

No. 691,888.

Patented Jan. 28, 1902.

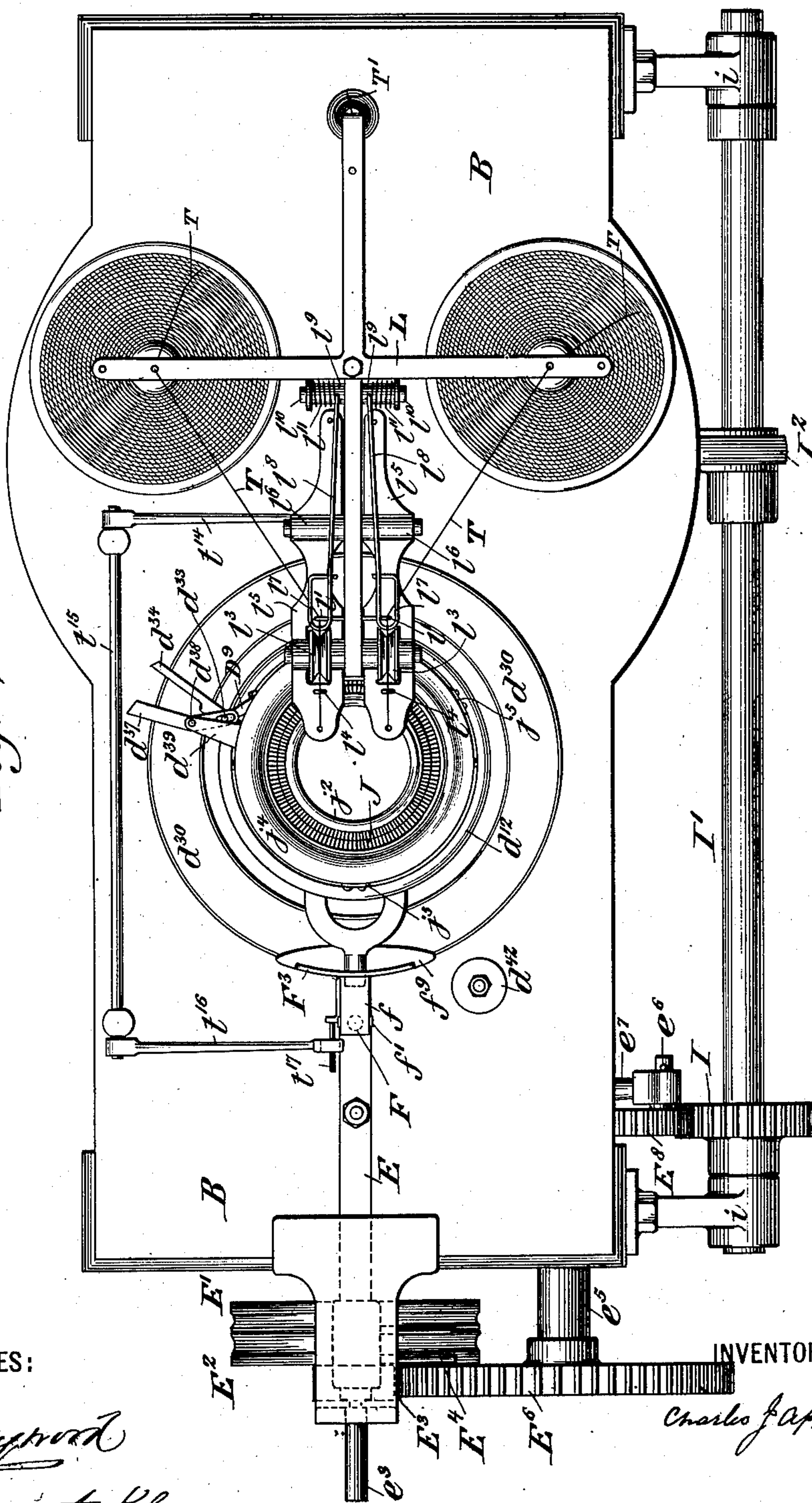
C. J. APPLETON.
KNITTING MACHINE.

(Application filed Mar. 15, 1897.)

(No Model.)

10 Sheets—Sheet 1.

Fig. 1.



WITNESSES:

R. H. Maynard

Hermann A. Klemm

INVENTOR

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No. 691,888.

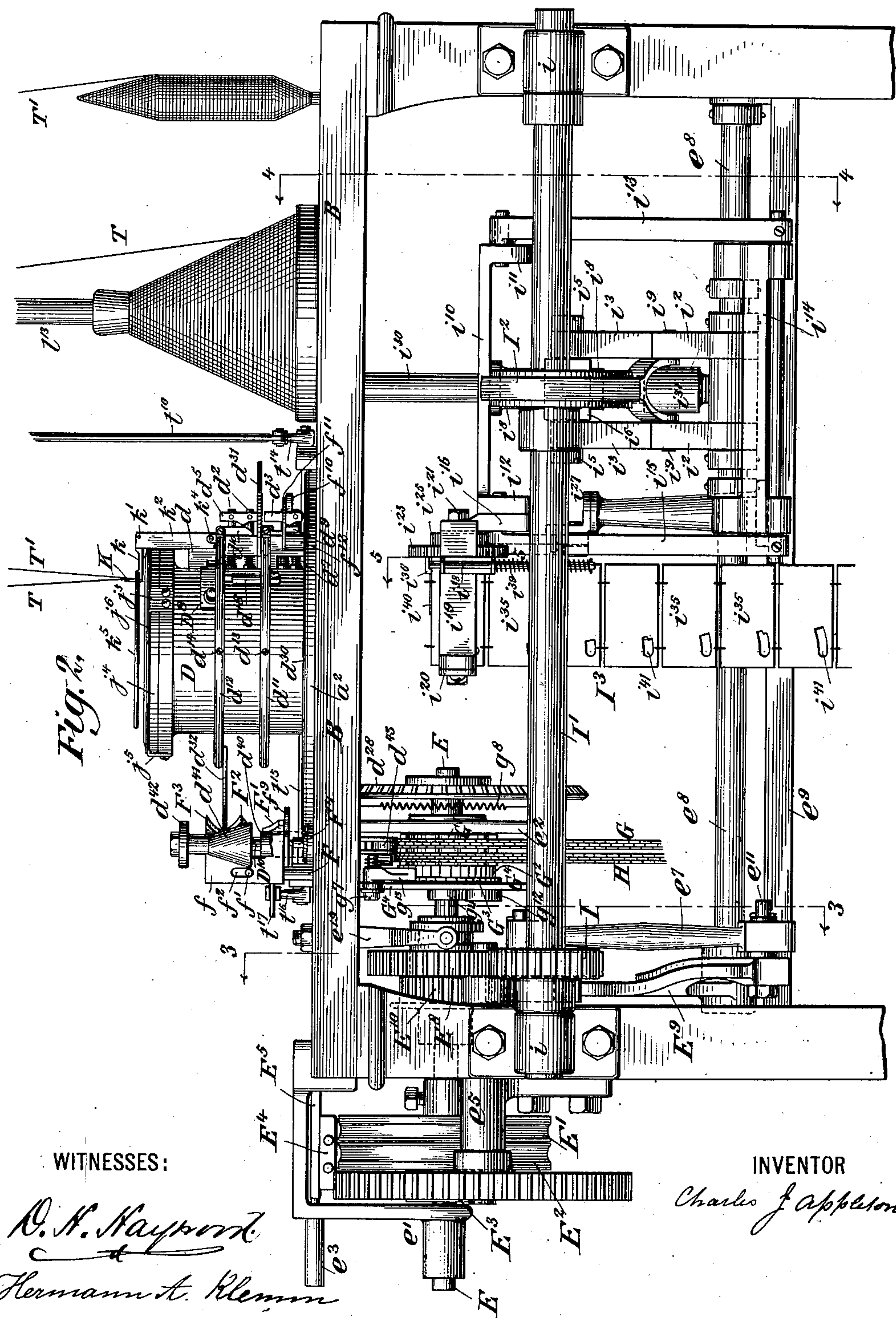
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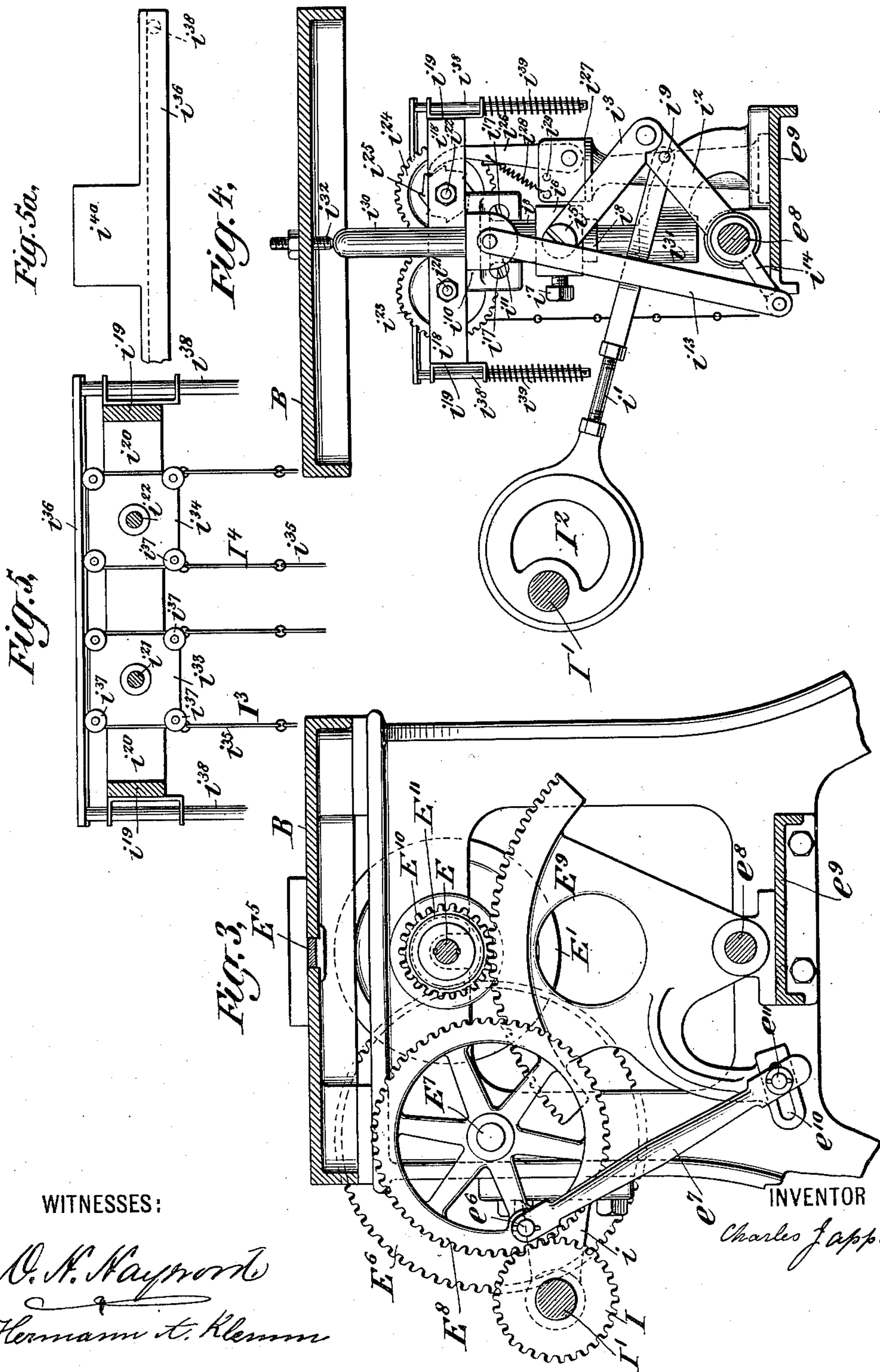
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WITNESSES:

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Fig. 7.

