

(No Model.)

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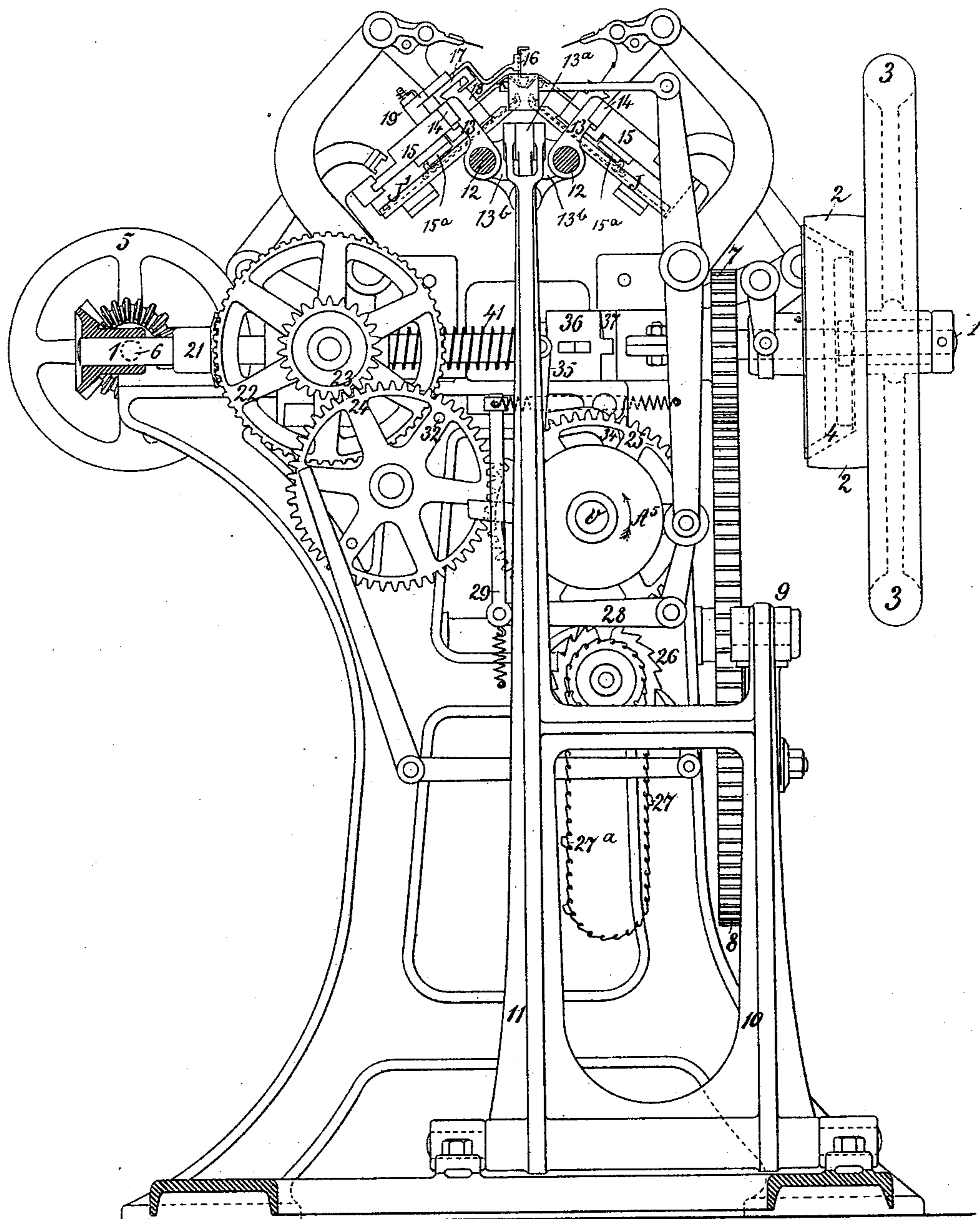
A. BEYER.

STRAIGHT KNITTING MACHINE.

No. 391,011.

Patented Oct. 16, 1888.

Fig. 1.



Witnesses:

Norman L. ...
Arthur L. ...

Inventor:

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R. F. ...
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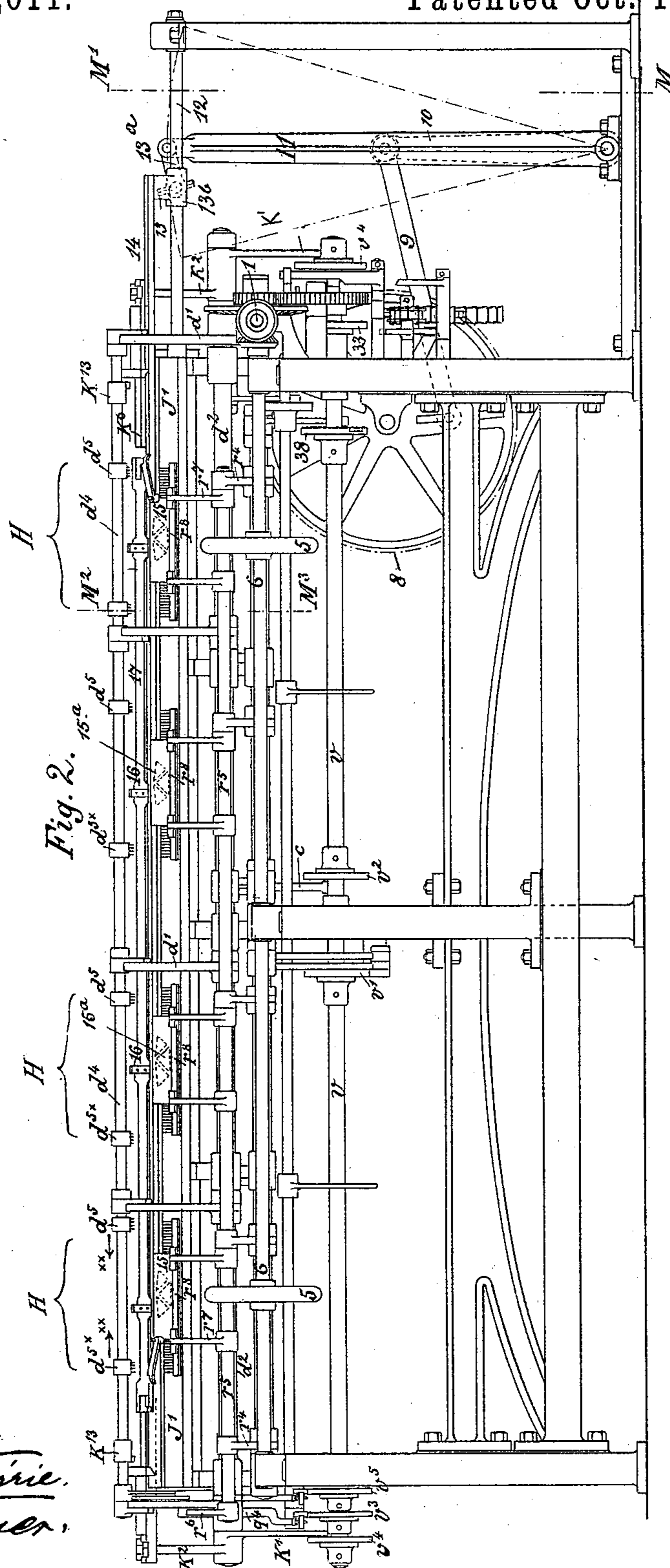
(No Model.)

10 Sheets—Sheet 2.

A. BEYER.
STRAIGHT KNITTING MACHINE.

No. 391,011.

Patented Oct. 16, 1888.



