order, means to oscillate said supports to cause the raised portion or portions of a single bar to actuate needles of the corresponding bank repeatedly whereby the needles engaged by said
 90 bars are moved into operative position a predetermined number of times and whereby a fixed number of needles in each bank are thrown into operative position at successive rounds of knitting. 95

11. In a straight-knitting machine, the combination with the front and rear banks of needles, of supports extending respectively longi-
 100 tudinally along and adjacent to the front and rear needles, each support carrying a plurality of longitudinally-extending needle-actuating projections raised above the surface of said support, out of alinement with each other, and extending longitudinally of said support and having cut-away portions, means
 105 enabling said projections to actuate needles in alinement therewith, means whereby said needle-actuating projections are shifted longitudinally to bring them into position to actuate predetermined needles to throw them
 110 into operative position, means to impart to said supports a simultaneous movement of rotation after each shift of the projections whereby the needles of both banks are moved into operation in a predetermined order. 115

12. In a straight-knitting machine, the combination with the front and rear banks of needles, of supports extending respectively longi-
 120 tudinally along and adjacent to the front and rear needles, each support carrying a plurality of longitudinally-extending needle-actuating projections raised above the surface of said support, out of alinement with each other, and extending longitudinally of said support and having cut-away portions, means
 125 enabling said projections to actuate needles in alinement therewith, means whereby said needle-actuating projections are shifted longitudinally to bring them into position to actuate predetermined needles to throw them
 130 into operative position, means to impart to said supports a simultaneous movement of rotation after each shift of the projections whereby the needles of both banks are moved

into operation in a predetermined order, means to oscillate said support to cause a single needle-actuating projection of each support to actuate needles of the corresponding bank repeatedly whereby the needles actuated by said projections are moved into operative position a predetermined number of times and whereby a fixed number of needles in each bank are moved into operative position at successive rounds of knitting.

13. In a straight-knitting machine, the combination with the needles and means for supporting them independently normally out of operative position, of needle-lifting devices, a cylinder, means for rotating said cylinder, a series of bars secured circumferentially upon said cylinder, said bars having raised portions and cut-away portions, the raised portions being in alinement with some or all of said needles, the raised portion of the bars in the rotation of the cylinder being adapted to strike the corresponding needle-lifting devices and move the corresponding needles into operative position, and means for simultaneously shifting said bars longitudinally.

14. In a straight-knitting machine the combination with the needles and means for supporting them independently normally out of operative position, of needle-lifting devices, a support, means for rotating said support, a series of bars secured upon said support, said bars having raised portions and cut-away portions, the raised portions being in alinement with some or all of said needles, the raised portion of the bars in the rotation of the support being adapted to strike one or more of the needle-lifting devices and move the corresponding needles into operative position, and means for simultaneously shifting said bars longitudinally.

15. In a straight-knitting machine the combination with the needles and means for supporting them independently normally out of operative position, of needle-lifting devices, a cylinder, bars on said cylinder each of which has projecting surfaces in alinement with some or all of the needles, said cylinder being rotatably supported, a ratchet secured to said cylinder, a pawl-holder, pawls connected to said holder and engaging said ratchet to act upon it in opposite directions, means for reciprocating said pawl-holder a limited distance to oscillate said cylinder, means to reciprocate said pawl-holder a greater distance, and pawl-disengaging devices engaging the return-pawl in the last-named reciprocation to withdraw it out of engagement with said ratchet whereby in the return movement of said pawl-holder the ratchet is disengaged from the return-pawl and whereby in successive reciprocations of said pawl-holder said cylinder is rotated.

16. In a straight-knitting machine the combination with the needles and means for supporting them independently normally out of operative position, of needle-lifting devices, a support, bars on said support each of which

has projecting surfaces in alinement with some or all of the needles, said support being rotatably supported, a ratchet secured to said support, a pawl-holder, pawls connected to said holder and engaging said ratchet to act upon it in opposite directions, means for reciprocating said pawl-holder a limited distance to oscillate said support, means to reciprocate said pawl-holder a greater distance, and pawl-disengaging devices engaging the return-pawl in the last-named reciprocation to withdraw it out of engagement with said ratchet whereby in the return movement of said pawl-holder the ratchet is disengaged from the return-pawl and whereby in successive reciprocations of said pawl-holder said support is rotated.