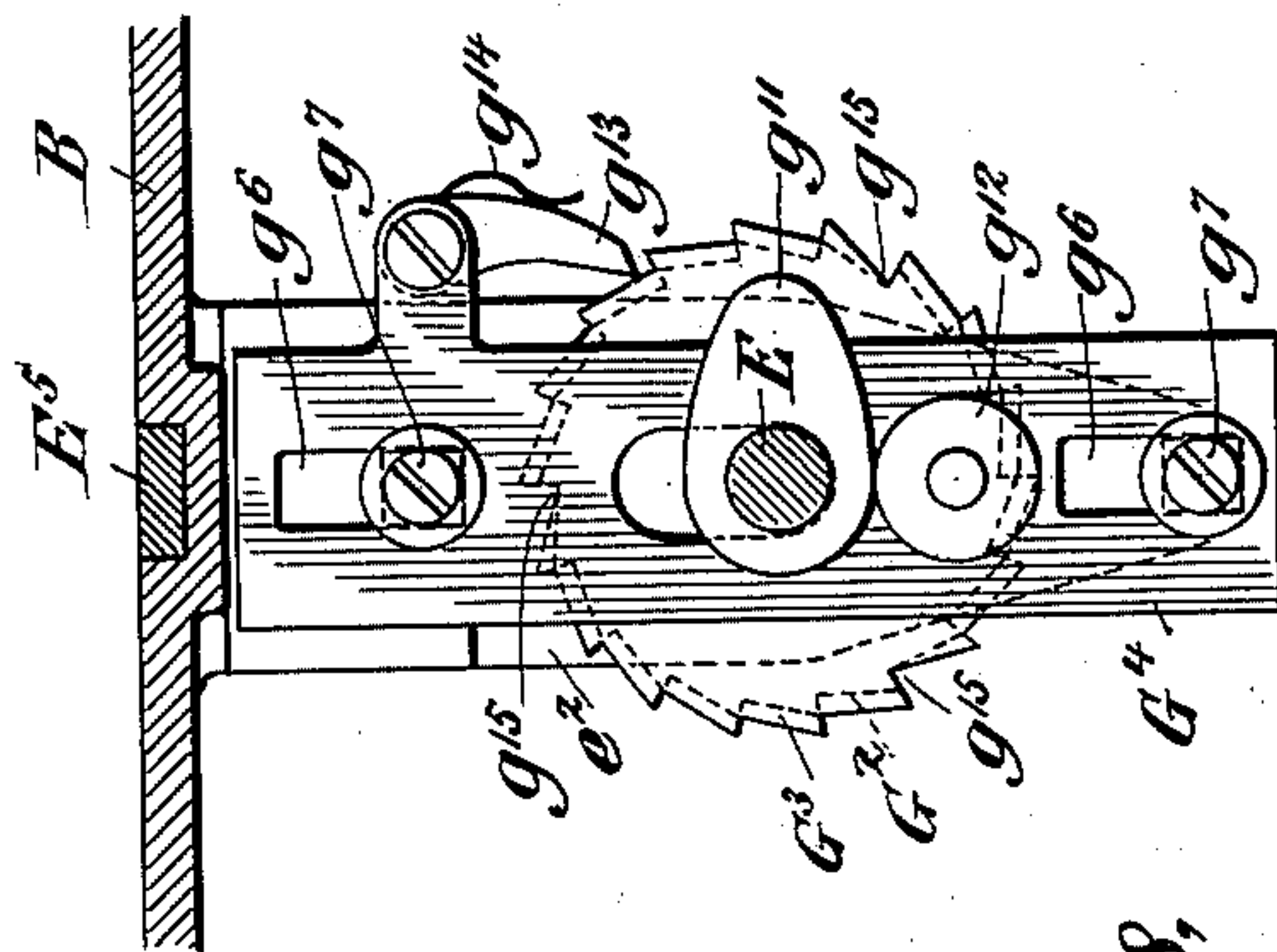


Fig. 8.

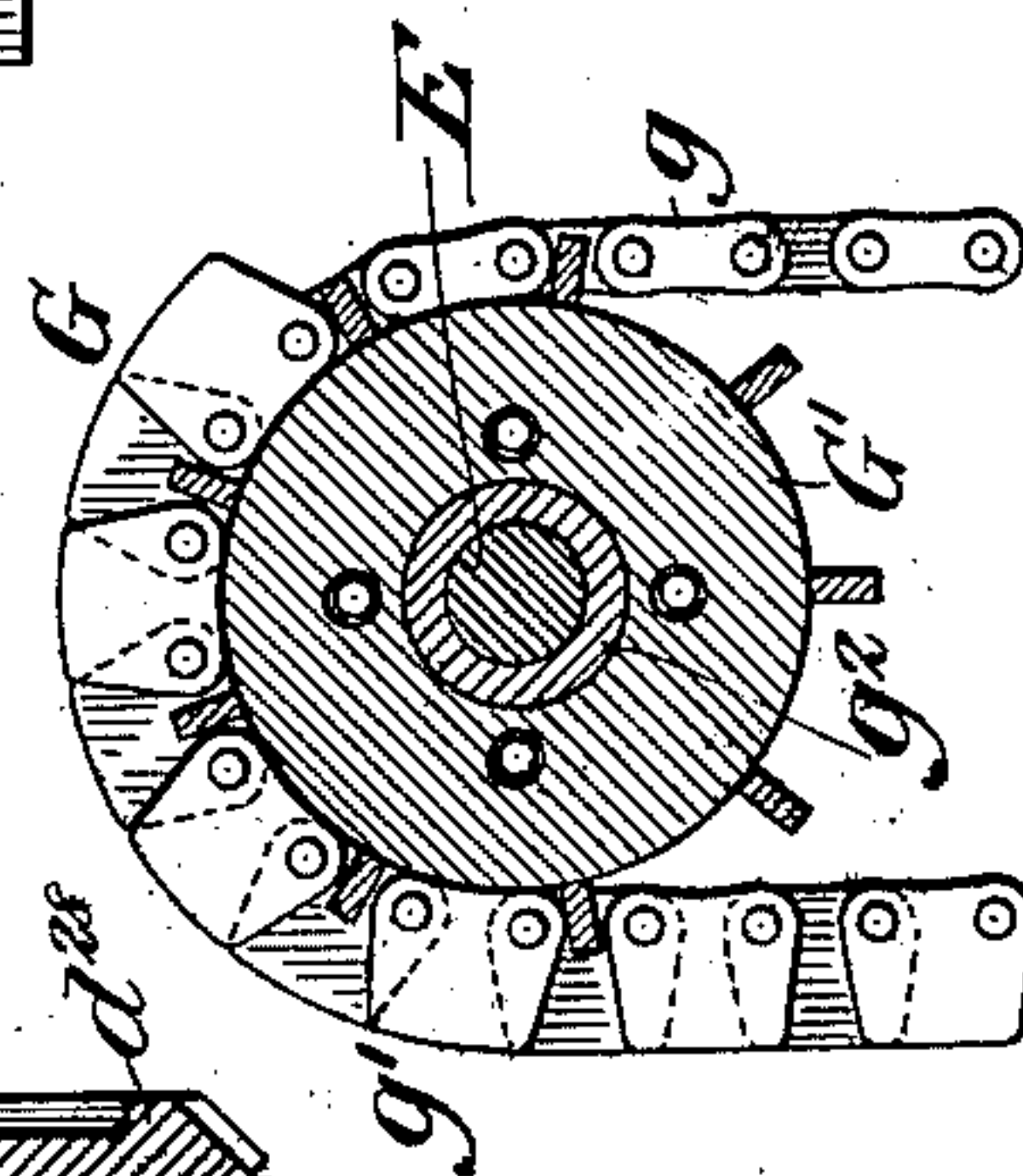
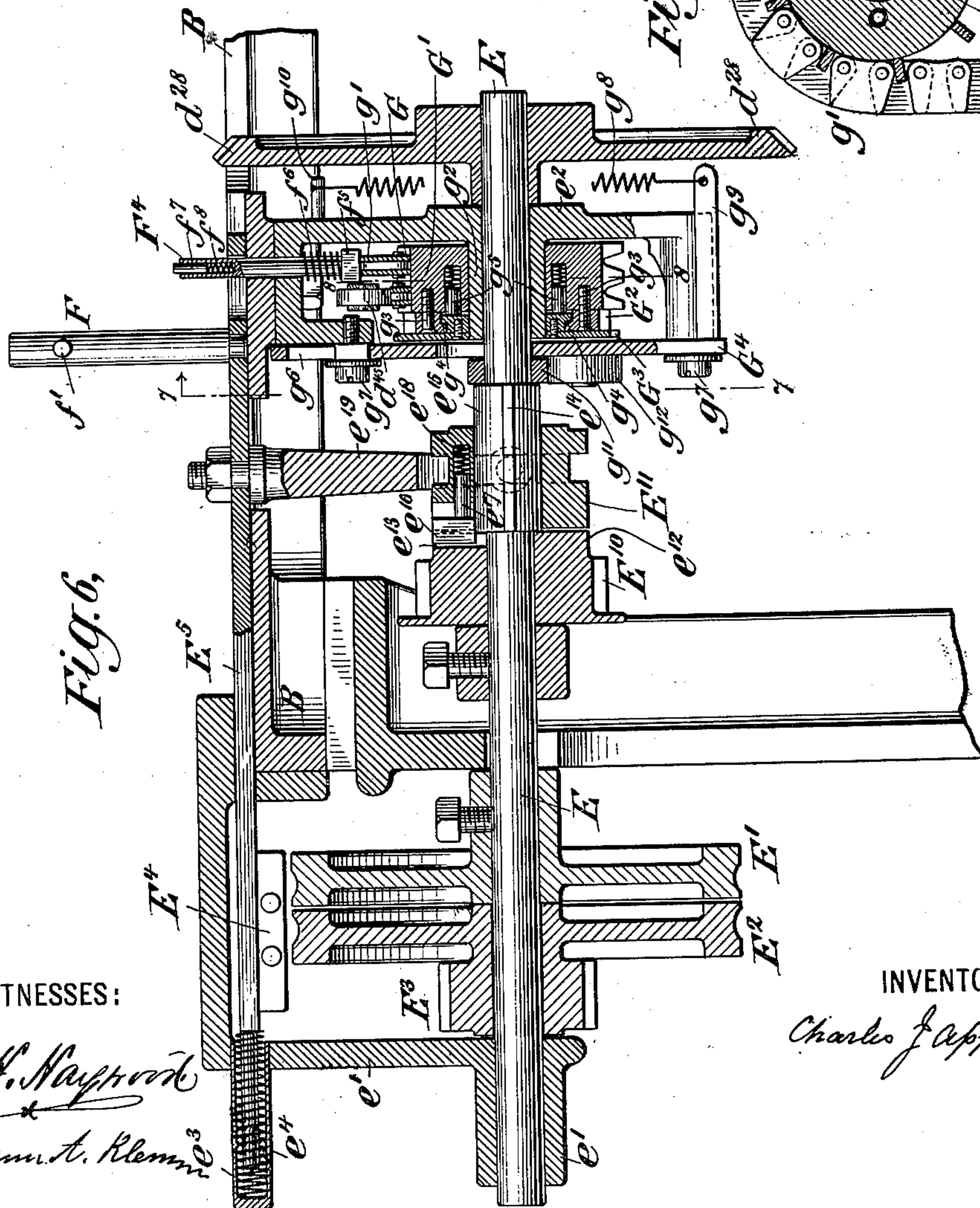


Fig. 6.



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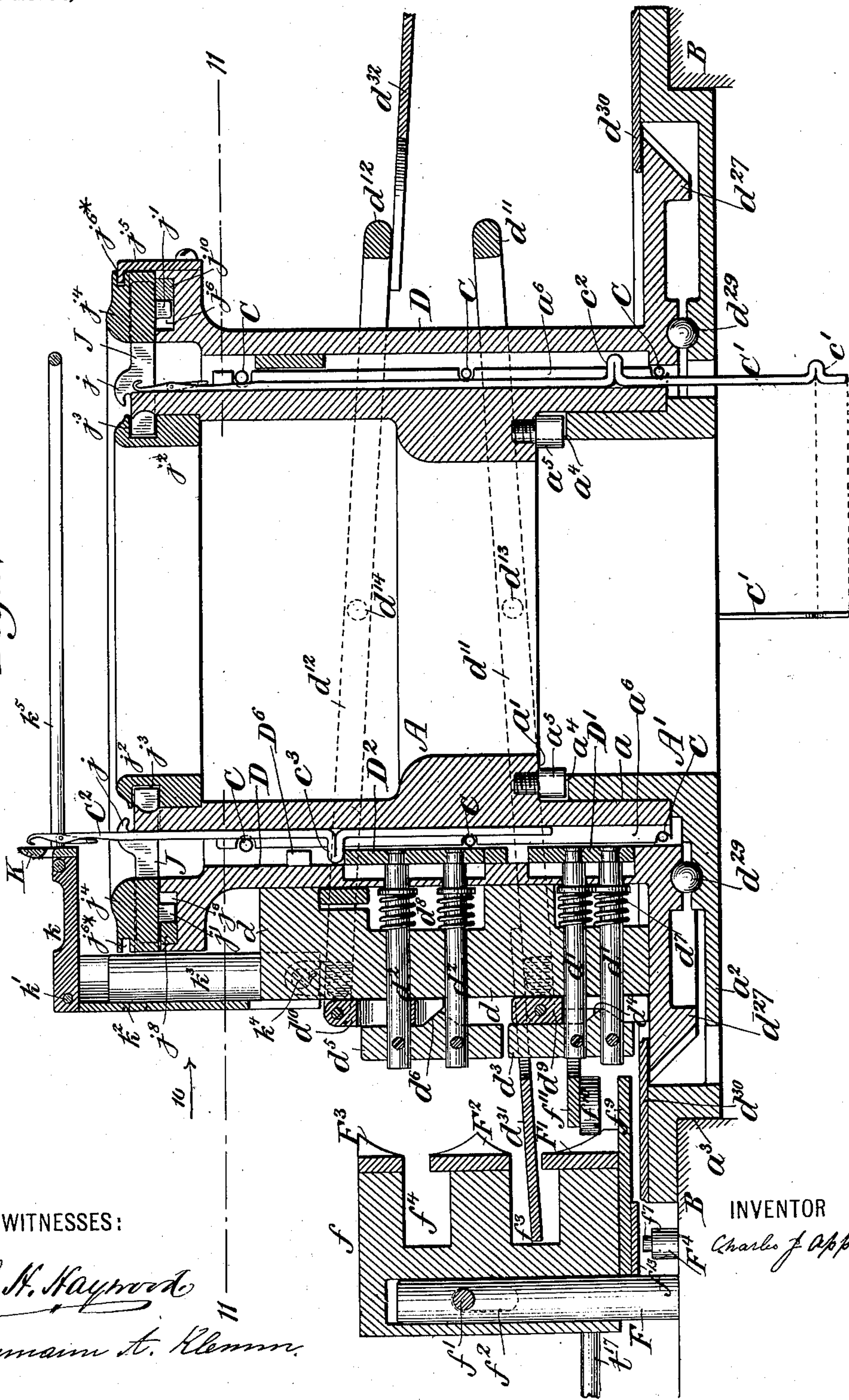
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(No Model.)

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Fig. 9.