Witnesses:
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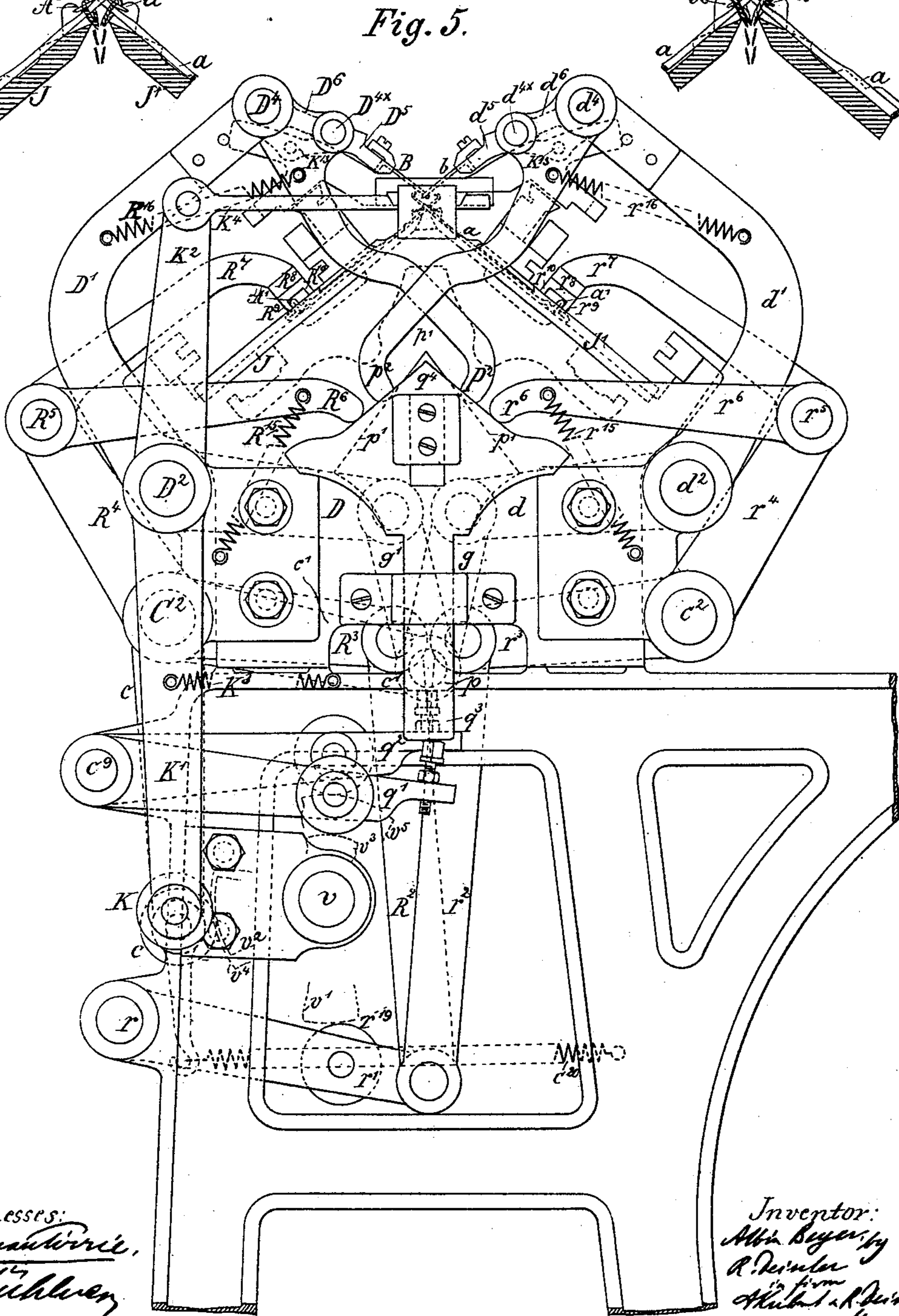
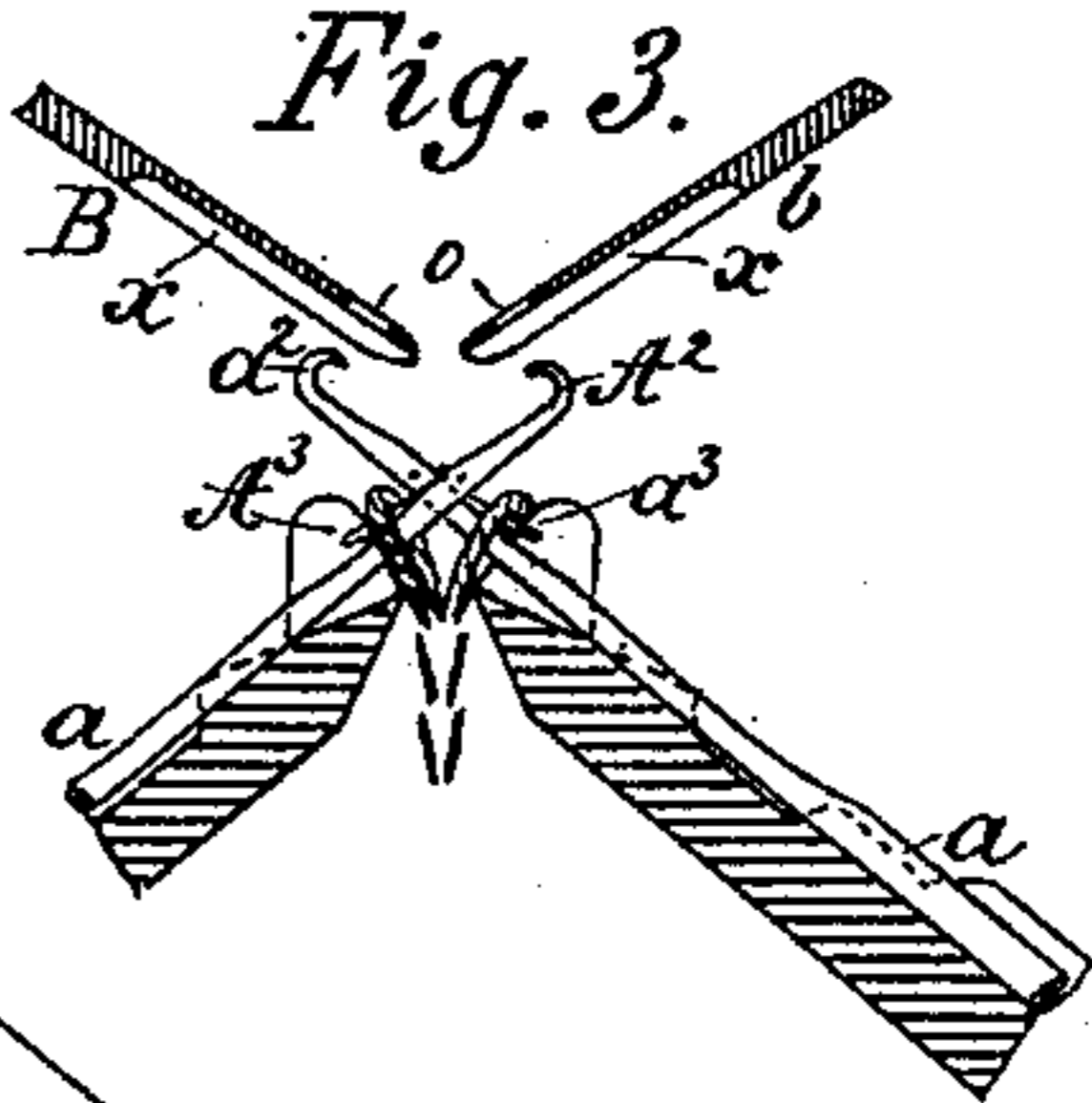
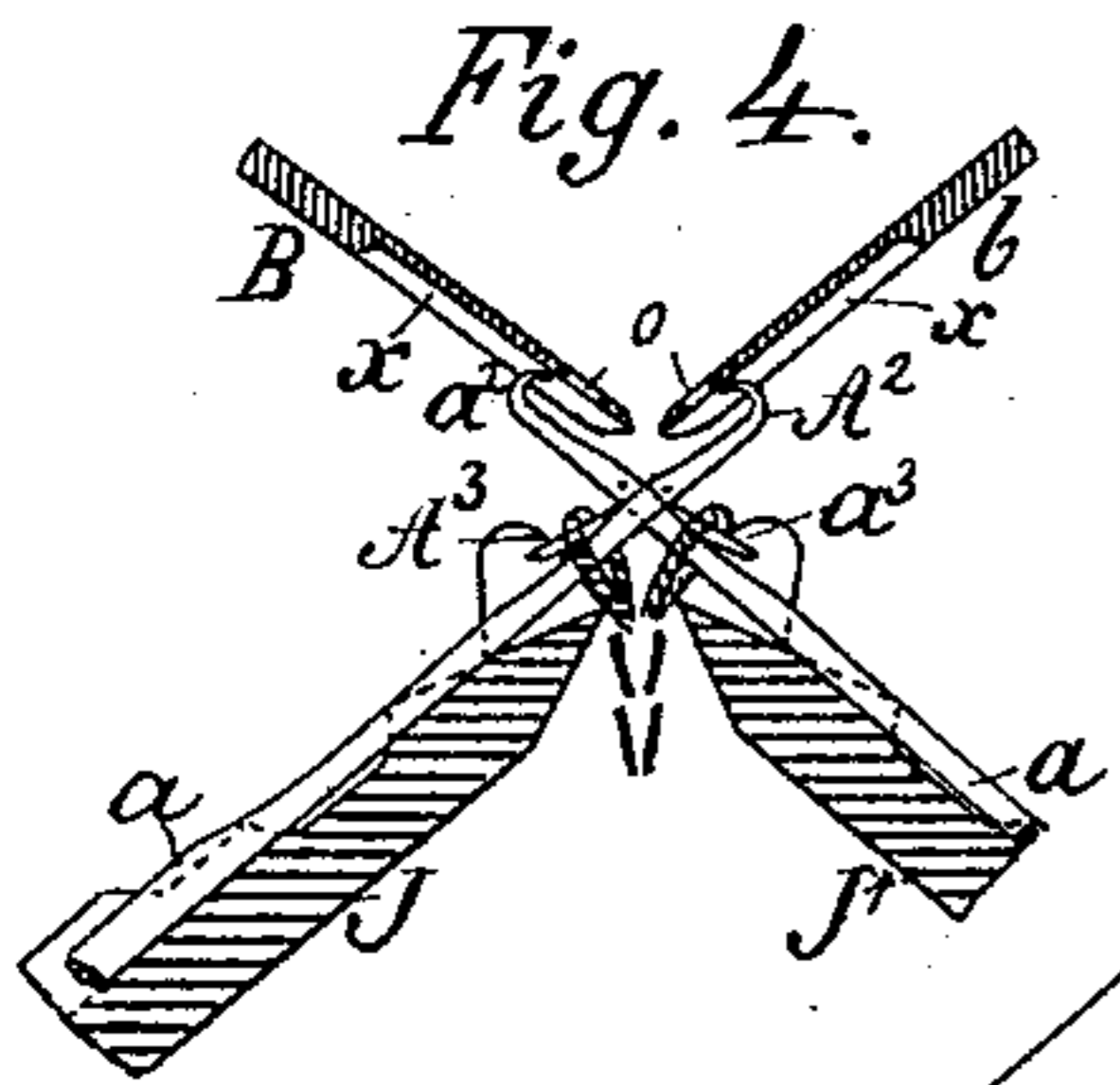
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10 Sheets—Sheet 3.