17. In a straight-knitting machine in combination with the needles and means for supporting them independently normally out of operative position, of devices corresponding to the needles and each adapted in its movement to lift the corresponding needle into operative position, a cylinder, a bar in said cylinder having projecting surfaces in alinement with some or all of the needles, said cylinder being rotatably supported, a ratchet secured to said cylinder, a pawl-holder, pawls connected to said holder and acting upon the ratchet-wheel in opposite directions, said pawl-holder being secured so as to be capable of oscillation, a driving-shaft, a cam upon the main driving-shaft having at one point a cam-surface, a roller traveling on said cam, and connection between said roller and the pawl-holder whereby when the pawl-holder strikes the cam-surface said pawl-holder is oscillated.

18. In a straight-knitting machine the combination with the needles and means for supporting them independently normally out of operative position, of a cylinder, a bar in said cylinder having projecting surfaces in alinement with some or all of the needles, means enabling said projecting surfaces to actuate needles in alinement therewith, said cylinder being rotatably supported, a ratchet secured to said cylinder, a pawl-holder, pawls connected to said holder and acting upon the ratchet-wheel in opposite directions, said pawl-holder being secured so as to be capable of oscillation, a driving-shaft, a cam upon the main driving-shaft having at one point a cam-surface, a roller traveling on said cam, and connection between said roller and the pawl-holder whereby when the pawl-holder strikes the cam-surface said pawl-holder is oscillated.

19. In a straight-knitting machine the combination with the needles and means for supporting them independently normally out of operative position, of devices corresponding to the needles and each adapted in its movement to force the corresponding needle into operative position, a support, a bar in said support having projecting surfaces in alinement with some or all of the needles, said support being rotatably supported, a ratchet

secured to said support, a pawl-holder, pawls connected to said holder and acting upon the ratchet-wheel in opposite directions, said pawl-holder being secured so as to be capable of oscillation, a driving-shaft, a cam upon the main driving-shaft having at one point a cam-surface, a roller traveling on said cam, and connection between said roller and the pawl-holder whereby when the pawl-holder strikes the cam-surface said pawl-holder is oscillated.

20. In a straight-knitting machine the combination with the needles and means for supporting them independently normally out of operative position, of a support, a bar in said support having projecting surfaces in alignment with some or all of the needles, means enabling said projecting surfaces to actuate needles in alignment therewith, said support being rotatably supported, a ratchet secured to said support, a pawl-holder, pawls connected to said holder and acting upon the ratchet-wheel in opposite directions, said pawl-holder being secured so as to be capable of oscillation, a driving-shaft, a cam upon the main driving-shaft having at one point a cam-surface, a roller traveling on said cam, and connection between said roller and the pawl-holder whereby when the pawl-holder strikes the cam-surface said pawl-holder is oscillated.

21. In a straight-knitting machine the combination with the front and rear needles and means for supporting them independently normally out of operative position, of devices corresponding to the needles and each adapted in its movement to lift the corresponding needle into operative position, cylinders adjacent respectively to the rear and front needles, a bar in each cylinder having projecting surfaces in line of movement with some or all of its corresponding needles, each of said cylinders being supported so as to be oscillated to bring its bar against and away from its corresponding lifting devices of the needles, a main driving-shaft, cams upon said shaft, each cam having at one point a cam-surface, said cam-surfaces being oppositely set upon said cams, a roller coacting with each cam, a ratchet connected to each of said cylinders, an oscillating pawl-holder for each cylinder, pawls connected to said pawl-holders, each set of pawls acting upon its corresponding ratchet in opposite directions, and connection between each pawl-holder and one of said rollers, whereby in the rotation of the shaft, the pawl-holders are alternately oscillated, the extent of said cam-surface being such as to move each of the bars against and away from the corresponding needle-lifting devices.