WITNESSES:

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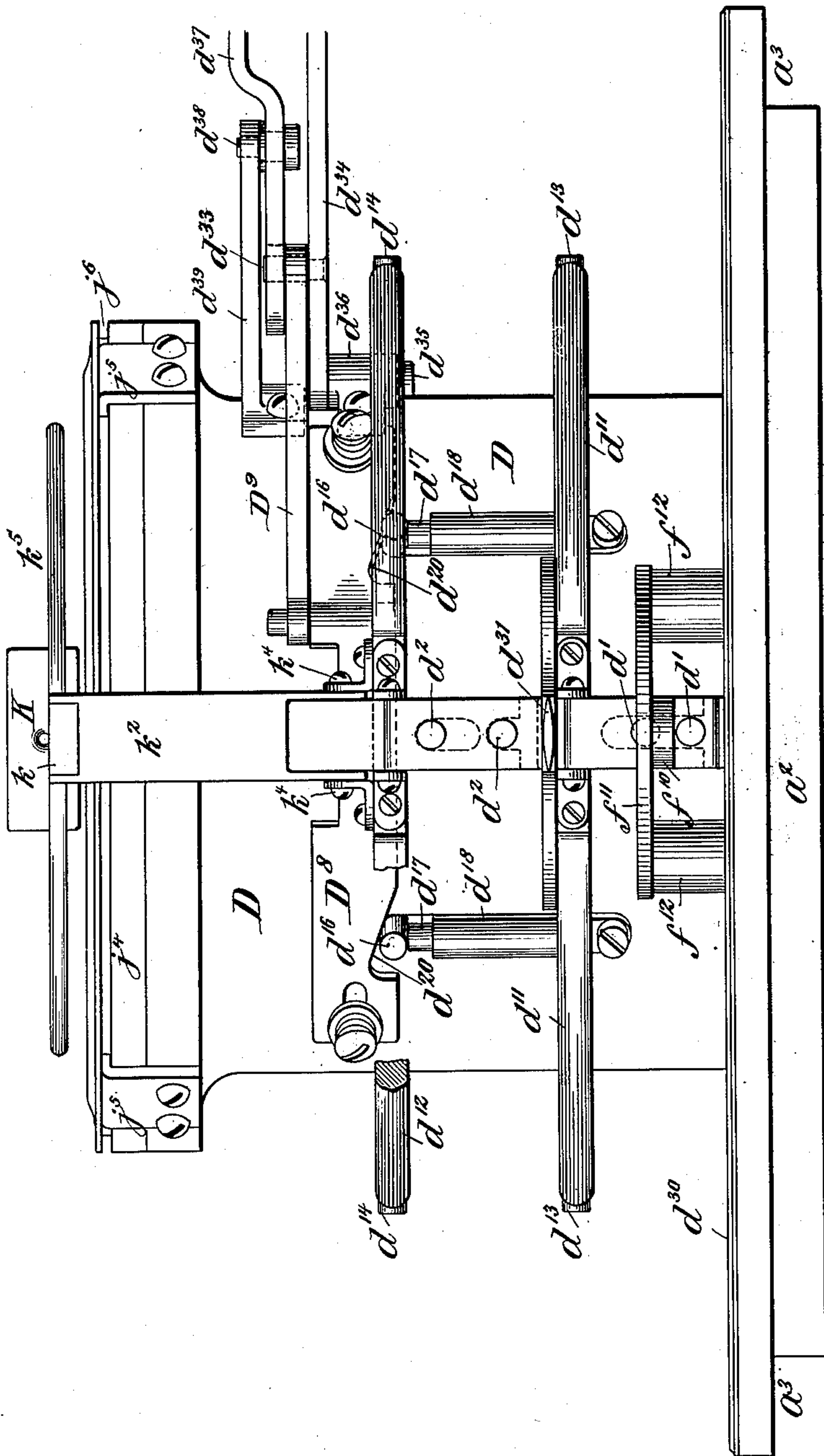
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(No Model.)

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Fig. 10.



WITNESSES:

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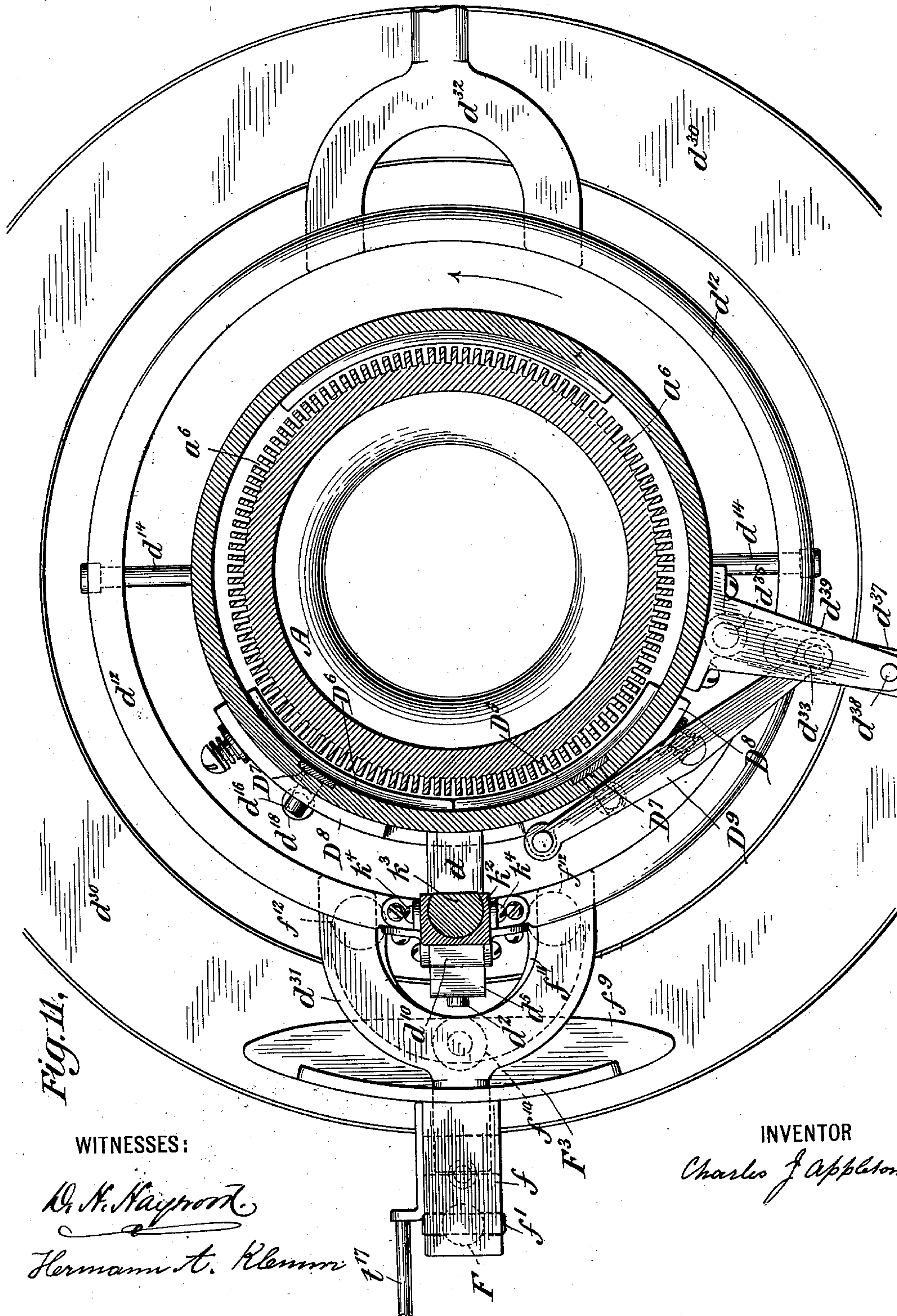


Fig. 11.

WITNESSES:

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Fig. 14,

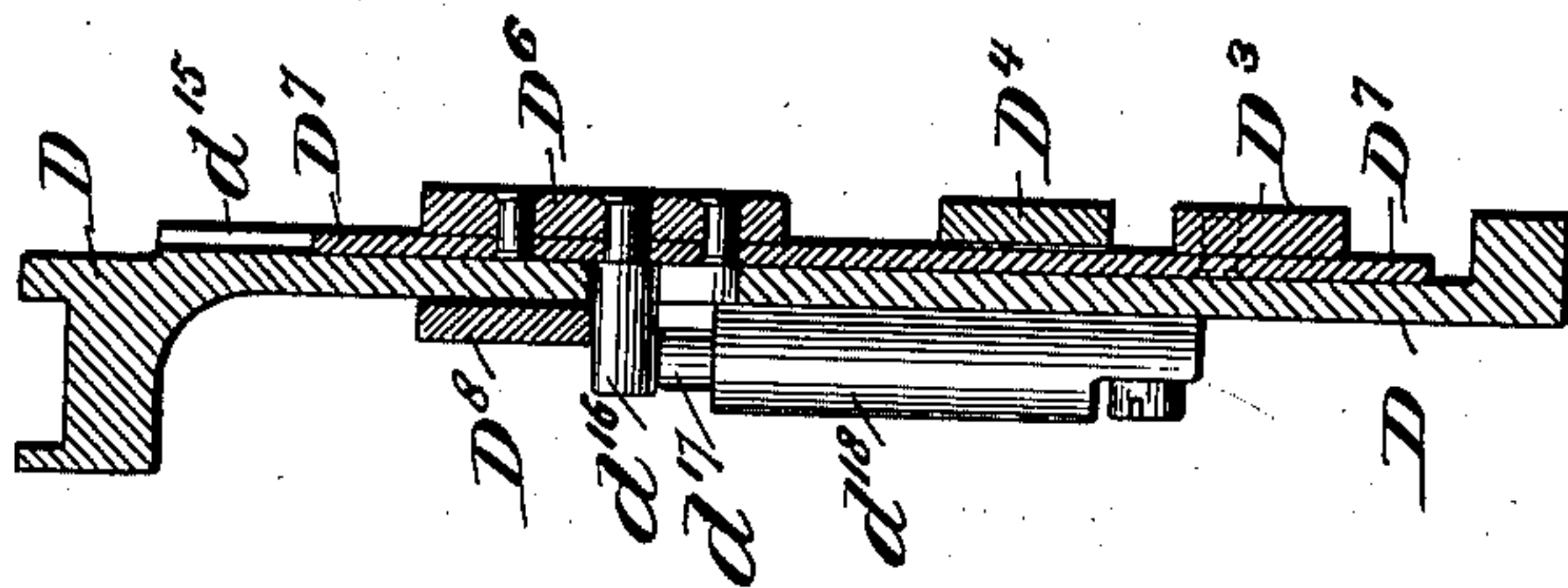


Fig. 13,

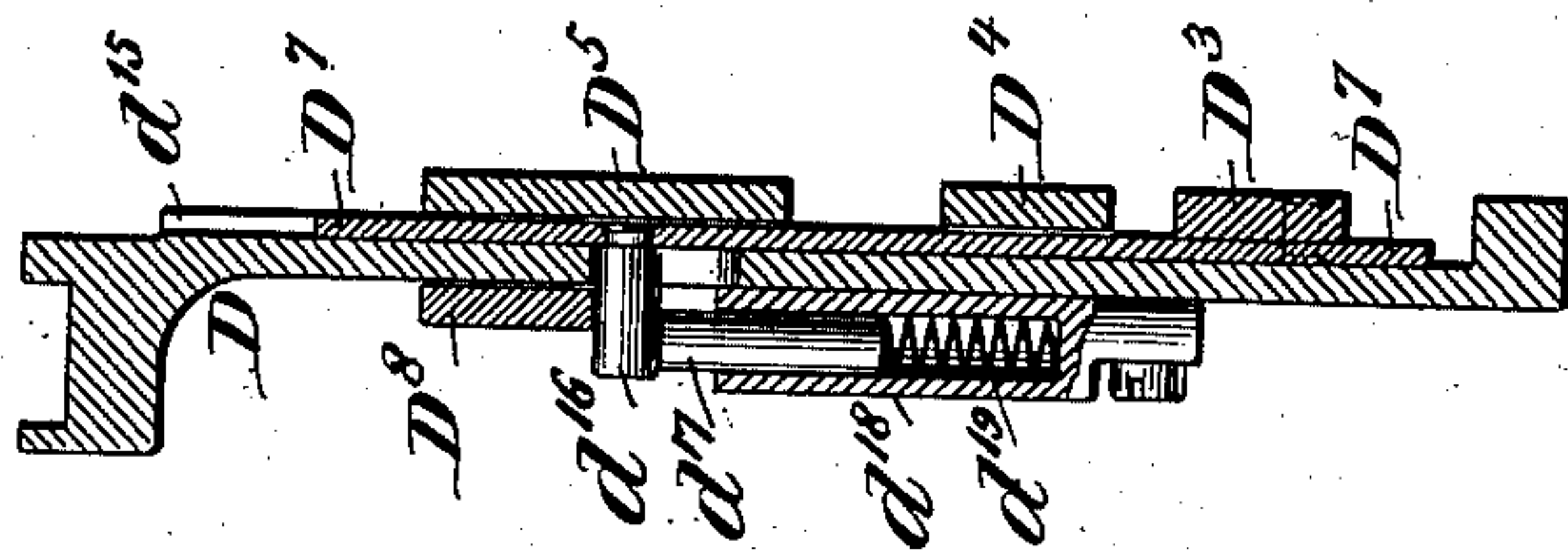
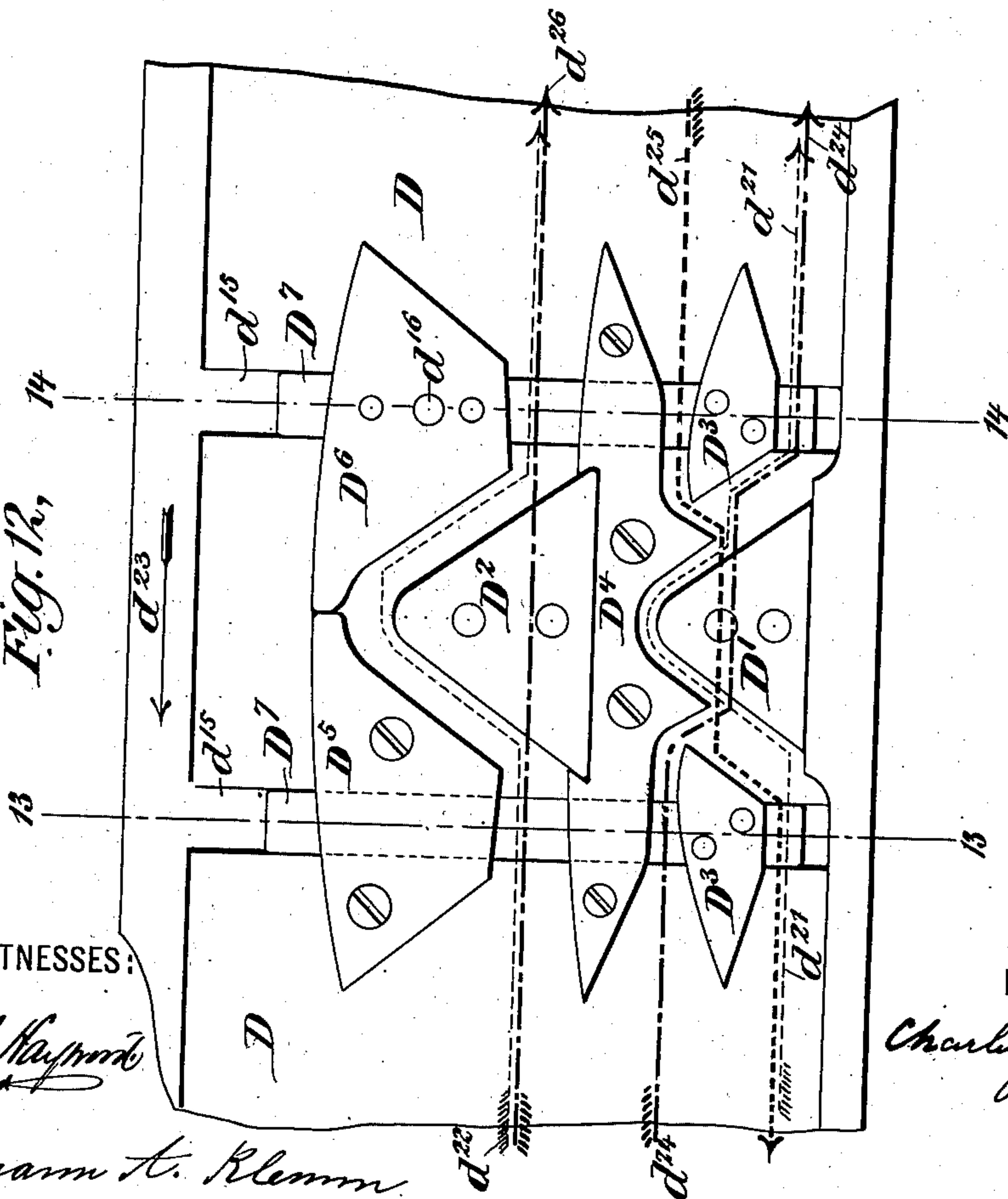