A. BEYER.
STRAIGHT KNITTING MACHINE.

No. 391,011.

Patented Oct. 16, 1888.



Witnesses:
Monmouthville,
 J. Kuhlman

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(No Model.)

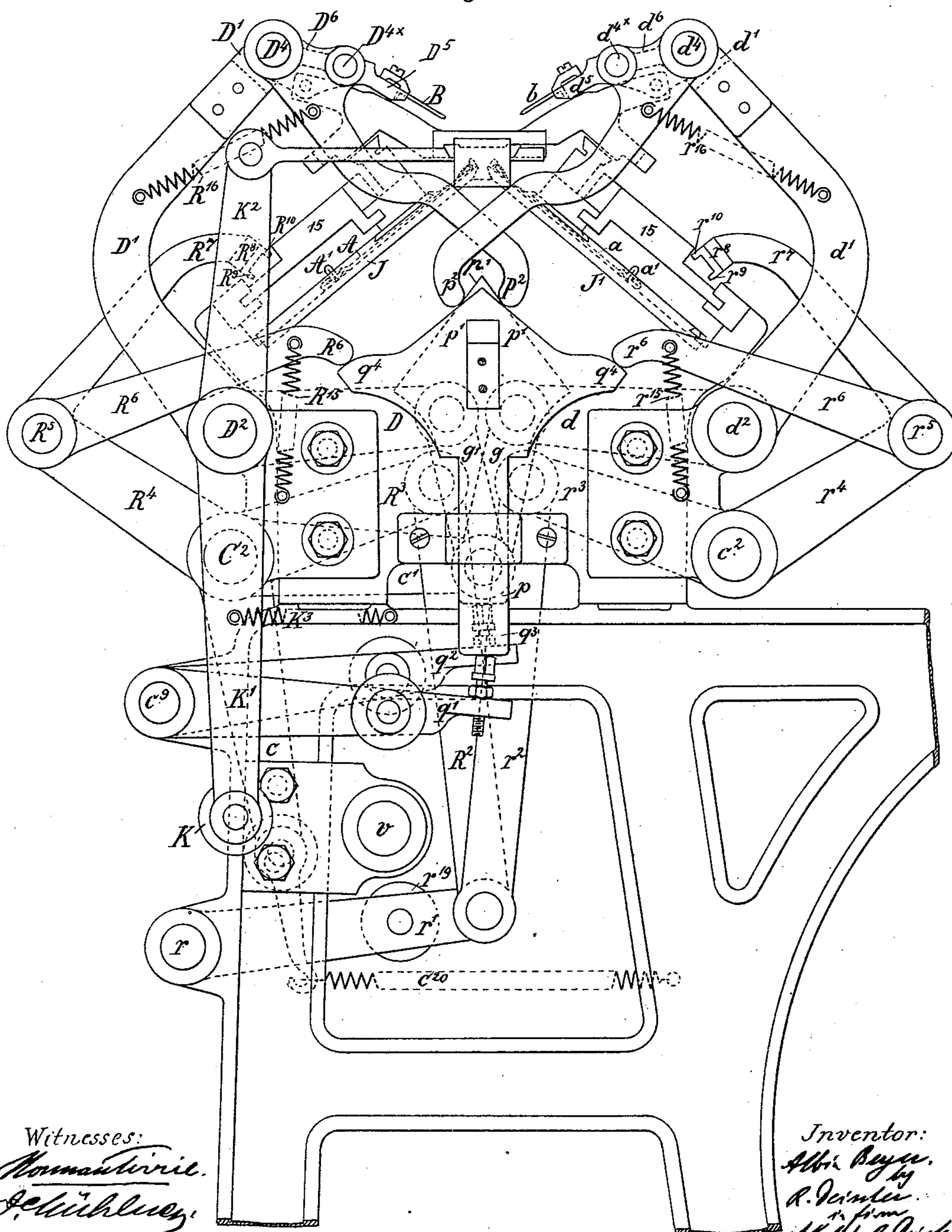
10 Sheets—Sheet 4.

A. BEYER.
STRAIGHT KNITTING MACHINE.

No. 391,011.

Patented Oct. 16, 1888.

Fig. 6.



Witnesses:
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A. BEYER.
STRAIGHT KNITTING MACHINE.

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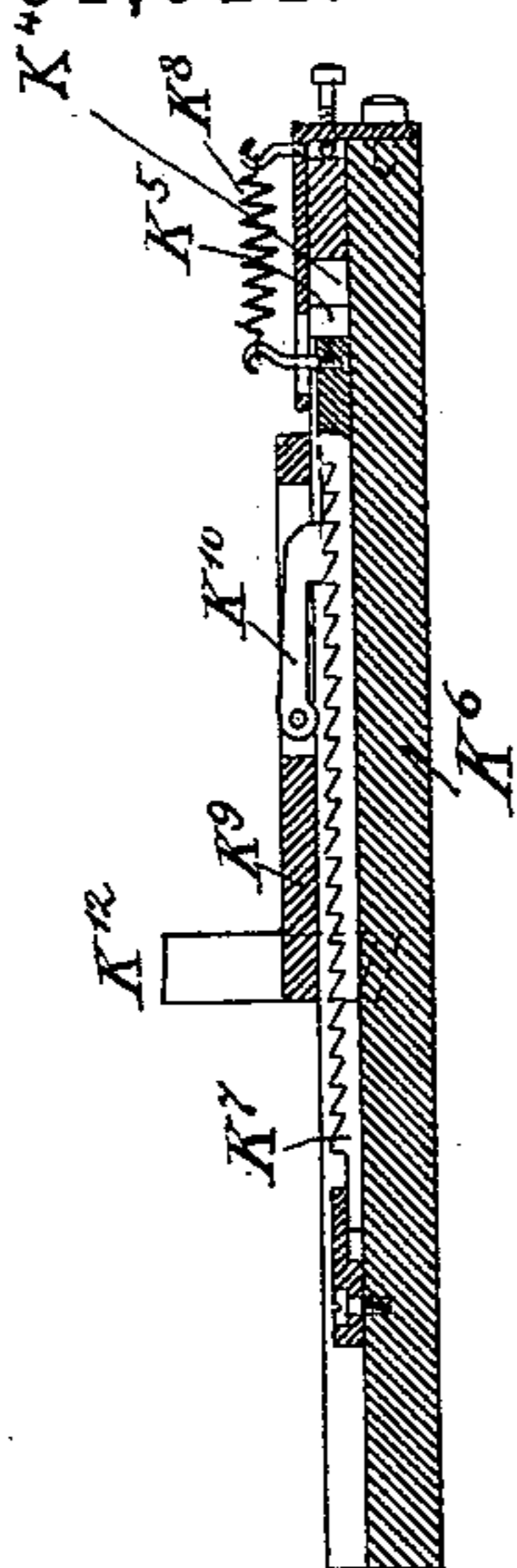


Fig. 9.