22. In a straight-knitting machine the combination with the front and rear needles and means for supporting them independently normally out of operative position, of needle-lifting devices, cylinders adjacent respectively to the rear and front needles, a bar in each cylinder having projecting surfaces in line of movement with some or all of the cor-

responding needles, each of said cylinders being supported so as to be oscillated to bring its bar against and away from its corresponding needles, a main driving-shaft, cams upon said shaft, each cam having at one point a cam-surface, said cam-surfaces being oppositely set upon said cams, a roller coacting with each cam, a ratchet connected to each of said cylinders, an oscillating pawl-holder for each cylinder, pawls connected to said pawl-holders, each set of pawls acting upon its corresponding ratchet in opposite directions, and connection between each pawl-holder and one of said rollers, whereby in the rotation of the shaft, the pawl-holders are alternately oscillated, the extent of said cam-surfaces being such as to move each of the bars against and away from the corresponding needle-lifting devices.

23. In a straight-knitting machine the combination with the front and rear needles and means for supporting them independently normally out of operative position, of needle-lifting devices, supports adjacent respectively to the rear and front needles, a bar in each support having projecting surfaces in line of movement with some or all of its corresponding needles, each of said supports being supported so as to be oscillated to bring its bar against and away from its corresponding needle-lifting devices, a main driving-shaft, cams upon said shaft, each cam having at one point a cam-surface, said cam-surfaces being oppositely set upon said cams, a roller coacting with each cam, a ratchet connected to each of said supports, an oscillating pawl-holder for each support, pawls connected to said pawl-holders, each set of pawls acting upon its corresponding ratchet in opposite directions, and connection between each pawl-holder and one of said rollers, whereby in rotation of the shaft the pawl-holders are alternately oscillated, the extent of said cam-surfaces being such as to move the bars against and away from the corresponding needle-lifting devices.

24. In a straight-knitting machine the combination with the needles and the means for supporting them independently normally out of operative position, of needle-lifting devices, a cylinder, a series of bars secured circumferentially upon said cylinder, said bars having portions of their surfaces projecting beyond said cylinder, said cylinder being rotatably supported, a driving-shaft, cams upon said driving-shaft one cam having a cam-surface at one point, the other having a cam-surface at two points oppositely placed, devices connected with said cylinder and adapted to be connected with either of said cams, the single cam-surface being of extent sufficient to move the bar against and away from the needle-lifting device, the cam-surfaces of the other cam being of extent sufficient to move the bars against and beyond the needle-lifting device.

25. In a straight-knitting machine the com-

bination with the needles and means for sup-
 porting them independently normally out of
 operative position, of needle-lifting devices, a
 support, a series of bars secured upon said
 5 support, said bars having portions of their
 surfaces projecting beyond said support, said
 support being rotatably supported, a driving-
 shaft, cams upon said driving-shaft, one cam
 having a cam-surface at one point, the other
 10 having a cam-surface at two points oppositely
 placed, devices connected with said support
 and adapted to be connected with either of
 said cams, the single cam-surface being of ex-
 tent sufficient to move the bar against and
 15 away from the needle-lifting device, the cam-
 surfaces of the other cam being of extent suf-
 ficient to move the bars against and beyond
 the needle-lifting devices.

26. In a straight-knitting machine the com-
 20 bination with the needles and means for sup-
 porting them independently normally out of
 operative position, of needle-lifting devices, a
 cylinder, a series of bars secured circumfer-
 25 entially upon said cylinder, said bars having
 portions of their surfaces projecting beyond
 said cylinder, and said cylinder being rota-
 tably supported, a ratchet moving said cylin-
 der, a pawl-holder supported so as to be os-
 30 cillated, a driving-shaft, cams upon said driv-
 ing-shaft, one cam having a cam-surface at
 one point, the other having a cam-surface at
 two points oppositely placed, a roller adapted
 to be connected with either cam-surface and
 35 connection between said roller and the pawl-
 holder, the single cam-surface being of ex-
 tent sufficient to move the bar against and
 away from the needle-lifting device, the cam-
 surfaces of the other cam being of extent suf-
 40 ficient to move the bars against and beyond
 the needle-lifting device.

27. In a straight-knitting machine the com-
 bination with the needles and means for sup-
 porting them independently normally out of
 operative position, of needle-lifting devices, a
 45 support, a series of bars secured upon said
 support, said bars having portions of their
 surfaces projecting beyond said support, said
 support being rotatably supported, a ratchet
 moving with said support, a pawl-holder sup-
 50 ported so as to be oscillated, a driving-shaft,
 cams upon said driving-shaft, one cam having
 a cam-surface at one point, the other having
 a cam-surface at two points oppositely placed,
 a roller adapted to be connected with either
 55 cam-surface and connection between said
 roller and the pawl-holder, the single cam-sur-
 face being of extent sufficient to move the bar
 against and away from the needle-lifting de-
 vice, the cam-surfaces of the other cam being
 60 of extent sufficient to move the bars against
 and beyond the needle-lifting device.