Fig. 12,



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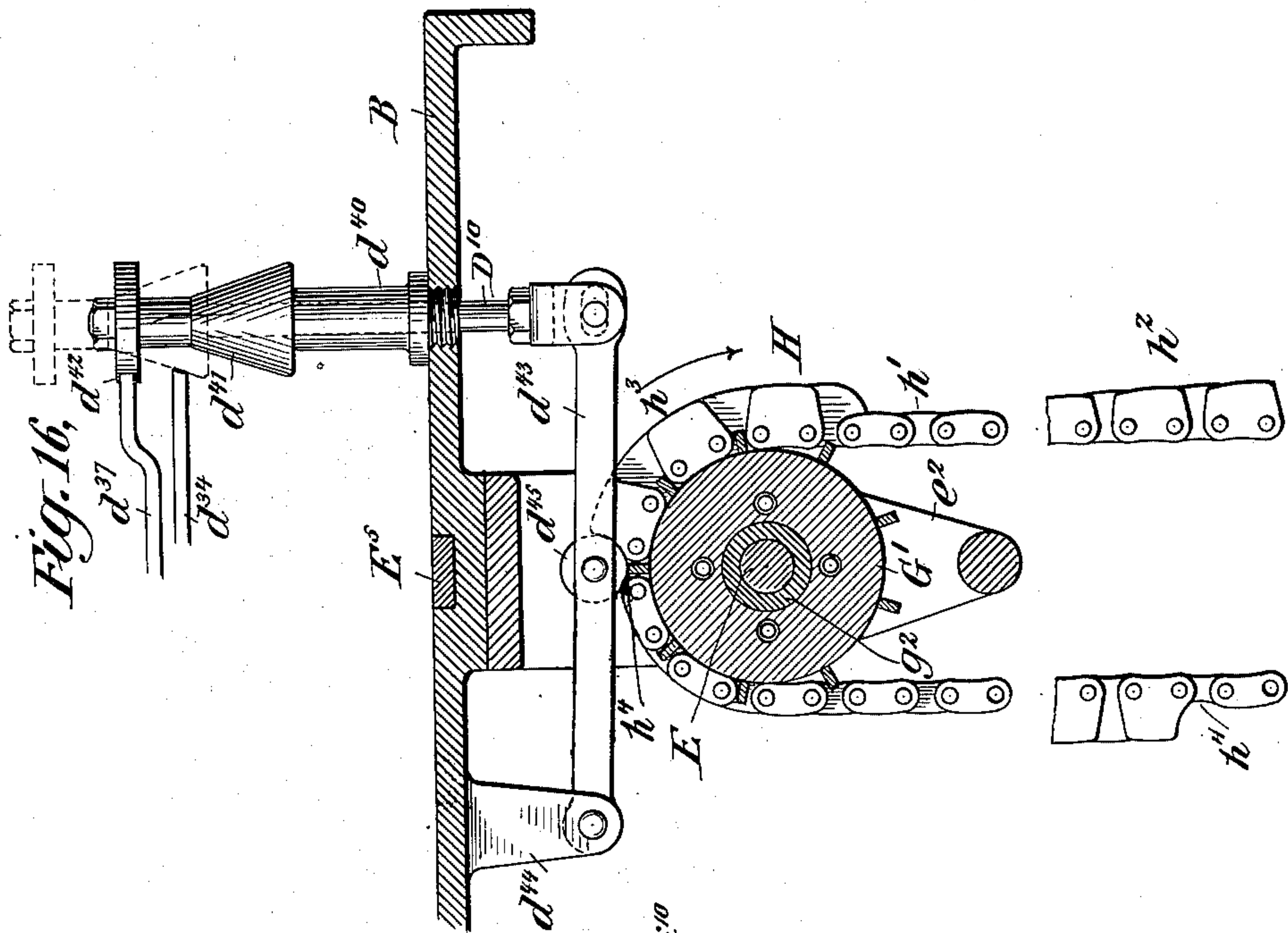
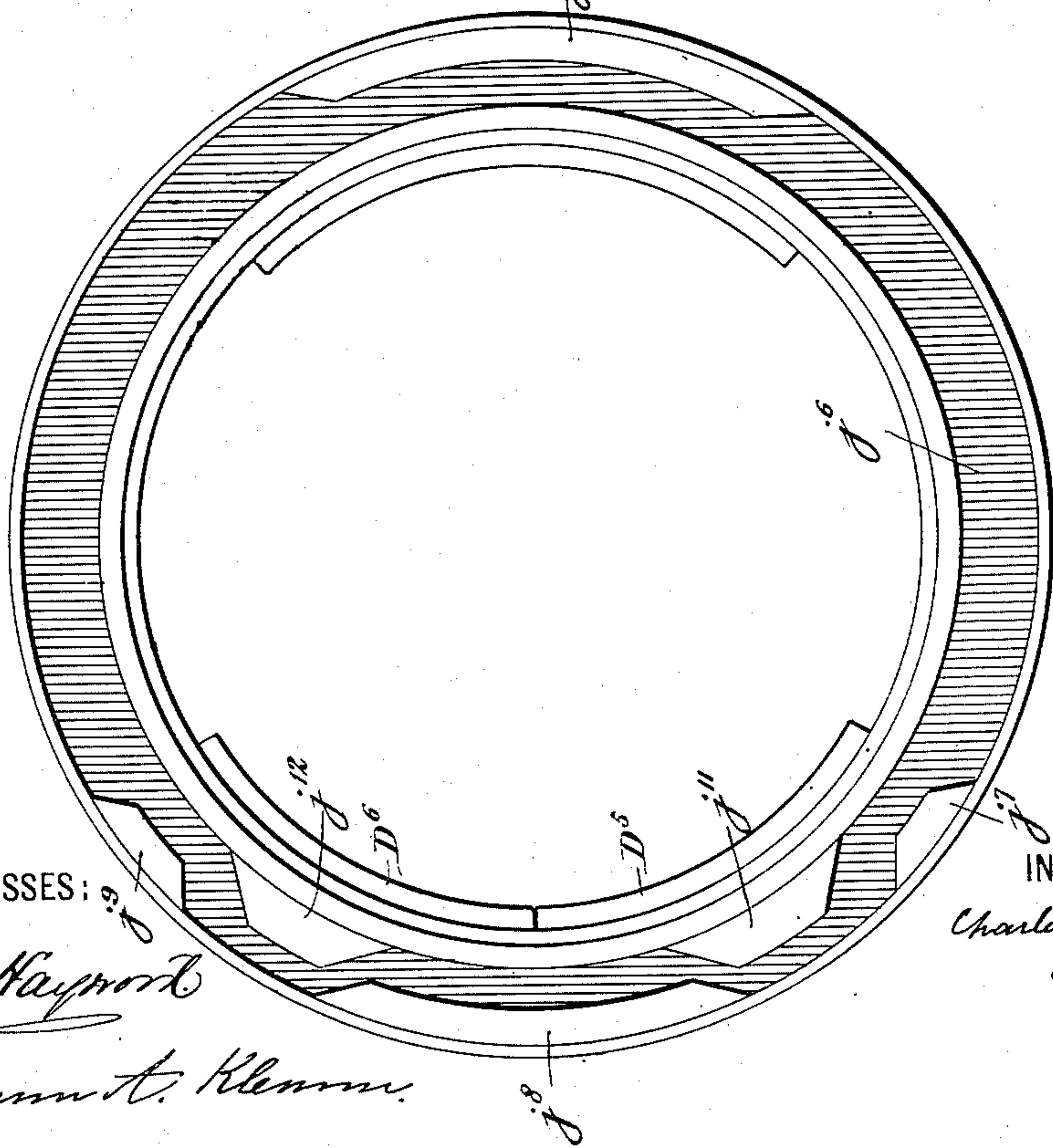


Fig. 15,



WITNESSES:

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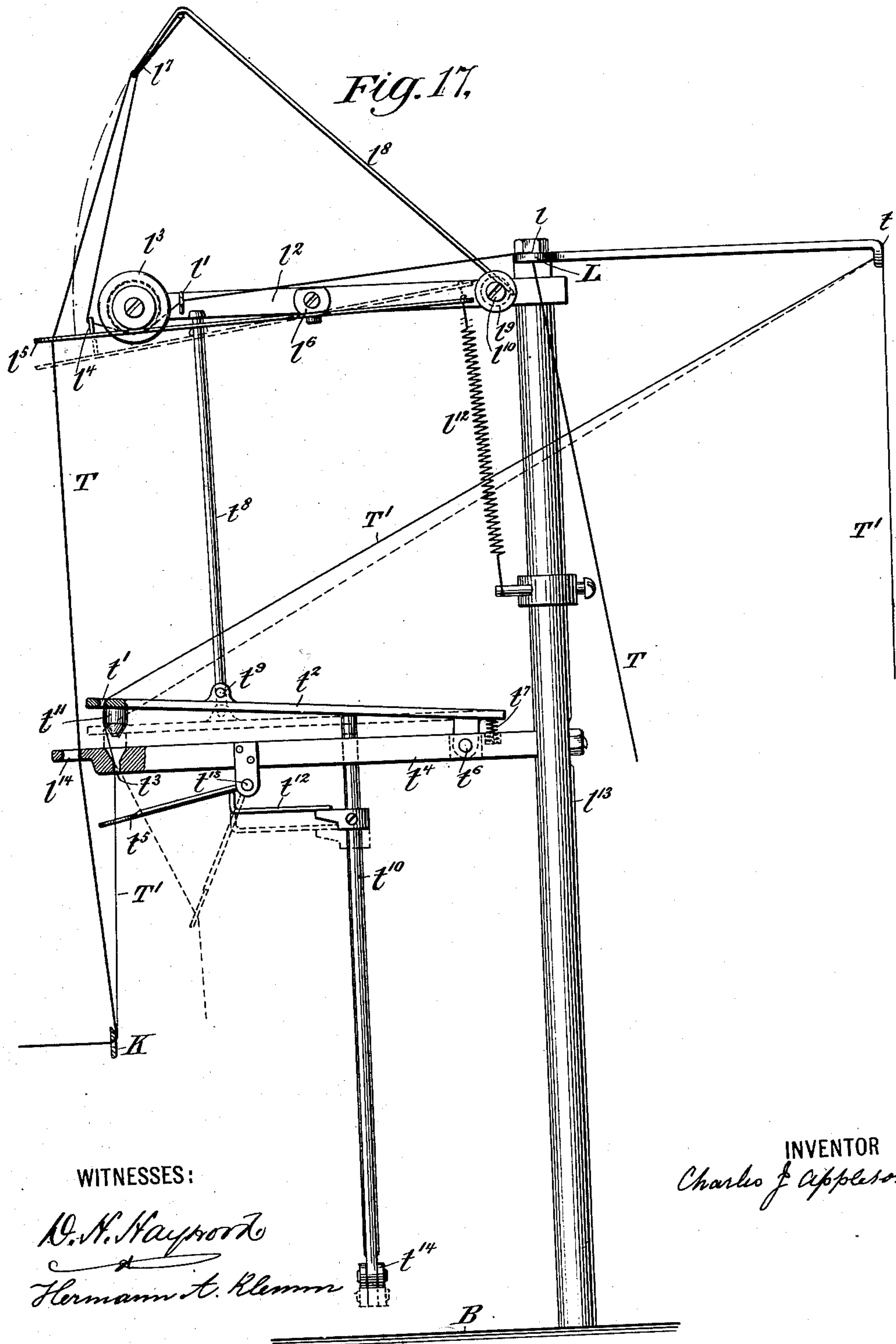
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C. J. APPLETON.
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(No Model.)