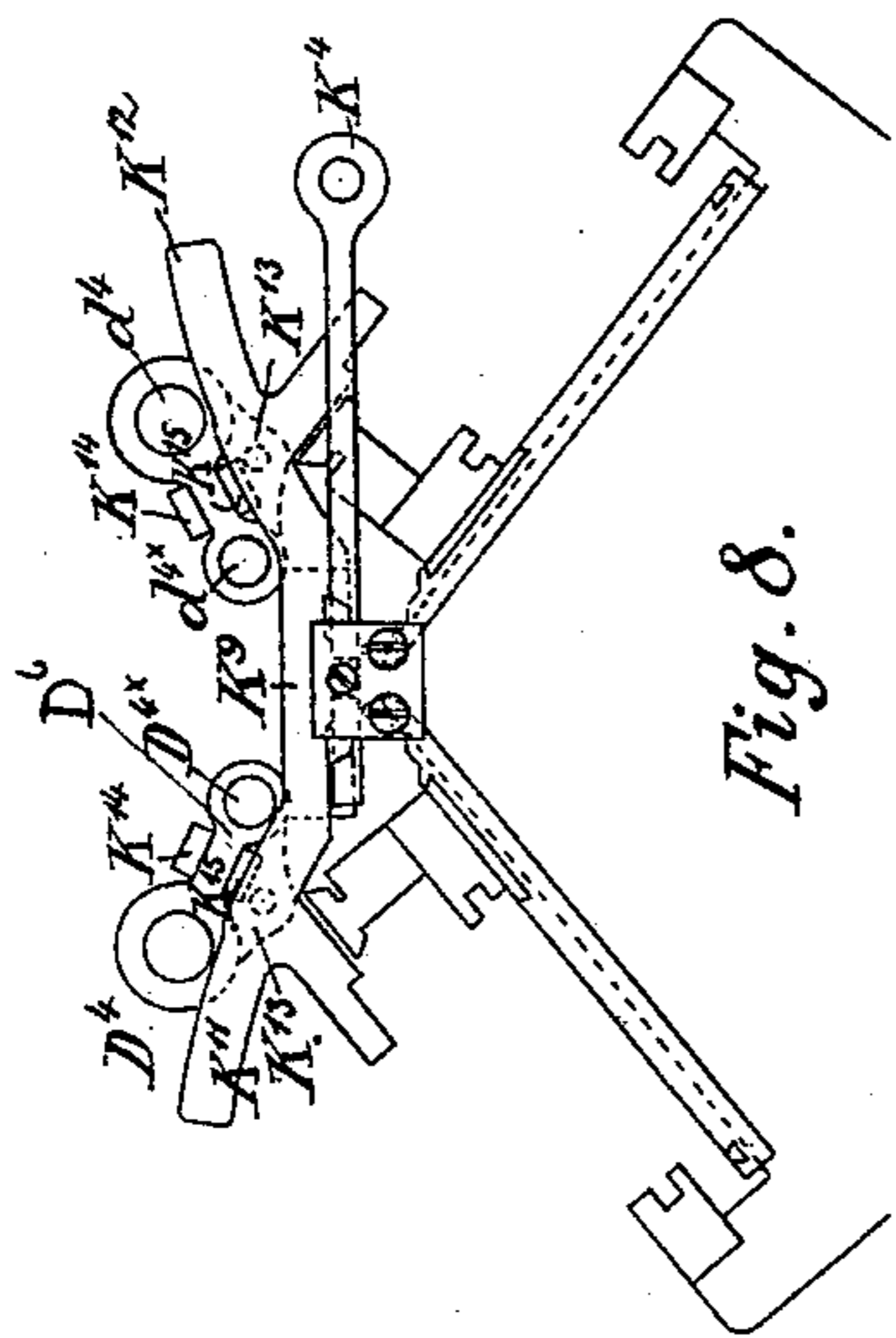


Fig. 8.