28. In a straight-knitting machine the com-
 bination with the needles and means for sup-
 porting them independently normally out of
 65 operative position, of needle-lifting devices,
 a cylinder, a series of bars secured circum-
 ferentially upon said cylinder, said bars hav-

ing portions of their surfaces projecting be-
 yond said cylinder, said cylinder being rota-
 tably supported, a driving-shaft, cams upon 70
 said driving-shaft, one cam having a cam-
 surface at one point, the other having a cam-
 surface at two points oppositely placed, de-
 vices connected with said cylinder adapted
 to be connected with either of said cams, 75
 the single cam-surface being of extent suf-
 ficient to move the bar against and away
 from the needle-lifting device, the cam-sur-
 face of the other cam being of extent suffi-
 80 cient to move the bars against and beyond
 the needle-lifting device, the cylinder-actu-
 ating device being normally in contact with
 the single cam-face, a clutch-holder control-
 ling the position of said device with relation
 to the cams, a cam controlling said clutch- 85
 holder, means to rotate said cam, a pattern-
 chain, a lug upon said chain adapted to con-
 nect the cam with its rotating means.

29. In a straight-knitting machine, the com-
 bination with the needles, and means for sup- 90
 porting them independently normally out of
 operative position, of needle-lifting devices,
 a support, a series of bars secured upon said
 support, said bars having portions of their
 surfaces projecting beyond said support, said 95
 support being rotatably supported, a driving-
 shaft, cams upon said driving-shaft, one cam
 having a cam-surface at one point, the other
 having a cam-surface at two points oppositely
 placed, devices connected with said support 100
 and adapted to be connected with either of
 said cams, the single cam-surface being of
 extent sufficient to move the bar against and
 away from the needle-lifting device, the cam-
 surfaces of the other cam being of extent suf- 105
 ficient to move the bars against and beyond
 the needle-lifting device, the device being
 normally in contact with the single cam-face,
 a clutch-holder controlling the position of
 said device with relation to the cams, a cam 110
 controlling said clutch-holder, means to ro-
 tate said cam, a pattern-chain, a lug upon
 said chain adapted to connect the cam with
 its rotating means.

30. In a straight-knitting machine, the com- 115
 bination with the needles and means for sup-
 porting them independently normally out of
 operative position, of needle-lifting devices,
 a cylinder, a series of bars secured circum-
 ferentially upon said cylinder, said bars hav- 120
 ing portions of their surfaces projecting be-
 yond said cylinder, said cylinder being rota-
 tably supported, a driving-shaft, cams upon
 said driving-shaft, one cam having a cam-sur-
 face at one point, the other having a cam-sur- 125
 face at two points oppositely placed, devices
 connected with said cylinder and adapted to
 be connected with either of said cams, the sin-
 gle cam-surface being of extent sufficient to
 move the bar against and away from the nee- 130
 dle-lifting device, the cam-surfaces of the other
 cam being of extent sufficient to move the
 bars against and beyond the needle-lifting de-
 vice, the cylinder-actuating device being nor-

mally in contact with the single cam-face, a clutch-holder controlling the position of said device with relation to the cams, a cam controlling said clutch-holder, a reciprocating lever reciprocated by the driving-shaft, a wheel, having three or more projections connected with the last-mentioned cam, said lever being adapted to engage said projections, the distance between two of the projections in said wheel being greater than the throw of the lever, a pattern-chain, a lug upon said pattern-chain at predetermined point, mechanism in line of movement of the lug connected with the wheel having projections and adapted when struck by the lug to move the wheel.