WITNESSES:

R. H. Hayworth
Hermann A. Klemm

INVENTOR

Charles J. Appleton

UNITED STATES PATENT OFFICE.

CHARLES J. APPLETON, OF LONG ISLAND CITY, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO JOHN J. SHAW, TRUSTEE, OF MAMARONECK, NEW YORK.

KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 691,888, dated January 28, 1902.

Application filed March 15, 1897. Serial No. 627,468. (No model.)

To all whom it may concern:

Be it known that I, CHARLES J. APPLETON, of Long Island City, in the county of Queens and State of New York, have invented a certain new and useful Improvement in Knitting-Machines, of which the following is a specification.

My improvement relates mainly to circular-knitting machines.

I will describe a machine embodying my improvement and then point out the novel features in claims.

In the accompanying drawings, Figure 1 is a top view of a machine embodying my improvement. Fig. 2 is a front elevation of the same. Fig. 3 is a transverse vertical section taken at the plane of the dotted line 3 3, Fig. 2, looking in the direction indicated by the arrows at the end of said line. Fig. 4 is a transverse vertical section taken at the plane indicated by the dotted line 4 4, Fig. 2, but omitting certain parts which might be represented in the background of said figure. Fig. 5 is an enlarged transverse vertical section taken at the plane of the dotted line 5 5, Fig. 2, and looking in the direction of the arrows marked at the end of said line. Fig. 5^a is a top view of the top bar shown in Fig. 5. Fig. 6 is a central longitudinal section parallel with the front of the machine. Fig. 7 is a transverse vertical section taken at the plane of the dotted line 7 7, Fig. 6. Fig. 8 is a transverse vertical section taken at the plane of the dotted line 8 8, Fig. 6. Fig. 9 is a central vertical section of the cylinder in which the knitting is done and correlated parts, this view being upon a large scale. Fig. 10 is a side elevation of parts shown in Fig. 9 looking in the direction indicated by the arrow 10 marked adjacent to Fig. 9. Fig. 11 is a horizontal section taken at the plane of the dotted line 11, Fig. 9, the needles being omitted. Fig. 12 is an elevation of cam mechanism comprised in Fig. 9, but instead of being shown of cylindrical form it is developed. Fig. 13 is a vertical section at the plane of the dotted line 13, Fig. 12. Fig. 14 is a vertical section at the plane of the dotted line 14, Fig. 12. Fig. 15 is a plan of certain parts shown in Fig. 9, including cam-rings. Fig. 16 is a

vertical section of certain parts, including a pattern-chain that serves to vary the length of stitches. Fig. 17 is an elevation, partly in section, of mechanism for regulating the tension and for throwing in an extra thread for thickening any part of a knitted fabric.

Similar letters of reference designate corresponding parts in all figures.

It may be added as a summary of the various views that Figs. 1, 2, 6, 10, and 17, so far as the full lines are concerned, represent the parts in the positions they occupy while the cam-cylinder is oscillating, and Fig. 17 in dotted outline and Figs. 9 and 11 represent the parts in the positions they occupy during the time that the cam-cylinder is rotating. The remainder of the figures are not distinctive as to the positions of the parts for either operation.

A designates a cylinder, through which the knitting fabric descends. It may be made of any suitable material and will preferably be open at both ends. As here shown, it is provided in the lower portion with an internal recess a , the top of which forms a shoulder a' , that rests upon the upper part of a cylinder A' . This cylinder A' is open at both ends and at the lower end is fastened to a table or bench B of any suitable form, an opening being provided through it for the passage of the knitted fabric. As here shown, this cylinder A' is provided with an outwardly-extending base-flange a^2 , in the outer portion of which is a rabbet a^3 for fitting the opening in the table or bench B.

The cylinder A may be secured in place by screws or otherwise passing through its base-flange and engaging with the table or bench. To prevent the cylinder A from accidentally turning relatively to the cylinder A' , the latter is provided in its upper edge with notches a^4 and the former with lugs a^5 , extending downwardly from the shoulder a' of the cylinder A. These lugs may consist of screws inserted in the shoulder of the cylinder A.

In the outer circumference of the cylinder A are a number of vertical grooves a^6 , in which are fitted needles C' C^2 . The shanks of the needles C' are longer than those of the needles C^2 , as may be seen in Fig. 9. The

needles may be held in place by helical springs C, surrounding the cylinder A and passing through notches in the ribs or partitions between the needle-receiving grooves, so that they may press against the shanks of the needles. By contacting with the needle-shanks they produce sufficient friction to retain the needles in any positions into which they may be adjusted. Both series of needles may be of ordinary form, except that the needles C' have extra lugs c' . Besides these lugs the needles C' have lugs c^2 and the needles C² have lugs c^3 .

The lugs c' are for coaction with a jacquard mechanism, which will presently be described. The lugs c^2 of the needles C' and the lugs c^3 of the needles C² are for coaction with triangular cams D' D², arranged outside of the cylinder A and supported by a cam-cylinder D. These cams are shown well in section in Fig. 9; but their shape may best be understood by reference to Fig. 12, where they are developed. These cams D' D² are arranged in relation to recesses formed in the inner surface of the cam-cylinder D, so that they may be withdrawn into the recesses in order to be inoperative or shifted beyond the recesses to become operative. As here shown, the cam D' is supported by two shanks or rods d' and the cam D² is supported by shanks or rods d^2 , having a sliding connection with a block d , that is fastened to the exterior of the cam-cylinder. The shanks or rods d' of the cam D' are connected to a yoke d^3 , having on that side which is the nearer to the cam-cylinder a cam-face d^4 . A similar yoke d^5 connects the shanks or rods d^2 of the cam D² and is provided with a cam-face d^6 . Springs d^7 , surrounding the shanks or rods d' of the cam D', tend to force this cam out of its recess into an operative position, and similar springs d^8 , surrounding the shanks or rods d^2 of the cam D², perform the same office for the cam D². A slide d^9 , slotted or notched to embrace the shanks or rods d' of the cam D', is fitted to move vertically between the outer side of the block d and the cam-cylinder D and serves by presenting a suitably-shaped surface to the cam of the yoke d^3 to move the latter away from the said block d , and consequently to withdraw the cam D' into its recess. A similar slide d^{10} coacts in the same way with the yoke d^5 to withdraw the cam D² into its recess. The slides d^9 d^{10} are actuated by levers d^{11} d^{12} , which are pivotally connected to the slides and have ring-shaped portions surrounding the cam-cylinder D. These levers are pivoted by pins or trunnions d^{13} d^{14} to the sides of the cam-cylinder at diametrically opposite portions. The purpose of pivoting these rings or levers d^{11} d^{12} is to constitute rockers or rocking levers thereof. Obviously when both the cams D' D² are shifted into operative positions and the cam-cylinder is rotated or oscillated the cams will cause both sets of needles C' C² to be reciprocated vertically. By withdrawing the cams D' D² both series

of needles will cease to be operated by these cams. At times the needles C' may be operated by cams D³ and the jacquard mechanism hereinafter mentioned. I will merely mention these cams D³ in passing, and later on fully describe their construction and operation. Above the cam D' is a cam D⁴, which coacts with the cam D' and also with the cams D³. It is a fixture on the inner side of the cam-cylinder D, and hence is not adjustable horizontally into different positions like the cams D' D². Above the cam D² are cams D⁵ D⁶. The cams D⁵ D⁶ are incapable of any horizontal movement into and out of operative position. To make the operation of these cams perfectly clear, I will add that the cam D' is incapable of any movement except a horizontal movement relatively to the inner surface of the cam-cylinder for the purpose of adjusting it into an operative or an inoperative position. The cam D² is susceptible only of a similar movement.

The cams D³ have no horizontal motion, but they are fastened to vertical slide-bars D⁷, which work in grooves d^{15} , formed on the inner surface of the cam-cylinder D. Hence the cams D³ are susceptible of an up-and-down movement. The cam D⁶ is attached to one of these slide-bars D⁷. Hence it may move similarly to the cams D³ and with them. The cams D⁴ D⁵ have no movement of any kind except that they participate in the oscillation or rotary movement of the cam-cylinder, in which also all the other cams D' D² D³ D⁶ participate.

The slide-bars D⁷ are shown as retained in the grooves d^{15} by reason of the fact that the cams D⁴ D⁵ extend across such grooves. Shanks or rods d^{16} extend rearwardly from the slide-bars D⁷ through vertical slots formed in the cam-cylinder D and bear upon spring-supported rods d^{17} , which are fitted to vertical sockets d^{18} , with which the exterior of the cam-cylinder is provided, springs d^{19} being arranged in these sockets below said supports d^{17} . Thus the slide-bars D⁷ will be raised to their upper position. They are lowered by means of cams D⁸, fitted to the exterior of the cam-cylinder (see particularly Figs. 10, 11, 13, and 14) and capable of moving horizontally upon the circumference of the cam-cylinder. As here shown, these cams are longitudinally slotted and held in place by screws passing through slots and engaging with tapped holes in the exterior of the cam-cylinder, springs being interposed between the heads of the screws and the cams for keeping them in place with sufficient friction to preclude accidental movement. There are two of these cams; but they may be made integral and are so represented. The lower edge of each is provided with a notch d^{20} .

When the cams D⁸ are moving in one direction, both the slide-bars D⁷ and the cams D³ D⁶, connected to them, will be lowered, and upon a movement of the cams D⁸ in the reverse direction the springs d^{19} will raise the

slide-bars and said cams D^3 D^6 . The means for imparting movement to the cams D^3 will be described later on. It is sufficient here to say that it is directly effected by a rod D^9 , 5 pivotally connected at one end with the cams and at the other end with parts from which it derives motion.

It will be manifest from what I have already stated that when the cams D^1 D^2 are adjusted 10 into operative position, as shown in Fig. 9, and the cam-cylinder is rotated both series of needles C^1 C^2 will be reciprocated vertically by means of these cams in conjunction with the cams D^3 D^4 D^5 D^6 .

15 The manner in which the lugs c^2 of the needles C^1 are operated upon at this time is indicated by dotted line d^{21} in Fig. 12, and the manner in which the lugs c^3 of the needles C^2 are operated upon at the same time is indicated by the dotted line d^{22} in the same figure. I have shown arrow-heads at the ends 20 of these lines d^{21} d^{22} for the purpose of indicating the relative direction of the needles and cam-cylinder. The actual direction of movement of the cam-cylinder is indicated by the arrow d^{23} in Fig. 12. To avoid any misapprehension, I may add that although the 25 cams D^1 D^2 are in their operative positions at the same time, yet neither occupies an operative position during the whole time that the other occupies such a position, one being adjusted into its operative position and out of its operative position in advance of the same actions in the other. While the machine is 35 operating in this way, straight work is being done, or, in other words, work like the leg of a stocking as distinguished from the heel and toe. I do not, however, mean that the work is necessarily straight in the sense that 40 it does not vary circumferentially in size. If during any portion of this straight work it were desirable to elongate the stitches for the purpose of making a looser texture to enlarge the fabric, the cams D^3 and the cam D^6 will 45 be suitably lowered to give an extra length of reciprocation of the needles at certain times, the operation of these cams D^3 D^6 being determined, as already indicated, by a pattern-chain H, hereinafter to be described.

50 For making work which is not straight—as, for example, the heels and toes of stockings—the cam-cylinder will be oscillated instead of rotated and the cams D^1 D^2 will be adjusted into inoperative positions within their recesses and the needles C^2 will be left inoperative. The needles C^1 will remain operative, but will then be actuated by the jacquard mechanism presently to be described, 55 the upward movement being given by the jacquard mechanism and the downward movement by the cams D^3 D^4 . The action of the needles C^1 during this time is indicated in Fig. 12 by the dotted line d^{24} in one direction and by the dotted line d^{25} in the other. 60 During this work the stitches may be lengthened by a downward movement of the cams D^3 , produced by the pattern-chain H, already

mentioned and hereinafter to be described. The line d^{26} indicates that the needles C^2 will not be affected during this action, because 70 their lugs c^3 may pass the cams without contacting with them.