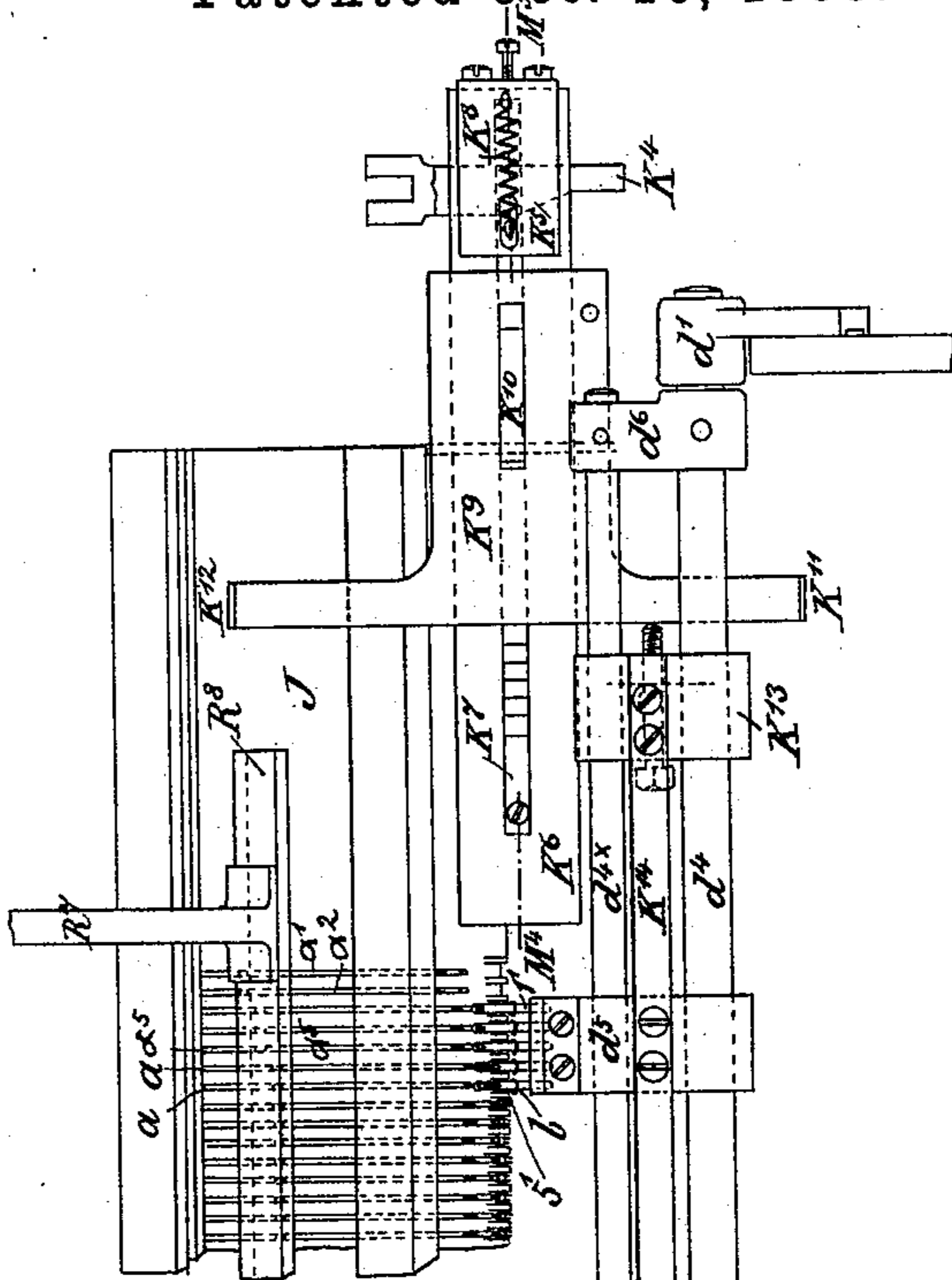
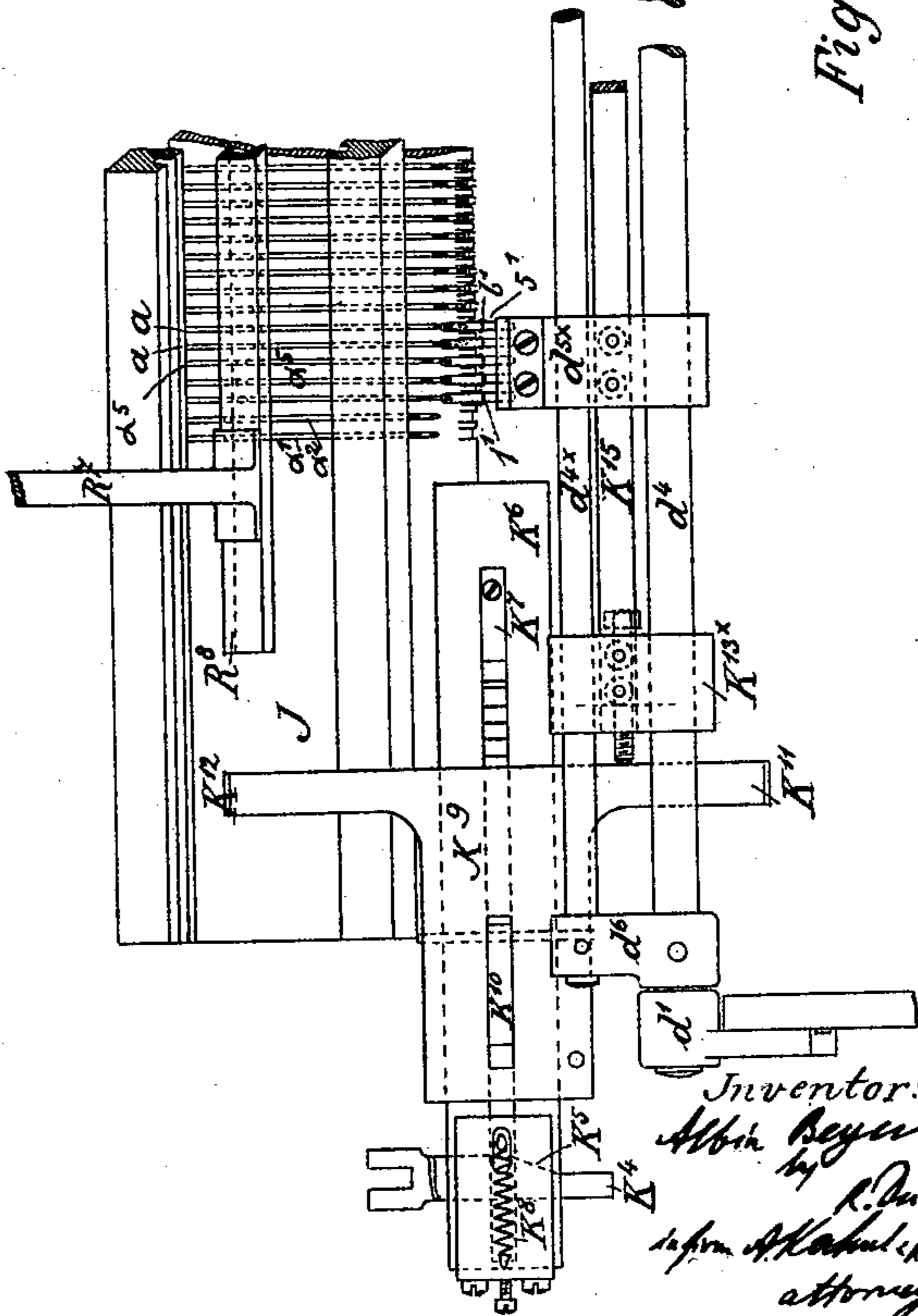


Fig. 7.