31. In a straight-knitting machine, the combination with the needles and means for supporting them independently normally out of operative position, of needle-lifting devices, a support, a series of bars secured upon said support, said bars having portions of their surfaces projecting beyond said support, said support being rotatably supported, a driving-shaft, cams upon said driving-shaft, one cam having a cam-surface at one point, the other having a cam-surface at two points oppositely placed, devices connected with said support and adapted to be connected with either of said cams, the single cam-surface being of extent sufficient to move the bar against and away from the needle-lifting device, the cam-surfaces of the other one being of extent sufficient to move the bars against and beyond the needle-lifting device, the cylinder-actuating device being normally in contact with the single cam-face, a clutch-holder controlling the position of said device with relation to the cams, a cam controlling said clutch-holder, a reciprocating lever reciprocated by the driving-shaft, a wheel having three or more projections, connected with the last-mentioned cam, said lever being adapted to engage said projections, the distance between two of the projections in said wheel being greater than the throw of the lever, a pattern-chain, a lug upon said pattern-chain at predetermined point, mechanism in line of movement of the lug connected with the wheel having projections and adapted when struck by the lug to move the wheel.

32. In a straight-knitting machine, the combination with the front and rear rows of needles and means for supporting them independently normally out of operative position, of needle-lifting devices, cylinders, one for the front row of needles, the other for the rear row of needles, a series of bars secured circumferentially upon each of said cylinders, and bars having portions of their surfaces projecting beyond said cylinder, each cylinder being rotatably supported, a driving-shaft, two sets of cams upon said driving-shaft, one set for each cylinder, one cam of each set having a cam-surface at one point, but oppositely set with reference to each other, the other cam of each set having a cam-surface at two points similarly placed with relation to each other but oppositely placed on each cam, a device connected with each cylinder and adapted to be connected with either cam of its set, the single cam-surface of each set being of extent sufficient to move the bar against and away from the needle-lifting device, the cam-surface of the other cam being of extent sufficient to move the bars against and beyond the needle-lifting device, a clutch-holder for each device controlling the position of its corresponding device with relation to the cams of its corresponding set, a cam controlling said clutch-

cam-surface at two points similarly placed with relation to each other but oppositely placed on each cam, a device connected with each cylinder and adapted to be connected with either cam of its set, the single cam-surface of each set being of extent sufficient to move the bar against and away from the needle-lifting device, the cam-surface of the other cam being of extent sufficient to move the bars against and beyond the needle-lifting device.

33. In a straight-knitting machine, the combination with the front and rear rows of needles and means for supporting them independently normally out of operative position, of needle-lifting devices, supports, one for the front row of needles, the other for the rear row of needles, a series of bars secured upon each of said supports, said bars having portions of their surfaces projecting beyond said support, each support being rotatably supported, a driving-shaft, two sets of cams upon said driving-shaft, one set for each support, one cam of each set having a cam-surface at one point, but oppositely set with reference to each other, the other cam of each set having a cam-surface at two points similarly placed with relation to each other, but oppositely placed on each cam, a device connected with each support and adapted to be connected with either cam of its set, the single cam-surface of each set being of extent sufficient to move the bar against and away from the needle-lifting device, the cam-surface of the other cam being of extent sufficient to move the bars against and beyond the needle-lifting device.

34. In a straight-knitting machine, the combination with the front and rear rows of needles and means for supporting them independently normally out of operative position, of needle-lifting devices cylinders, one for the front row of needles, the other for the rear row of needles, a series of bars secured circumferentially upon each of said cylinders, said bars having portions of their surfaces projecting beyond said cylinder, each cylinder being rotatably supported, a driving-shaft, two sets of cams upon said driving-shaft, one set for each cylinder, one cam of each set having a cam-surface at one point, but oppositely set with reference to each other, the other cam of each set having a cam-surface at two points similarly placed with relation to each other but oppositely placed on each cam, a device connected with each cylinder and adapted to be connected with either cam of its set, the single cam-surface of each set being of extent sufficient to move the bar against and away from the needle-lifting device, the cam-surface of the other cam being of extent sufficient to move the bars against and beyond the needle-lifting device, a clutch-holder for each device controlling the position of its corresponding device with relation to the cams of its corresponding set, a cam controlling said clutch-

holders, means to rotate said cam, a pattern-chain, a lug upon said chain adapted to connect the cam with its rotating means.