I will now describe the means for rotating or oscillating the cam-cylinder. At the base 75 of the cam-ring is an outwardly-extending flange, forming a bevel gear-wheel d^{27} , and this derives motion from a bevel gear-wheel d^{28} , which is affixed to a shaft E. This shaft is journaled in brackets e^1 e^2 , extending downwardly from the table or bench B. Prefer- 80 ably antifriction-rollers d^{29} will be interposed between the base-flange of the cam-cylinder and the base-flange of the cylinder A^1 . Any suitable means may be provided for retaining the base-flange of the cam-cylinder in 85 proper relation to the base-flange of the cylinder A^1 —as, for instance, an annular plate d^{30} attached to the top of the latter and extending over the top of the former. A belt-pulley E^1 is affixed to the shaft E, and another 90 belt-pulley E^2 is mounted upon said shaft, so as to be capable of turning loosely thereon. Affixed to this belt-pulley E^2 is a toothed wheel or pinion E^3 . Above these pulleys is a belt-shifter E^4 , and this is mounted upon a 95 bar E^5 , which is fitted to slide in a groove formed in the top of the table or bench B in a direction parallel with the front. With one end of this bar E^5 a spring e^3 is combined, it being here shown as arranged in a socket e^4 , 100 connected with the bracket e^1 , which contributes to the support of the shaft E. Motion of the bar E^5 in one direction is effected by this spring e^3 . The reverse motion is imparted to the bar by means of force trans- 105 mitted through a post F in a manner which may best be described later on. When the belt-shifter E^4 is moved in such direction as to apply the belt to the pulley E^1 , which is affixed to the shaft E, rotary motion will be 110 imparted to the shaft E continuously, and a rotary movement of the cam-cylinder D will consequently be produced. When the belt-shifter E^4 is moved in the reverse direction, the rotary movement of the cam-cylinder D 115 will be terminated, and motion will then be transmitted through the belt-pulley E^2 and pinion E^3 to a gear-wheel E^6 , affixed to a rotary shaft E^7 , supported by a bracket e^5 , which is affixed to one of the side pieces of the ta- 120 ble or bench B. Affixed to the same shaft E^7 is a gear-wheel E^8 , which so far as the mechanism now under consideration is concerned may be considered merely as a crank, it being provided with a crank-pin e^6 , which 125 transmits motion through a rod e^7 to a gear-segment E^9 , oscillated upon a shaft or stud e^8 , which is supported by a cross-piece or stretcher e^9 , connected to the two side pieces of the table or bench B. An adjustable con- 130 nection is afforded between the rod e^7 and the segment E^9 by means of a slot e^{10} in the segment and a bolt e^{11} passing through said slot and through said rod. Thus provision is af-

forded for varying the throw of the segment. The tooth-segment E^9 engages with a small gear wheel or pinion E^{10} , mounted loosely upon the shaft E . This gear-wheel E^{10} forms
 5 part of a clutch, and therefor has on one face a cylindrical boss e^{12} , with a single radial notch e^{13} . Just beyond this cylindrical boss the shaft E is provided with a spline e^{14} , which is here shown as formed upon an enlarged
 10 portion e^{15} of the shaft. Upon this enlarged portion of the shaft is fitted a clutch-piece E^{11} , having a clutch-tooth e^{16} capable of engaging with the notch e^{13} of the gear-wheel E^{10} . This tooth is shown as spring-actuated,
 15 and for this purpose is provided with a shank e^{17} , which passes into a socket in the clutch-piece E^{11} and is combined with a spring e^{18} for moving it outward into the notch e^{13} of the gear-wheel E^{10} . Obviously when the
 20 clutch-piece E^{11} is moved into such position that its spring-tooth e^{16} will engage with the notch e^{13} of the gear-wheel E^{10} the latter will be engaged with the shaft E , so as to be capable of turning said shaft. As the motion
 25 imparted to the gear-wheel E^{10} by the segment E^9 will be oscillatory, a corresponding movement will be imparted to the cam-cylinder D whenever the belt-shifter E^4 shifts its belt upon the pulley E^2 . The clutch-piece
 30 E^{11} is shifted into and out of engagement with the gear-wheel E^{10} by means of a rod e^{19} , attached to the slide-bar E^5 , said rod e^{19} being bifurcated at its lower end and provided there with pins for engaging a circumferential
 35 groove with which the clutch-piece E^{11} is provided.

Now I will explain the means for operating the levers $d^{11} d^{12}$, through which the cams $D' D^2$ are adjusted into and out of operative
 40 positions. Upon the post F a tappet-block f is mounted, so as to be free to move vertically, but so as to be incapable of any rotary movement. As here shown, this tappet-block is provided with a socket vertically arranged
 45 to fit loosely upon the post F , and a cross-piece f' extends through the post into vertical slots f^2 , with which the sides of the tappet-block are provided. One side of the tappet-block f is provided with notches $f^3 f^4$. Upon
 50 this side of the tappet-block, above and below the notches, tappets $F' F^2 F^3$ are arranged. The levers $d^{11} d^{12}$, which effect the shifting of the cams $D' D^2$ into and out of operative position, are provided with extensions or fingers
 55 $d^{31} d^{32}$, that extend into the notches of the tappet-block f . By coöperating with the tappets $F' F^2 F^3$ these extensions or fingers $d^{31} d^{32}$ are shifted so as to effect the desired adjustment of the cams $D' D^2$. It will be seen that the extension or finger d^{32} of the lever d^{12} is at a diametrically opposite side of the cam-cylinder
 60 from the extension or finger d^{31} of the lever d^{11} . Not only while the cam-cylinder is rotating will the tappets $F' F^2 F^3$ operate both of the levers $d^{11} d^{12}$, but also while the cam-cylinder is oscillating, because each oscillation will be
 65 at least a complete turn of the cam-cylinder

in the machine as here organized. The tappets $F' F^2 F^3$ operate to shift the levers $d^{11} d^{12}$ by means of a vertical movement which they
 70 have in common with the tappet-block f . This movement is produced by a vertical movement of a rod F^4 , which is moved by a pattern-chain G , it being provided at its lower extremity with a block f^5 for bearing upon
 75 the pattern-chain. The pattern-chain merely elevates the rod F^4 . It is lowered by gravity aided by a spring f^6 . It will be understood that whenever the pattern-chain raises the rod F^4 it will raise the tappet-block f and
 80 cause the tappets $F' F^2 F^3$ to shift the levers $d^{11} d^{12}$, controlling the position of the cams $D' D^2$.

I will now describe the manner in which I operate the slide-bar E^5 . The upper end of
 85 the rod F^4 is provided with a socket in which is fitted a pin f^7 and below this pin a supporting-spring f^8 . Whenever the rod F^4 is raised, the pin f^7 will first contact with the tappet-block f ; but this will have no effect
 90 upon the tappet-block, because the spring f^8 is so light that it will permit the pin f^7 to descend into the socket of the rod F^4 . When the rod F^4 elevates the tappet-block f , a plate f^9 , which is attached to the bottom of the
 95 tappet-block f , will be raised into the plane of an antifriction-roller f^{10} , carried by the cam-cylinder D , it being shown here as mounted upon an arc-shaped piece f^{11} , which is attached to the base-flange d^{27} of the cam-cylinder
 100 by means of posts f^{12} . The rotary or oscillatory movement of the cam-cylinder will cause this antifriction-roller f^{10} to coact with the opposite edge of the plate f^9 , and thus force the tappet-block f in a direction away
 105 from the cam-cylinder. As the tappet-block is mounted upon the post F and the latter is rigidly connected with the slide-bar E^5 , the latter will participate in the movement of the tappet-block in a direction away from the
 110 cam-cylinder. It will be seen, therefore, that the cam-cylinder by means of its antifriction-roller f^{10} operates the belt-shifter E^4 and also connects and disconnects the clutch $E^{10} E^{11}$. The movement of the tappet-block produced
 115 by the antifriction-roller f^{10} will not, however, move the tappets $F' F^2 F^3$ into such position as to prevent them from operating upon the levers $d^{11} d^{12}$. Attached to the under side of the plate f^9 is a plate f^{13} . When the tappet-block is by the rotation of the cam-cylinder
 120 D moved by the antifriction-roller f^{10} in a direction away from the cam-cylinder, the pin f^7 will rise in front of the plate f^{13} , and thus the tappet-block will be prevented from
 125 returning to its position adjacent to the cam-cylinder until the pattern-chain G permits the rod F^4 to descend. In order to relieve the pin f^7 of any friction, the motion of the tappet-block f , produced by the antifriction-roller
 130 f^{10} , will be great enough to move the plate f^{13} slightly away from the side of said pin.

The pattern-chain G has a number of links

of slight depth or thickness and a number of links g' of greater depth or thickness. Considered with reference to their effect these are high and low links. The low links permit the rod F^4 to descend under the influence of gravity, with or without the aid of the spring f^6 , and the high links elevate the rod to produce the effects already described. Only when the high links pass under the rod F^4 does this pattern-chain have any function. This pattern-chain is moved by means of a sprocket-wheel G' , which is loosely mounted upon a sleeve g^2 , that is shown as formed integral with the bracket e^2 , that contributes to the support of the shaft E. At the side of the sprocket-wheel G' are two ratchet-wheels G^2 G^3 . The ratchet-wheel G^2 is fastened to the side of the sprocket-wheel by means of screws g^3 or otherwise. The inner circumference of this ratchet-wheel G^2 is rabbeted and within it fits a reversely-rabbeted cylinder g^4 , which forms the hub of the ratchet-wheel G^3 . As shown, it is made in a separate piece and fastened to the ratchet-wheel proper by means of screws. The cylinder or hub g^4 is pressed by pins g^5 upon that side which is adjacent to the sprocket-wheel G' , and these pins extend into recesses with which the sprocket-wheel is provided, springs being interposed between the bottoms of the recesses and the pins, so as to force the ratchet-wheel G^3 away from the sprocket-wheel, and consequently away from the ratchet-wheel G^2 . The purpose of the springs is to produce enough friction between the overlapping portions of the ratchet-wheel G^2 and the hub of the ratchet-wheel G^3 to prevent any accidental movement of the latter. G^4 designates a slide which is provided with vertical slots g^6 , through which pass bolts g^7 . A spring g^8 , fastened at the lower end to a stud g^9 , extending from the slide G^4 and at the other end to a pin g^{10} , extending from the bracket e^2 , tends to raise said slide, and a cam g^{11} , affixed to the shaft E and operating upon an antifriction-roller g^{12} , mounted upon the slide G^4 , serves to lower said slide. A pawl g^{13} , pivoted to the slide, is held into engagement with both ratchet-wheels by means of a spring g^{14} . For each rotation of the shaft E the pawl coacts with the ratchet-wheels. The ratchet-wheel G^3 has five teeth of the same projection, and every sixth tooth g^{15} is a deeper tooth. Whenever the pawl coacts with one of these deeper teeth g^{15} , it is also permitted to coact with an adjacent tooth of the ratchet-wheel G^2 ; but at other times it does not coact with this ratchet-wheel at all. Because of this combination of ratchet-wheels with the sprocket-wheel that operates the pattern-chain G it requires six rotations of the shaft E to produce one movement of the sprocket-wheel equal to the length of one link of the pattern-chain G. I will now describe the means for operating the cams D^8 , by which the up-and-down movement of the cams D^3 D^6 is effected. I

have already stated that these cams D^8 are operated by a rod D^9 , which at one end is pivotally connected to them. At the other end this rod is pivotally connected to a pin d^{33} , that projects upward from a lever d^{34} , that is fulcrumed by means of a stud d^{35} in a bracket d^{36} , attached to the exterior of the cam-cylinder D. Another lever d^{37} is provided with a longitudinal slot, through which also passes the pin d^{33} , that connects the lever d^{34} with the rod D^9 . This lever d^{37} is fulcrumed by a pin or screw d^{38} to a bracket d^{39} , that is fastened to the exterior of the cam-cylinder D. D^{10} is a rod having a sliding movement in a hollow post d^{40} , which is here shown as connected with the table or bench B by means of a screw-threaded boss. This rod is raised and lowered by means of a pattern-chain H, which will be presently described. At its upper end it has two different projections d^{41} d^{42} . The projection d^{41} is inclined on the side which is adjacent to the lever d^{34} . It may be inclined all the way around, as represented. The upward projection, while shown here as a cylinder, need not be anything more than a finger. It is not inclined on its operative surface. The rod D^{10} is capable of adjustment to such a position that neither of its projections d^{41} d^{42} will have any effect upon the levers d^{34} d^{37} . It may also be moved into a position, as shown in Fig. 16, where its projection d^{42} will operate upon the lever d^{37} and its projection d^{41} will have no effect upon the lever d^{34} . If elevated still more, its projection d^{42} will be moved beyond the plane of the lever d^{37} , and its inclined projection d^{41} will be brought opposite the lever d^{34} , as indicated by dotted lines in Fig. 16, and according to whether different portions of the inclined surface of its projection d^{41} will be opposite the lever d^{34} so will the effect of the said projection upon this lever be varied. The rod D^{10} is connected at its lower end with one end of a lever d^{43} , which at the other end is fulcrumed to a bracket d^{44} . Intermediate of its ends it is provided with an antifriction-roller d^{45} , and this coacts with the pattern-chain H. The pattern-chain H passes around the sprocket-wheel G' and derives motion therefrom in harmony with the pattern-chain G. This pattern-chain H comprises different links, some low links h' , which allow the rod D^{10} to descend to such a position that neither of its projections d^{41} d^{42} will be operative, some links h^2 , which are graduated in height, so as to elevate the rod D^{10} sufficiently to bring different portions of its inclined projection d^{41} into operation for varying the transverse dimensions of the fabric—as, for instance, while knitting the calf portion of a stocking—some high links h^3 for elevating the rod D^{10} into such a position that the lower part of its inclined projection d^{41} will continuously be opposite the end of the lever d^{34} for the purpose of knitting several lines of extra long stitches for indicating the division line between two stockings, and occasional depressed links h^4 occurring one at a

time for the purpose of lowering the rod D^{10} to such a position that its projection d^{42} will be opposite the end of the lever d^{37} . While the projection d^{41} of the rod D^{10} is opposite the lever d^{34} , the rotation of the cam-cylinder D will carry said lever into contact with the said projection, and thereupon the cams D^8 will be shifted into operative position; but the operative position will vary in degree according to the elevation of the projection d^{41} of the rod D^{10} . When the rod D^{10} is lowered sufficiently for its projection d^{42} to occupy the same plane as the end of the lever d^{37} , the rotation of the cam-cylinder will cause said projection d^{42} to oscillate the lever d^{37} in such a direction as to shift the cams D^8 into an in-operative position.