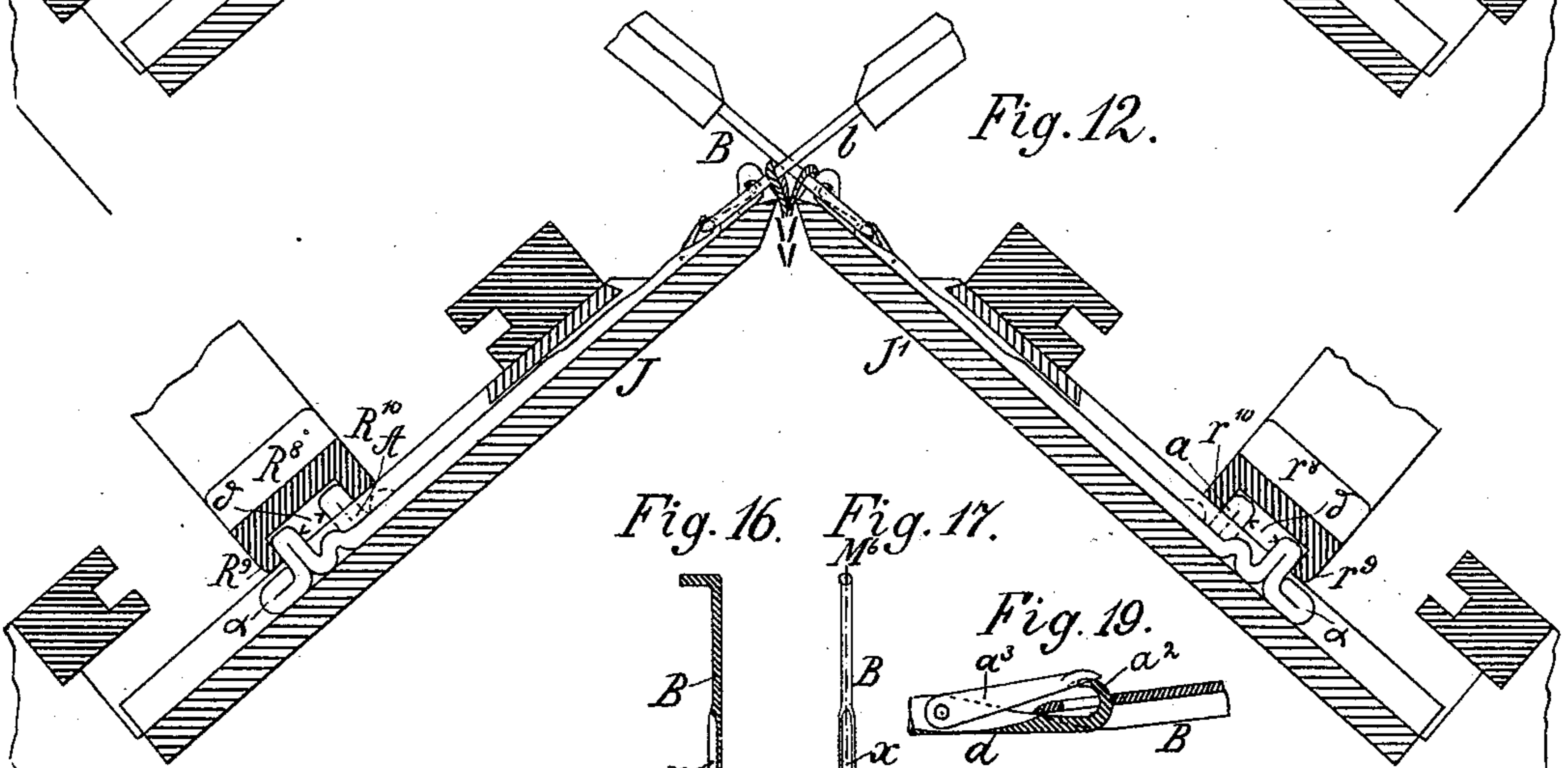
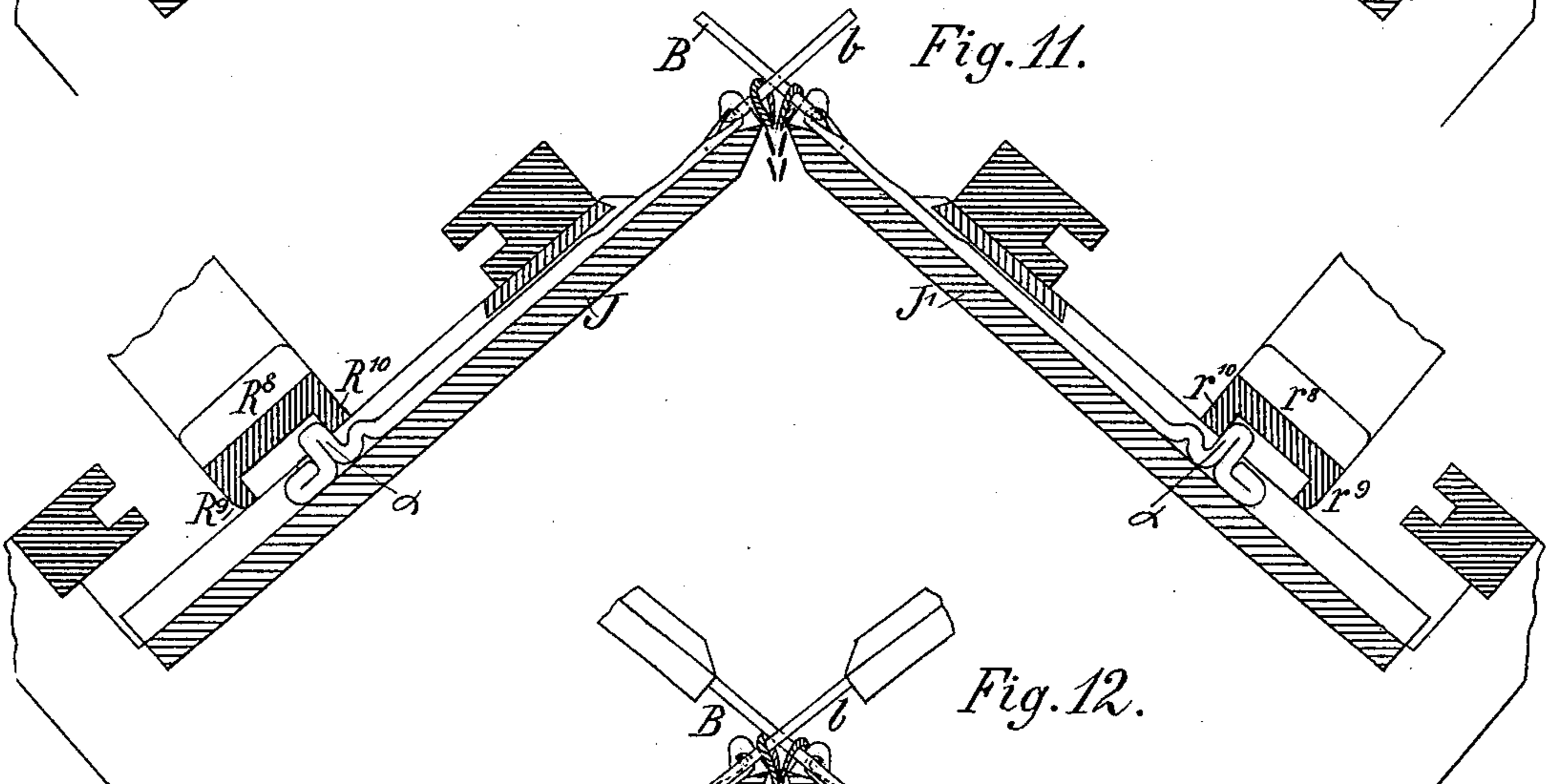
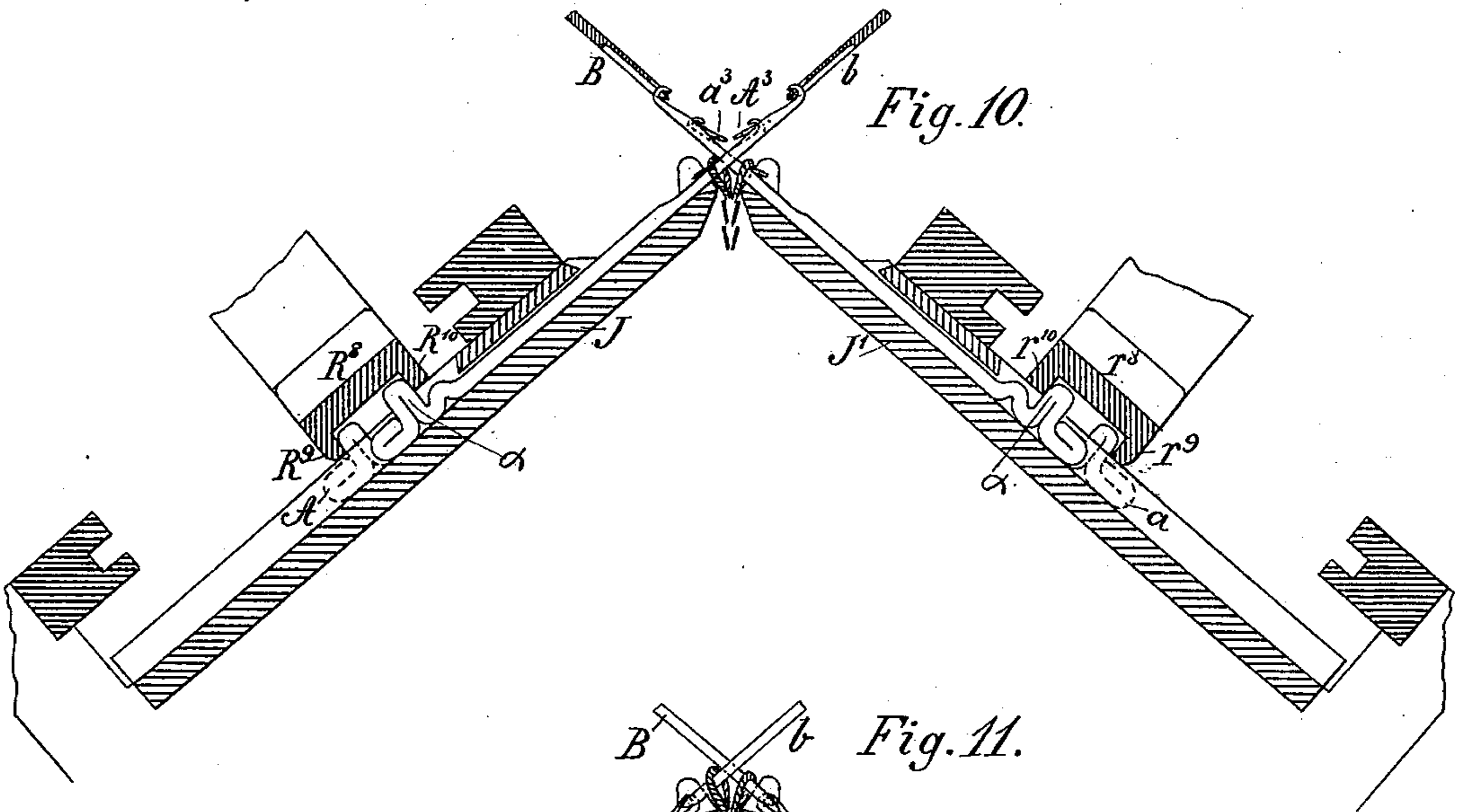
Witnesses:
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STRAIGHT KNITTING MACHINE.

No. 391,011.