35. In a straight-knitting machine, the combination with the front and rear rows of needles and means for supporting them independently normally out of operative position, of needle-lifting devices, supports, one for the front row of needles the other for the rear row of needles, a series of bars secured upon each of said supports, said bars having portions of their surfaces projecting beyond said support, each support being rotatably supported, a driving-shaft, two sets of cams upon said driving-shaft, one set for each support, one cam of each set having a cam-surface at one point, but oppositely set with reference to each other, the other cam of each set having a cam-surface at two points similarly placed with relation to each other but oppositely placed on each cam, a device connected with each support and adapted to be connected with either cam of its set, the single cam-surface of each set being of extent sufficient to move the bar against and away from the needle-lifting device, the cam-surface of the other cam being of extent sufficient to move the bars against and beyond the needle-lifting device, a clutch-holder for each device controlling the position of its corresponding device with relation to the cams of its corresponding set, a cam controlling said clutch-holders, a reciprocating lever reciprocated by the driving-shaft, a wheel having projections, in connection with the last-mentioned cam, said lever reciprocating between said projections, the distance between two of the projections on said wheel being greater than the throw of the lever, a pattern-chain, a lug upon said pattern-chain at predetermined point, mechanism in line of movement of the lug connected with the wheel having projections and adapted when struck by the lug to move the wheel.

36. In a straight-knitting machine, the combination with the needles and means for supporting them independently normally out of operative position, of needle-lifting devices, a cylinder, a series of bars secured circumferentially upon said cylinder, said bars having portions of their surfaces projecting beyond said cylinder, said cylinder being rotatably supported, a ratchet moving with said cylinder, a pawl-holder supported so as to be oscillated, a driving-shaft, cams upon said driving-shaft, one cam having a cam-surface at one point, the other having a cam-surface at two points oppositely placed, a roller adapted to be connected with either cam-surface and connection between said roller and the pawl-holder, the single cam-surface being of extent sufficient to move the bar against and away from the needle-lifting device, the cam-surface of the other cam being of extent sufficient to move the bars against and beyond the needle-lifting device, the roller being normally in contact with the single cam-face, a clutch-

holder controlling the position of said roller with relation to the cams, a cam controlling said clutch-holder, means to rotate said cam, a pattern-chain, a lug upon said chain adapted to connect the cam with its rotating means.

37. In a straight-knitting machine, the combination with the needles and means for supporting them independently normally out of operative position, of needle-lifting devices, a support, a series of bars secured upon said support, said bars having portions of their surfaces projecting beyond said support, said support being rotatably supported, a ratchet moving with said support, a pawl-holder supported so as to be oscillated, a driving-shaft, cams upon said driving-shaft, one cam having a cam-surface at one point, the other having a cam-surface at two points oppositely placed, a roller adapted to be connected with either cam-surface and connection between said roller and the pawl-holder, the single cam-surface being of extent sufficient to move the bar against and away from the needle-lifting device, the cam-surface of the other cam being of extent sufficient to move the bars against and beyond the needle-lifting device, the roller being normally in contact with the single cam-face, a clutch-holder controlling the position of said roller with relation to the cams, a cam controlling said clutch-holder, means to rotate said cam, a pattern-chain, a lug upon said chain adapted to connect the cam with its rotating means.

38. In a straight-knitting machine, the combination with the needles and means for supporting them independently normally out of operative position, of needle-lifting devices, a cylinder, a series of bars secured circumferentially upon said cylinder, said bars having portions of their surfaces projecting beyond said cylinder, said cylinder being rotatably supported, a ratchet moving with said cylinder, a pawl-holder supported so as to be oscillated, a driving-shaft, cams upon said driving-shaft, one cam having a cam-surface at one point, the other having a cam-surface at two points oppositely placed, a roller adapted to be connected with either cam-surface, and connection between said roller and the pawl-holder, the single cam-surface being of extent sufficient to move the bar against and away from the needle-lifting device, the cam-surfaces of the other cam being of extent sufficient to move the bars against and beyond the needle-lifting device, the roller being normally in contact with the single cam-face, a clutch-holder controlling the position of said roller with relation to the cams, a cam controlling said clutch-holder, means to rotate said cam, a pattern-chain, a lug upon said chain adapted to connect the cam with its rotating means, a reciprocating lever reciprocated by the driving-shaft, a wheel having projections on the shaft of the last-mentioned cam, said lever being adapted to engage said projections the distance between two of the projections on said wheel being greater than

the throw of the lever, a pattern-chain, a lug upon said pattern-chain at predetermined point, mechanism in line of movement of the lug connection with the wheel having projections and adapted when struck by the lug to move the wheel.