I will now describe the jacquard mechanism, premising that it is more particularly represented in Figs. 2, 4, 5, and 5^A. E^8 designates a wheel which has heretofore been considered merely in its function of a crank for imparting motion to the gear-segment E^9 for oscillating the cam-cylinder D . It will be seen that this wheel is a gear-wheel and that it engages with a similar gear wheel or pinion I , that is affixed to a shaft I' , journaled in brackets i , extending from the side pieces of the table or bench B . Affixed to this shaft I' is an eccentric I^2 , whose rod i' extends to toggle-levers i^2 i^3 . The toggle-lever i^2 is mounted loosely upon a cross-rod or stretcher e^8 , connecting the side pieces of the table or bench B , and the toggle-lever i^3 is pivotally connected by means of a pin or screw i^5 to a block i^6 , which is made in the form of a collar and adjustably connected by means of a set-screw i^7 to a sleeve i^8 . The sleeve i^8 is mounted upon an upright rod i^{30} , which at the lower end is supported in a bracket i^{31} and at the upper end is supported by means of an arbor i^{32} , which is here shown as made in the form of a screw fastened to the table or bench B . The eccentric-rod is pivotally connected by means of a pin i^9 to the toggle-lever i^2 . The sleeve i^8 is provided with a horizontally-extending bar i^{10} , having upon its ends downwardly-extending lugs i^{11} i^{12} . To the lug i^{11} is pivotally connected one end of a rod i^{13} , which at the other end is pivotally connected to a yoke i^{14} , that is loosely mounted upon the shaft or stud e^8 . A similar rod i^{15} is pivotally connected at one end with said yoke and at the other end with the lug i^{12} , its connection with this lug being made by extending a pin through a lug i^{16} and thence into the lug i^{12} . The lug i^{12} is elongated horizontally, so as to provide room for the passage of screws i^{17} , that are employed for securing this lug rigidly to the lug i^{16} . When the eccentric operates the toggle-levers i^2 i^3 in one direction, the sleeve i^8 will be raised, and when the toggle-levers are moved in the reverse direction said sleeve will be lowered. Upon the raising of the sleeve i^8 the lug i^{16} will be carried upwardly by means of the cross-bar i^{10} . The purpose of the rods i^{13} i^{15}

and yoke i^{14} is to secure a parallel motion for the said rod i^{10} . Rigidly connected with the lug i^{16} is a frame comprising a bar i^{18} and two bars i^{19} , extending from the ends of the latter at right angles to it. The outer ends of these bars i^{19} are connected by an independent bar i^{20} . The bars i^{18} i^{20} support studs i^{21} i^{22} , upon which gear-wheels i^{23} i^{24} are loosely mounted. These gear-wheels intermesh. Affixed to the gear-wheel i^{24} is a ratchet-wheel i^{25} , with which engages a pawl i^{26} , which is pivotally connected to a stationary post i^{27} , which is mounted upon the cross-piece or stretcher e^9 of the table or bench B . A spring i^{28} holds the pawl i^{26} in engagement with the ratchet-wheel i^{25} . When the gear-wheels and ratchet-wheel are elevated by the eccentric I^2 , no rotary motion of the gear-wheels will occur, but the pawl will play over two teeth of the ratchet-wheel and take a new position beyond the second tooth. The gear-wheels and ratchet-wheel will be carried up beyond the reach of the pawl, and the latter will then be drawn against a pin i^{29} and remain there until the descent of the gear-wheels and ratchet-wheel. Upon the descent of the gear-wheels and ratchet-wheel the pawl will impart a short rotary movement to the ratchet-wheel, and consequently to the two gear-wheels. This motion in the present instance will be a quarter-rotation.

Affixed to the gear-wheels i^{23} i^{24} are sprocket-drums i^{33} i^{34} , with which are engaged chains I^3 I^4 , comprising jacquard-cards i^{35} , whose construction is best shown in Fig. 2. The drums are square, and each surface corresponds in size with a jacquard-card. The drums of course are rotated a quarter-turn each time that the ratchet-wheel i^{25} and the gear-wheels i^{23} i^{24} are similarly rotated. As they are rectangular, they will always stop with a flat surface presented upwardly. To make sure that they shall always stop with the upper surface exactly in a horizontal position and to prevent them from accidentally turning, I combine with them a bar i^{36} , which extends across them near one side and coacts with rollers i^{37} , with which the corners of the drums are provided. This bar has connected to its ends rods i^{38} , that extend downwardly through brackets on the bars i^{19} and below these brackets are fitted with springs i^{39} , which rest at the lower ends upon cross-pins passing through said rods. Thus it will be seen that the bar i^{36} will be held downwardly by spring-pressure upon the rollers i^{37} of the drums and also upon the cards which happen to be at the top of the drum, and yet this bar may rise to permit of the rotation of the drums. Reference to Fig. 5^A will show that the top of the bar i^{36} has a horizontal extension i^{40} from one side. This extension is to cover the space between the two drums, and hence between the two uppermost jacquard-cards.

It will be seen that the uppermost jacquard-cards are beneath the needles C' . The cards are provided with holes i^{41} , and only those

needles whose lower ends can pass through such holes will be left unmoved when the cards move upward. The holes i^{41} are different in the different cards. The holes i^{41} of alternate cards are narrowed at one end, so that they will only permit the lower extremity of the opposite needle to pass through without permitting the lug c' to pass through. Thus the needles which are at the narrowed ends of these holes will be moved upward a less distance than the others. The needles thus operated will be working along one edge of the knitted fabric—as, for instance, along an edge which will subsequently form part of that seam or point of union which occurs at an angle in the heel portion of a stocking where the work turns at approximately a right angle. Each needle which is lifted, as just described, less far than the remainder will be the last-operated needle in its course of knitting or stitch-forming, and by reason of the fact that it is lifted less high than the others it will at the next succeeding operation have a second loop formed around it in contiguity with the last previous one instead of being made as an independent loop for a stitch. Thus a double loop will be formed, because the next to the last loop will not be released, by reason of the shorter upward movement of the needle. In the diagram of Fig. 12 the lines d^{24a} and d^{25a} show the paths at the commencement of each reciprocation which the needles lifted less far than the other needles will take, and the paths d^{24} and d^{24a} will meet as the stationary cam D^4 contacts with the two kinds of needles.

I will now describe the holddowns. They consist of a number of independent radially-arranged bars J , having hooks j , which extend from points intermediate of the length of the bars upwardly and toward the axis of the cam-cylinder, and lugs j' , extending downwardly from near their outer ends. The inner ends of these bars extend into a ring j^2 , which is fitted into a rabbet formed in the upper part of the cylinder A and engaged with it, so as to be stationary. In the exterior of the upper portion of the ring j^2 is a circumferential groove j^3 , into which the inner ends of the holddown-bars J extend. In the upper end of the cylinder A are a number of radial notches, through which the holddown-bars extend and by which they are held in position, so that they cannot rotate with the cam-cylinder D , but can only slide longitudinally toward and from the axial line of said cam-cylinder. The outer ends of the holddown-bars extend over the top of the cam-cylinder D and into radial notches formed in the bottom of a ring j^4 , that is arranged above the cam-cylinder, it being held in place by lugs j^5 , fastened to the upper portion of the cam-cylinder and having hooked upper ends extending into a circumferential groove j^6 , with which the exterior of said ring j^4 is provided. In the upper part of the cam-cylinder is an annular recess j^6 , into which the

lugs j' of the holddown-bars extend. Cams j^7, j^8, j^9, j^{10} are arranged within the recess j^6 , near the outer circumference thereof, and cams j^{11}, j^{12} are arranged in said recess near the inner circumference thereof. These two sets of cams cooperate with the lugs j' of the holddown-bars to shift said holddown-bars radially inward and outward. Owing to the radially-inward movement of the holddown-bars they intermittently hold the knitted fabric while the needles ascend, and they operate upon the fabric with a pushing movement.

I will now describe the thread-guide. As here shown, it consists, essentially, of an eye K , rigidly affixed to a bar k , that is hinged at k' to a block k^2 , the latter being fitted to slide vertically upon a post k^3 , fastened to the block d , that is attached to the exterior of the cam-cylinder D . The sliding block k^2 is connected, by means of pivot-pins k^4 , with the lever d^{12} . When the lever d^{12} is raised or lowered at that end or arm which is connected with the sliding block k^2 , the latter will be similarly moved, and such movement will be imparted to the thread-guide. During the operation of the thread-guide it does not have any oscillating movement upon the pivot-pin k' , because just forward of said pivot-pin it is supported upon a shoulder portion of the sliding block k^2 . The object of the pivot-pin k' is to permit the thread-guide to be drawn backward out of the way. A ring k^5 is rigidly connected to the bar k and encircles all of the needles when the latter are elevated, its purpose being to preclude the latches of the needles from being accidentally moved out of their proper position. When the bar k is swung back upon the pivot-pin k' , not only the thread-guide K , but also the ring k^5 , will be moved out of the way. The thread-guide is reciprocated vertically at the time that the cam D^2 is shifted into and out of its operative position, and hence when a change of work occurs. The advantage of this will be seen—as, for example, when the change is from straight knitting to work requiring the jacquard mechanism. The cams D' and D^2 , Fig. 12, being then in operation, the throw of the needles is thereby lessened and the point at which the needle takes the yarn is less elevated, as will be clear from said figure. It is at this time the thread-guide is lowered. Thus my thread-guide is automatically adjusted into the most advantageous position for delivering the thread to the needles while they are performing different kinds of work.

I will now describe a tension mechanism which I have illustrated. T designates the threads. They may be taken from spools in the ordinary manner. Each passes up through a guide l , made in the form of an eye in a plate L , thence through an eye l' , extending from the side of a bar l^2 , and thence around a wheel l^3 , having a V-shaped groove. From the wheel l^3 each thread passes through an

eye l^4 , arranged upon a rocking plate l^5 , which is fulcrumed by a pin or screw l^6 , having an oscillating connection with the bar l^2 . Each plate l^5 normally bears against a hub extending beyond the sides of the corresponding wheel l^3 , thus acting as a brake. Leaving the eye l^4 , each thread passes up through an eye l^7 in a rod l^8 , which is fastened to a sleeve l^9 , that is mounted upon a stud l^{10} , attached to a side of the bar l^2 , a spring l^{11} being coiled around such sleeve and connected at one end therewith and at the other end to a stationary part. The tendency of the spring is to raise the rod l^8 , and hence this rod operates with a spring tension upon the thread passing through it. From the loop l^7 each thread passes down through an eye in the plate l^5 and is delivered to the thread-guide K. Each rocking plate l^5 is at the rear end connected with one end of a spring l^{12} , which at the other end is connected with a post l^{13} , at whose upper end the bars L and l^2 are supported.

I will now describe mechanism whereby a supplemental thread may be introduced. T' designates such a thread. It passes from a spool or other suitable source through an eye t , comprised in the bar L, thence downwardly through an eye t' , provided in the forward end of a lever l^2 , thence down through an eye t^3 provided in the forward end of a bar t^4 , and from the latter through a guide t^5 , and thence to the thread-guide K. The bar t^4 is fastened rigidly to the post l^{13} . The lever l^2 is fulcrumed by a pin t^6 to the bar t^4 . Between the rear end of the lever l^2 and the bar t^4 is a spring t^7 , that is compressed every time the forward end of the lever l^2 is raised. Hence this spring has a tendency to depress the forward end of the lever l^2 . Two rods t^8 are pivotally connected at their lower ends by means of a pin t^9 with the forward portion of the lever l^2 . One of them is shown in Fig. 17. The other is in rear of it and of similar construction. Each of these rods extends through one of the plates l^5 and has a head above said plate. The lever l^2 extends over a rod t^{10} . During the time that the cam-cylinder is rotating this rod occupies the position shown in dotted outline in Fig. 17, and then it permits the lever l^2 to descend into the position in which it is in said figure represented by dotted lines. When the lever descends to this position, a protuberance t^{11} , with which its under side is provided near the forward end, drops into a socket formed coincidentally with the eye t^3 and grips the thread T' there, so that it may be broken off at the needle to which it then extends. The lowering of the rod t^{10} to the position thus described also permits the guide t^5 to drop into the position in which it is represented in dotted outline, because a prop t^{12} , extending from the rod t^{10} to a position beneath the shank of the guide t^5 , will be sufficiently lowered. Thus the thread T' after being broken will be shifted to one side, as shown in dotted outline. It will be seen that the guide t^5 is pivotally connected

with the bar t^4 by means of a pin t^{13} . While the cam-cylinder is oscillating the rod t^{10} is elevated to the position in which it is represented by full lines in Fig. 17, and the extra thread T' is allowed to pass freely through the eye t^3 of the bar t^4 . The free end of the thread will by the raising of the guide t^5 be adjusted into a position where it may engage with the main threads, so as to be carried into the thread-guide. I may here remark that both the main threads T are brought together by passing through an eye t^{14} , formed at the outer end of the bar t^4 . When the lever l^2 is lowered, its rods t^8 depress the plates l^5 , thus leaving the rollers l^3 free to rotate. These plates l^5 are automatically moved away from the wheels l^3 whenever the tension of the threads T pulls down the rods l^8 until the eyes l^7 of said rods act upon the adjacent ends of the plates l^5 . The rod t^{10} is pivotally connected at the lower end with an arm t^{14} , affixed to a rock-shaft t^{15} , at whose other end is an arm t^{16} , which at its outer extremity is forked to embrace a pin t^{17} , carried by the tappet-block f.

The operation of the thread-feeding means may be briefly described as follows: The plates l^5 normally bearing upon the hubs of wheels l^3 produce a tension upon the thread T. The rods l^8 are sprung downward as the thread is drawn through the guide K; but whenever the eye l^7 on rod l^8 is drawn down to contact with plate l^5 it tends to lower said plate, relieving, partly, the pressure upon the hub of wheel l^3 , and thus a control is afforded of the tension upon the main threads. The auxiliary thread is shown to be controlled from the tappet-block f, though it may be controlled from any other part in like manner. When through the pattern-chain G the tappet-block is elevated and the cams D' D² thereby shifted and the cam-cylinder movement changed from a rotary to an oscillating one, the rocking shaft t^{15} is actuated through the arm t^{16} and the part t^{17} upon the tappet-block, Figs. 1 and 2. This serves to elevate rod t^{10} , Fig. 17, and with it the auxiliary-thread guide t^5 , the lever l^2 , and the rods t^8 , thereby releasing the auxiliary thread at the eye t^3 , carrying the loose end thereof into proximity to the main threads at the guide K, through which the two may then pass together, and simultaneously releasing the tension-plates l^5 , apply the tension to the main threads, as above described, the parts then occupying the positions shown in full lines in Fig. 17. When the tappet-block is lowered, these movements are reversed, the parts taking the dotted-line positions, and the auxiliary thread cut off.

Obviously by employing a suitable pattern-chain I may widen or enlarge any desired portion of a stocking.

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

1. In a knitting-machine having a mechanism for operating the needles, the combination of means for rendering said mechanism inop-

erative, and an auxiliary needle-operating means, comprising a jacquard mechanism, the jacquard-cards adapted to actuate needles when the usual needle-operating mechanism is not operating, whereby such needles are caused to knit.

2. In a knitting-machine, the combination of two sets of needles, knitting-cams for operating the needles of the two sets, and a jacquard mechanism for actuating the needles of one set when the said knitting-cams are not operating.

3. In a circular-knitting machine the combination of two sets of vertical needles, knitting-cams for operating both sets, means for rendering said cams inoperative, a jacquard mechanism for elevating needles of one set, a lowering-cam, and means for retaining the needles of the one set in their elevated position until acted upon by said lowering-cam.

4. A knitting-machine having needles and means for operating them, in combination with a jacquard mechanism for actuating needles and means for operating the jacquard mechanism when the first-named needle-operating means is inoperative.

5. In a circular-knitting machine, the combination of two sets of vertical needles, rotating cams for operating both sets, means to render said cams inoperative relatively to the needles, and pattern-cards for actuating needles of one set to effect widening or narrowing.

6. In a circular-knitting machine the combination of two sets of needles of different lengths, a mechanism for operating both sets, a device for rendering said mechanism inoperative, and a jacquard mechanism for actuating the set of longer needles while the other set is not operating.

7. In a circular-knitting machine the combination of a long set of needles and a short set, rotating cams for operating both sets, a device for rendering the cams inoperative, means for controlling said device, and a jacquard mechanism, also controlled by the said means, and adapted to contact directly with the longer set of needles to operate such needles while the other set is inoperative.

8. In a circular-knitting machine, the combination of two sets of needles, a cam adjustable into and out of position for operating needles, and a jacquard mechanism for actuating needles of one set, the said jacquard mechanism thrown into and out of operation alternately with the said cam.

9. In a circular-knitting machine the combination of a needle-cylinder, two sets of needles arranged in said cylinder, one set having tails projecting beyond the needle-cylinder, cams for operating said needles adapted to be moved into and out of operative position relatively to the needles, means for effecting the said movements of said cams, jacquard-cards adapted to engage the projecting tails of needles of the one set to actuate such needles, and a jacquard mechanism for operating said cards.

10. In a circular-knitting machine, the combination of a needle-cylinder, two sets of needles fitted to said cylinder, one set being of greater length so that the tails thereof may project beyond the needle-cylinder, suitable cam mechanism having cams for operating the needles of both sets, means for actuating said mechanism, means for moving a cam or cams into operative or inoperative positions, so that the needles of neither set may be operated by such cams, and a jacquard mechanism for engaging directly the projecting tails of a part or all of said long needles to operate such needles, the said jacquard mechanism being thrown into operation automatically, when the said needle-operating cams are moved into inoperative positions.

11. In a circular-knitting machine the combination of two sets of needles one set being of extra length, a cam mechanism for each set comprising needle-operating cams, a means for moving both mechanisms into inoperative or operative positions, a jacquard mechanism for elevating needles of the longer set when said cam mechanisms are in inoperative positions, and cams for cooperating with said jacquard mechanism by lowering such needles.

12. In a circular-knitting machine the combination of a needle-cylinder, two sets of vertical needles arranged therein, one set having tails projecting beyond the needle-cylinder, a cam-cylinder, cams carried by the cam-cylinder for operating said needles, means for moving cams into and out of operative positions relatively to said needles, whereby neither set may be operated by such cams, a jacquard mechanism for engaging the projecting tails of the one set of needles to actuate such needles, cams carried by the cam-cylinder for cooperating with said jacquard mechanism, means for rotating said cam-cylinder, means for oscillating the cam-cylinder, said rotating means being in operation when the first-named cams are in operative positions, and said oscillating means and the jacquard mechanism being in operation when the said cams are in inoperative positions.

13. In a circular-knitting machine the combination of a needle-cylinder, two sets of vertical needles fitted thereto, a cam-cylinder fitted to rotate or oscillate concentrically with the needle-cylinder cams carried by said cam-cylinder and fitted to be moved into and out of operative positions relatively to the needles, means for rotating the cam-cylinder, means for oscillating it, a step-by-step pattern device for controlling said cam-cylinder rotating and oscillating means, so that either thereof may be caused to actuate the cam-cylinder, means controlled by said pattern device adapted to move said cams into operative positions when the cam-cylinder is being rotated, and into inoperative positions when the cam-cylinder is being oscillated, and means other than said cams including pattern-cards for actuating needles of one set

when the cam-cylinder is being oscillated for effecting widening in the knitted fabric.

14. In a circular-knitting machine the combination of a needle-cylinder provided with means for oscillating it and means for rotating it, a part fitted to move toward and from the cylinder, means operated by the moving of said part for shifting the power from the cam-cylinder-oscillating means to the cam-cylinder-rotating means and vice versa, the said part adapted to be moved to and from the cam-cylinder through engagement with a projection upon the cylinder, in connection with a spring, a pattern-chain for controlling the engagement of the said part and said projection, whereby the pattern of said chain controls the rotation or oscillation of the cam-cylinder, and mechanism controlled by the said pattern-chain for rendering one set of needles inoperative when the cam-cylinder-oscillating means is operating.

15. In a circular-knitting machine the combination of a needle-cylinder provided with means for oscillating it and means for rotating it, a part fitted to move toward and from the cylinder, means operated by the moving of said part for shifting the power from the cam-cylinder-oscillating means to the cam-cylinder-rotating means and vice versa, the said part adapted to be moved to and from the cam-cylinder through engagement with a projection upon the cylinder, in connection with a spring, a pattern-chain for controlling the engagement of the said part and said projection, whereby the pattern of said chain controls the rotation or oscillation of the cam-cylinder, mechanism controlled by the said pattern-chain for rendering one set of needles inoperative when the cam-cylinder-oscillating means is operating, and jacquard mechanism for effecting knitting operations of the remaining needles when the one set is thrown out of operation.

16. In a circular-knitting machine the combination of two sets of needles, a jacquard mechanism for engaging one set, means for driving the jacquard mechanism, a reciprocating part, as f , for controlling said driving means, pin f' and a pattern-chain operating pin f'' to control said reciprocating part, substantially as specified.

17. In a circular-knitting machine, the combination of a needle-cylinder, two sets of vertical needles fitted thereto, the needles of one set having tails which project beyond the said cylinder, a cam-cylinder adapted at some times to be rotated about said needle-cylinder, and at other times oscillated about it, movable cams carried by said cam-cylinder for operating needles, a mechanism for rotating the cam-cylinder, mechanism for oscillating it, a source of power for actuating said mechanisms, a device for shifting the power from one to the other of said mechanisms, a pattern-chain for controlling said device, means controlled by said pattern-chain for shifting cams carried by the cam-cylinder into

an operative position when the cylinder is being rotated, and to an inoperative position when the cylinder is being oscillated, a jacquard mechanism operated from the said cam-cylinder-oscillating mechanism and adapted to contact with the tails of needles projecting beyond said needle-cylinder to elevate such needles to knit, and cams for lowering the needles that are elevated by the jacquard mechanism.

18. In a circular-knitting machine, the combination of two sets of needles, rotating cams for operating the two sets of needles, means for moving said cams so as to render both sets of needles inoperative, a movable tappet-block carrying a tappet for operating the cam-actuating means, a jacquard mechanism operating directly on the shanks of one set of needles, and driving mechanism for the jacquard mechanism, said driving mechanism being controlled by the movement of the tappet-block, substantially as specified.

19. In a circular-knitting machine the combination of two sets of needles, cams for operating the two sets of needles, and means for rotating or oscillating the cams, means for moving said cams so as to render both sets of needles inoperative, a tappet-block supported so as to be movable, and adapted to engage said last-named means, a jacquard mechanism contacting directly with the tails of one set of needles, driving mechanism for the jacquard mechanism, said driving mechanism being controlled by the movement of the tappet-block, and a device adapted to move with the cams and serving to impart movement to said tappet-block.

20. In a circular-knitting machine, the combination of a needle-cylinder having vertical needles arranged therein, a cam-cylinder having cams for operating said needles and adapted at some times to be rotated about said needle-cylinder, and at other times to be oscillated about it, means for rotating said cam-cylinder, means for oscillating it, a suitable power for actuating both the said means, a slide for shifting the power from one means to the other, a projection carried by the cam-cylinder for actuating said slide, a corresponding part carried by the slide adapted to be moved by said projection when the former is in the path of revolution of the latter, a device for effecting a relative change of position between the said projection and the said part, means for actuating said device to cause the engagement of the said parts at suitable intervals in the knitting operation, means for retaining the slide when it is moved by said projection, means for releasing the slide at suitable intervals in the knitting operation, and means for moving back the said slide, substantially as specified.

21. In a circular-knitting machine the combination of a needle-cylinder having vertical needles arranged therein, a cam-cylinder rotatably mounted without the needle-cylinder, a needle-operating cam carried by the cam-cyl-

inder, the said cam fitted to shift into and out of operative position, a ring surrounding the cam-cylinder, and provided with oppositely-arranged pivots, constructed to be rotated with the cam-cylinder, means intermediate the said ring and said cam whereby the ring may effect the shifting of said cam, and a part for actuating said ring at suitable times in the knitting operation.

22. In a circular-knitting machine the combination of a needle-cylinder, needles carried by said cylinder, a jacquard mechanism having means for operating it for raising said needles, a cam adapted to be oscillated about said needles for lowering said needles, the said cam being adjustable, and means for varying the position of said cam, whereby the length of stitch may be varied to any desired length between the shortest and longest extremes, substantially as described.

23. In a circular-knitting machine the combination of needle-operating cams movable in the direction of the length of the needles, a cam D^8 for shifting the needle-operating cams, a lever d^{34} for operating said cam D^8 , a cam projection d^{41} upon a rod, adapted to engage said lever d^{34} , to vary the position of the needle-cam, a second projection upon said rod, means adapted to be engaged by said second projection for returning the lever d^{34} to an initial position, and a pattern-chain for varying the position of said projections relatively to said lever d^{34} , substantially as specified.

24. In a circular-knitting machine, the combination of two sets of needles, means for throwing one of them out of operation, a yarn-guide adapted to be vertically adjusted for operation with the other set of needles, and means for adjusting said yarn-guide simultaneously with the throwing out of one set of needles, substantially as specified.

25. In a knitting-machine a set of needles operated normally from knitting-cams, said cams, a jacquard mechanism for operating needles when the said cams are not operating, means for changing the needle-operating means, and a yarn-guide automatically adjusted relatively to the needles, when the needle-operating means is changed, substantially as specified.

26. In a circular-knitting machine the combination of two sets of needles, means for rendering one set inoperative, a jacquard mechanism for cooperating with the other set, and a yarn-guide adjusted when the jacquard mechanism is adjusted simultane-

ously with throwing out the first-named set of needles.

27. In a knitting-machine the combination of needles having lugs near their lower ends, jacquard-cards for coacting with the needles and having openings which at the end are notched or narrowed to prevent the loop from being thrown off the latch of the needles, at certain times, and means for operating the jacquard-cards, substantially as specified.

28. The combination with knitting-needles, of a jacquard-card adapted to coact with needles, and having openings which are notched or narrowed at certain places, whereby the corresponding needles may pass through such narrowed places only as far as the shoulder of the needles, so that the loops may be prevented from passing off the latches of such needles, substantially as specified.

29. In a knitting-machine, the combination with a series of knitting-needles, of needle-operating means comprising jacquard mechanism, and a means included in said jacquard mechanism for causing two loops to be formed on a suitable needle, said means adapted to partly actuate said needle, whereby the loop thereon may not pass off the latch of such needle, so that such loop and the next succeeding loop will simultaneously occupy said needle.

30. In a knitting-machine, the combination of knitting-needles arranged in series, a jacquard or pattern mechanism to operate a set of needles variable in number and having pattern-cards adapted to effect the operation of the first or last needle of the variable set in such manner that such needle may receive a thread without casting off the previously-formed loop and in the succeeding operation cast off the two loops together.

31. In a knitting-machine, the combination of knitting-needles, jacquard-cards, jacquard mechanism, the needles adapted to coact with said jacquard-cards, portions of a jacquard-card being open, the corresponding needles remaining idle, other portions adapted to actuate needles, and a portion adapted to partly actuate a needle, whereby a double loop may be formed on such needle.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES J. APPLETON.

Witnesses:

HERMANN A. KLEMM,
ANTHONY GREF.