39. In a straight-knitting machine, the combination with the needles and means for supporting them independently normally out of operative position, of needle-lifting devices, a support, a series of bars secured upon said support, said bars having portions of their surfaces projecting beyond said support, said support being rotatably supported, a ratchet moving with said support, a pawl-holder supported so as to be oscillated, a driving-shaft, cams upon said driving-shaft, one cam having a cam-surface at one point, the other having a cam-surface at two points oppositely placed, a roller adapted to be connected with either cam-surface, and connection between said roller and the pawl-holder, the single cam-surface being of extent sufficient to move the bar against and away from the needle-lifting device, the cam-surfaces of the other cam being of extent sufficient to move the bars against and beyond the needle-lifting device, the roller being normally in contact with the single cam-face, a clutch-holder controlling the position of said roller with relation to the cams, a cam controlling said clutch-holder, means to rotate said cam, a pattern-chain, a lug upon said chain adapted to connect the cam with its rotating means, a reciprocating lever reciprocated by the driving-shaft, a wheel, having projections, on the shaft of the last-mentioned cam, said lever being adapted to engage said projections the distance between two of the projections on said wheel being greater than the throw of the lever, a pattern-chain, a lug upon said pattern-chain at predetermined point, mechanism, in line of movement of the lug connecting with the wheel having projections and adapted when struck by the lug to move the wheel.

40. In a straight-knitting machine, the combination with the needles and means for supporting them independently normally out of operative position, of needle-lifting devices, a cylinder, a series of bars secured circumferentially upon said cylinder, so as to oscillate with and be adapted to be moved along said cylinder, said bars having a portion of their surfaces projecting beyond said cylinder and adapted in the movement of said cylinder to strike the needle-lifting devices, a block to which said bars are secured, a slide upon which said block is adapted to move, a pawl connected to said block, a rack in which said pawl works, said pawl being operative with relation to the said rack in its movement in one direction, and inoperative in its movement in the other direction, a wheel having projections, a reciprocating lever working between the projections on said wheel, the distance between the two projections on said wheel being greater than the throw of said

lever, a pattern-chain, a lug upon said pattern-chain, a device adapted to be struck by said lug in its movement, connection between said device and wheel having projections adapted when the lug strikes the device to move said wheel having projections into operative position with reference to said lever, a projection upon said wheel, a lever in line of movement of said projection, and connection between said lever and the rack, whereby when the projection last mentioned strikes the last-mentioned lever the rack is moved in one direction, and a spring to return said rack in the other direction.

41. In a straight-knitting machine, the combination with the needles and means for supporting them independently normally out of operative position, of needle-lifting devices, a support, a series of bars secured upon said support so as to oscillate with and be adapted to be moved along said support, said bars having a portion of their surfaces projecting beyond said support and adapted in the movement of said support to strike the needle-lifting devices, a block to which said bars are secured, a slide upon which said block is adapted to move, a pawl connected to said block, a rack in which said pawl works, said pawl being operative with relation to the said rack in its movement in one direction, and inoperative in the other direction, a wheel having projections, a reciprocating lever working between the projections on said wheel, the distance between the two projections on said wheel being greater than the throw of said lever, a pattern-chain, a lug upon said pattern-chain, a device adapted to be struck by said lug in its movement, connection between said device and the wheel having projections adapted when the lug strikes the device to move said wheel having projections into operative position with reference to said lever, a projection upon said wheel, a lever in line of movement of said projection, and connection between said lever and the rack, whereby when the projection last mentioned strikes the last-mentioned lever, the rack is moved in one direction, and a spring to return said rack in the other direction.

42. In a straight-bar knitting-machine, in combination sinkers or web-holders provided with pivotal orifices, of a sinker-block provided with slots, sinker-holders in said slots, said sinker-holders having heads projecting beyond said slots and orifices in said heads between pairs of which sinker-holders the sinkers are placed, the orifices in the sinkers registering with the orifices in the holders, and a rod or bar passing through the orifices in the sinkers or holders.

In testimony of which invention I have hereunto set my hand, at Philadelphia, Pennsylvania, on this 2d day of March, 1899.

FRANK WILCOMB.

Witnesses:

FRANCES ELLIS,
GEO. W. REED.