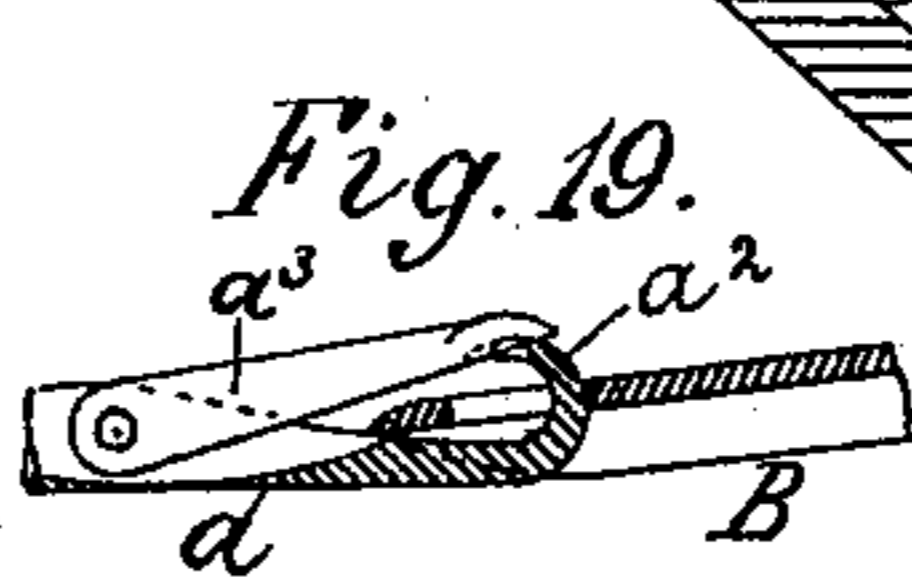
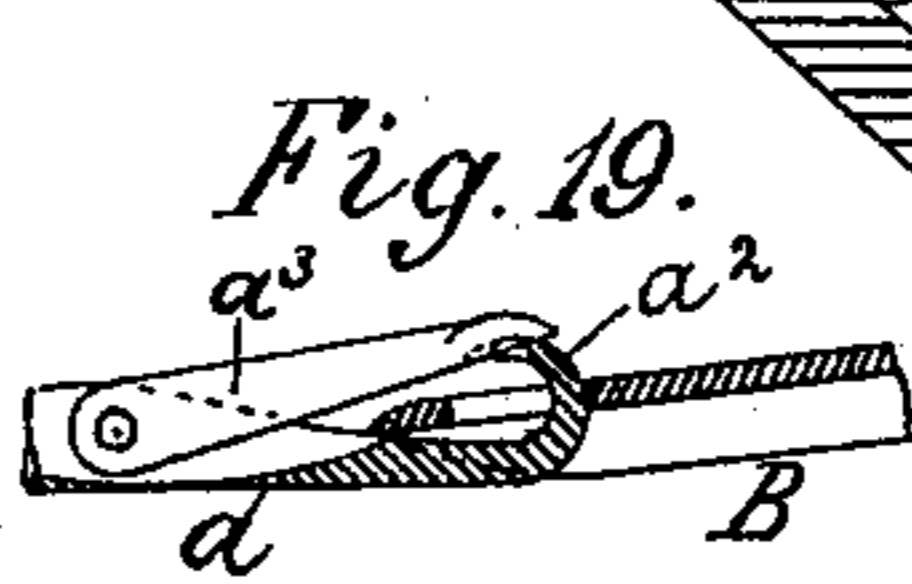
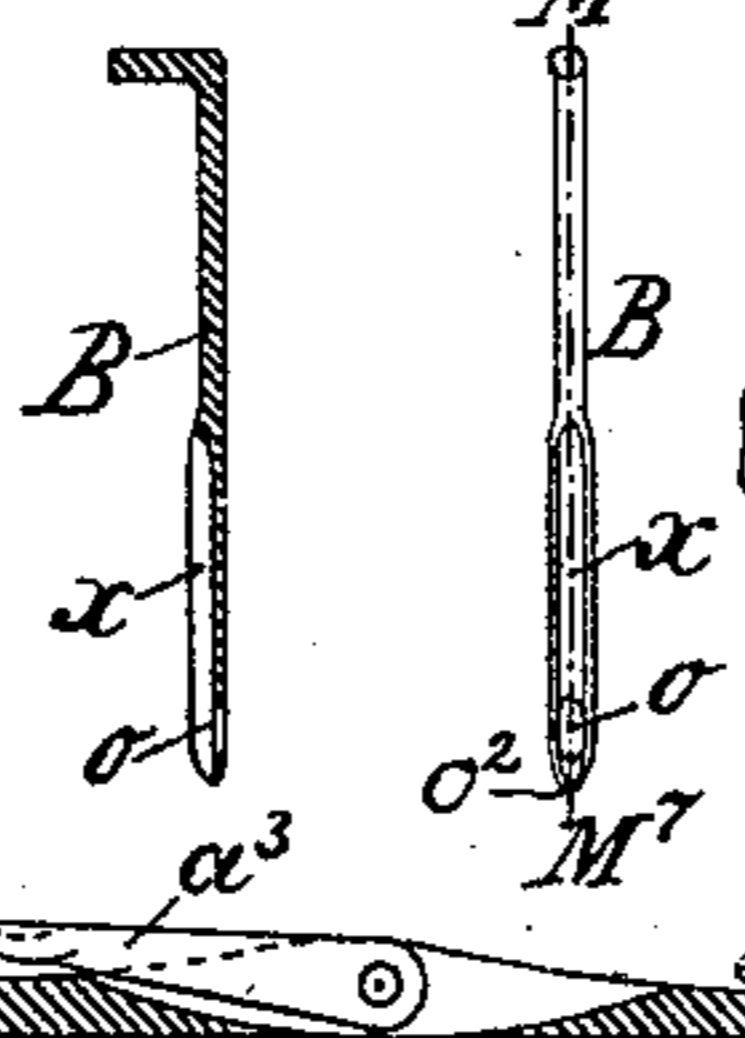
Patented Oct. 16, 1888.



Witnesses:
Thomas Pirie
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Fig. 18.

Fig. 16. Fig. 17.



Inventor:

Alb. Beyer

Attorney

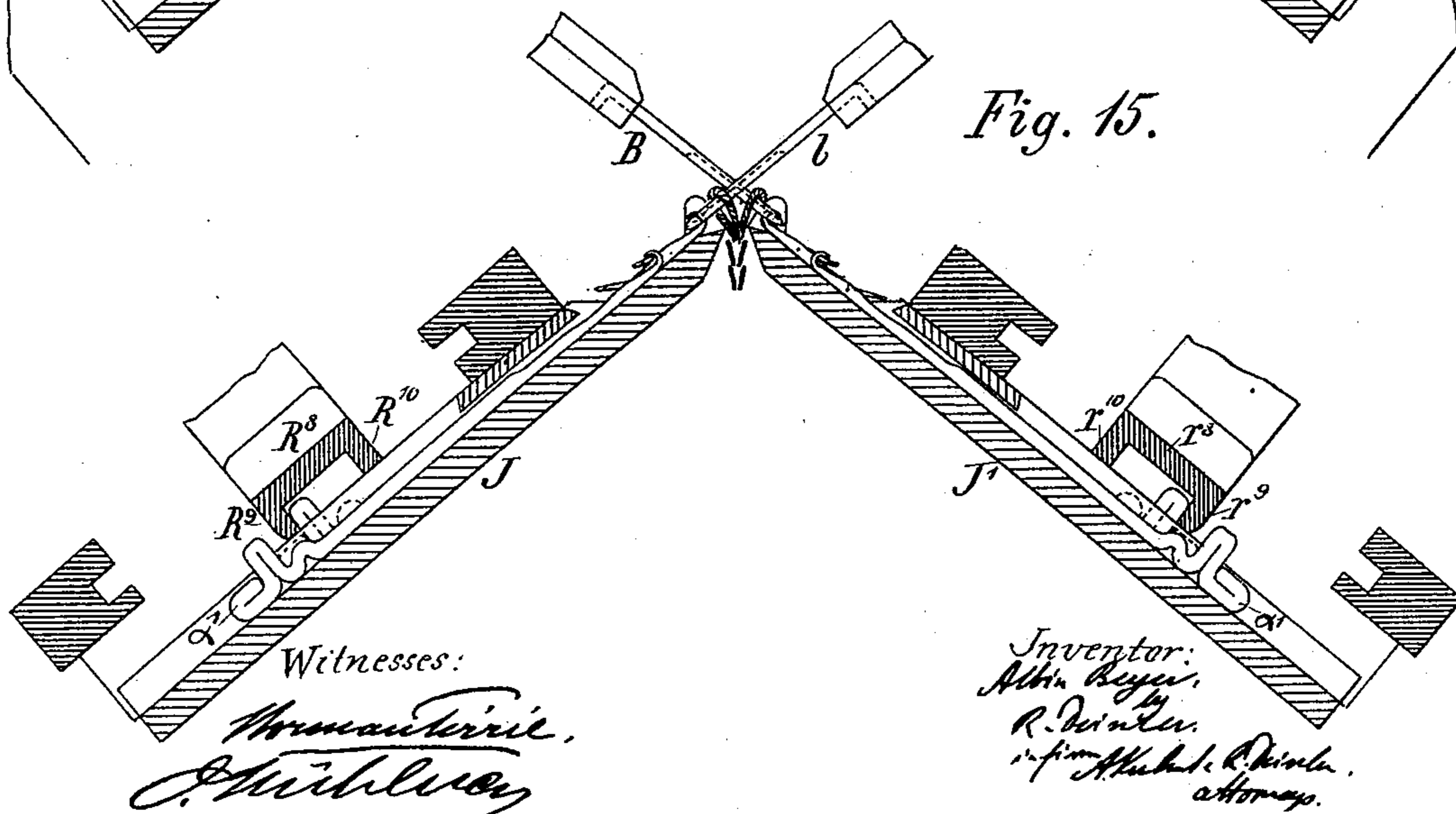
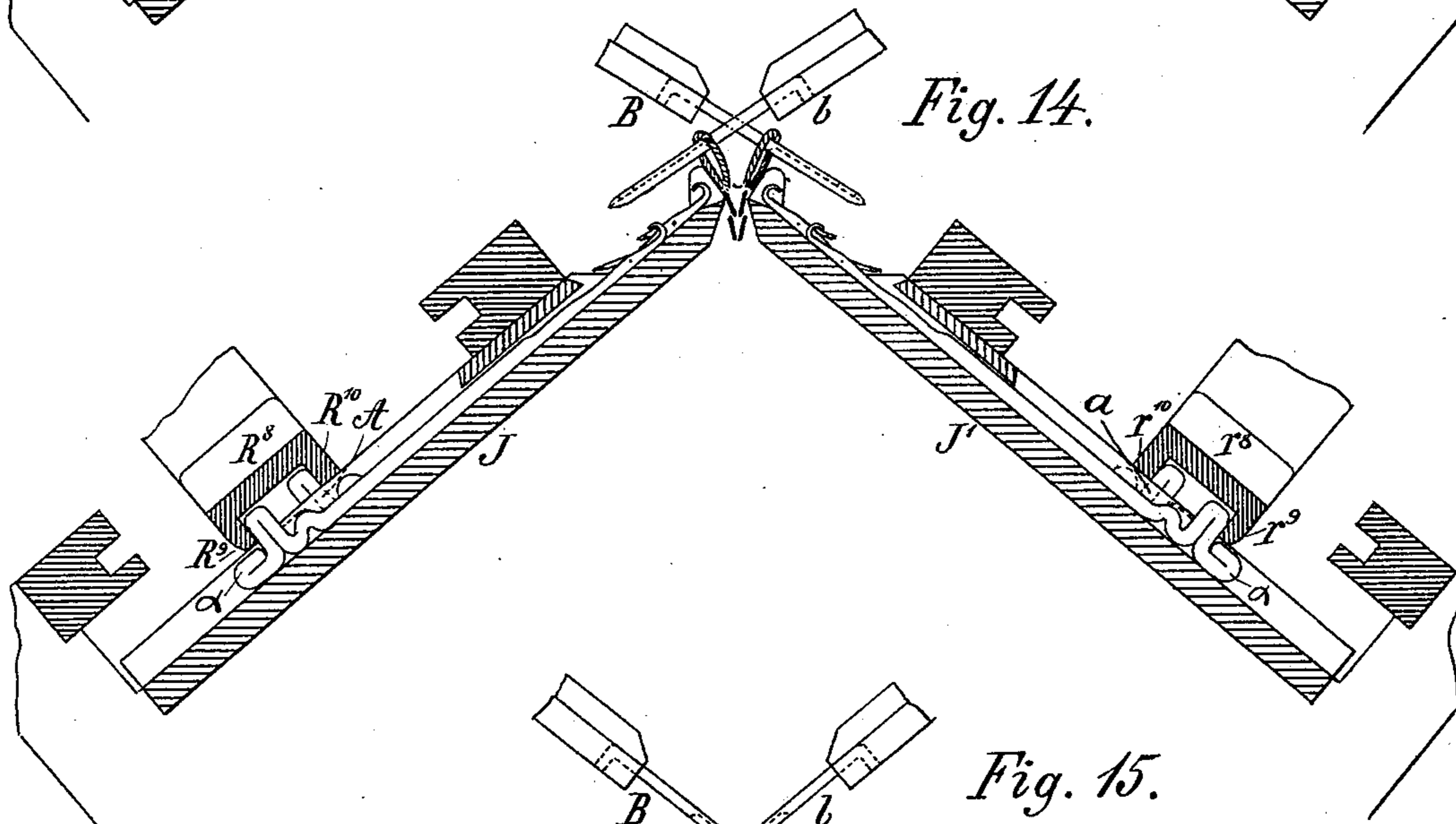
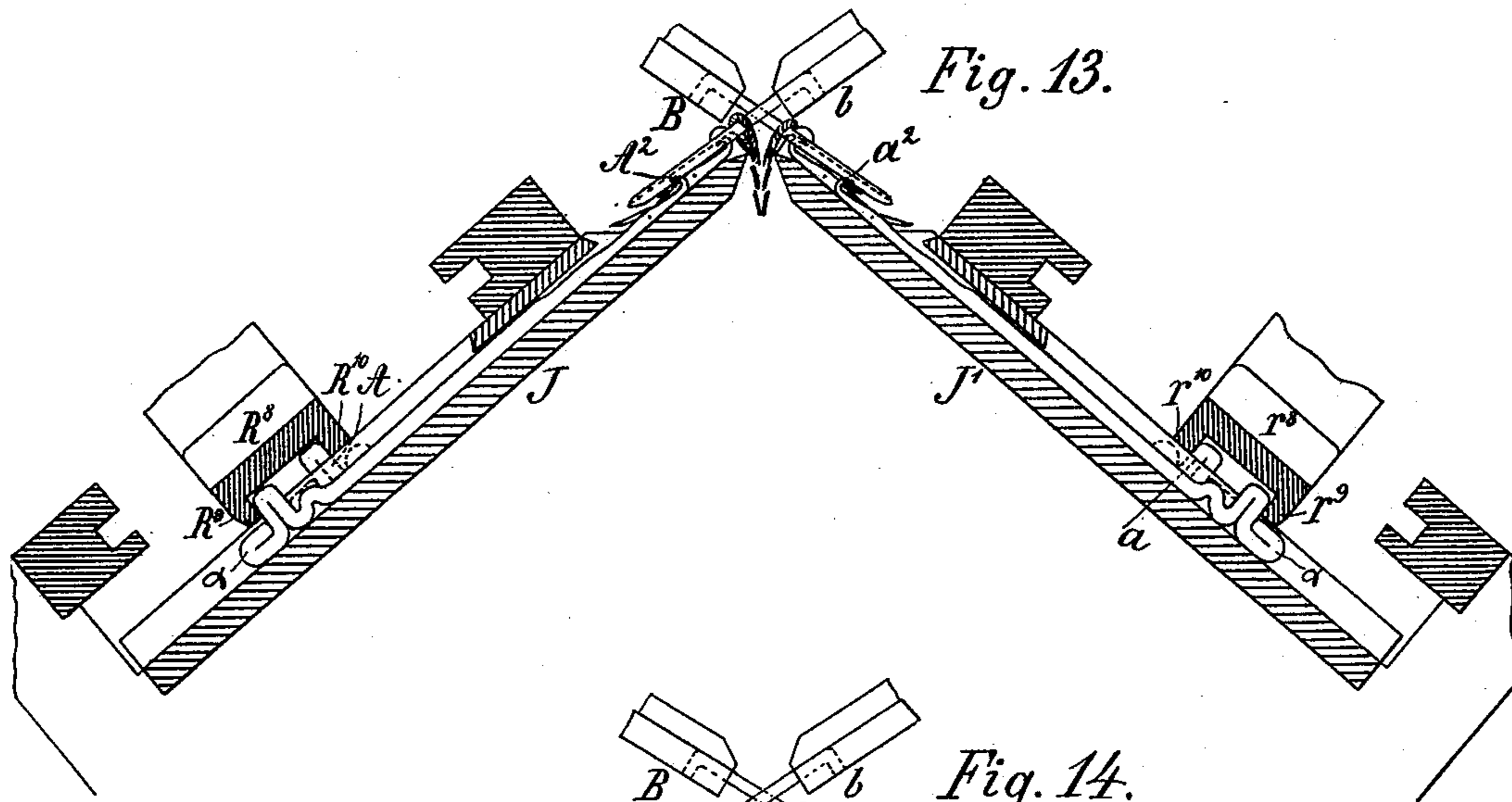
Wm. H. R. R.

Attorney

A. BEYER.
STRAIGHT KNITTING MACHINE.

No. 391,011.

Patented Oct. 16, 1888.



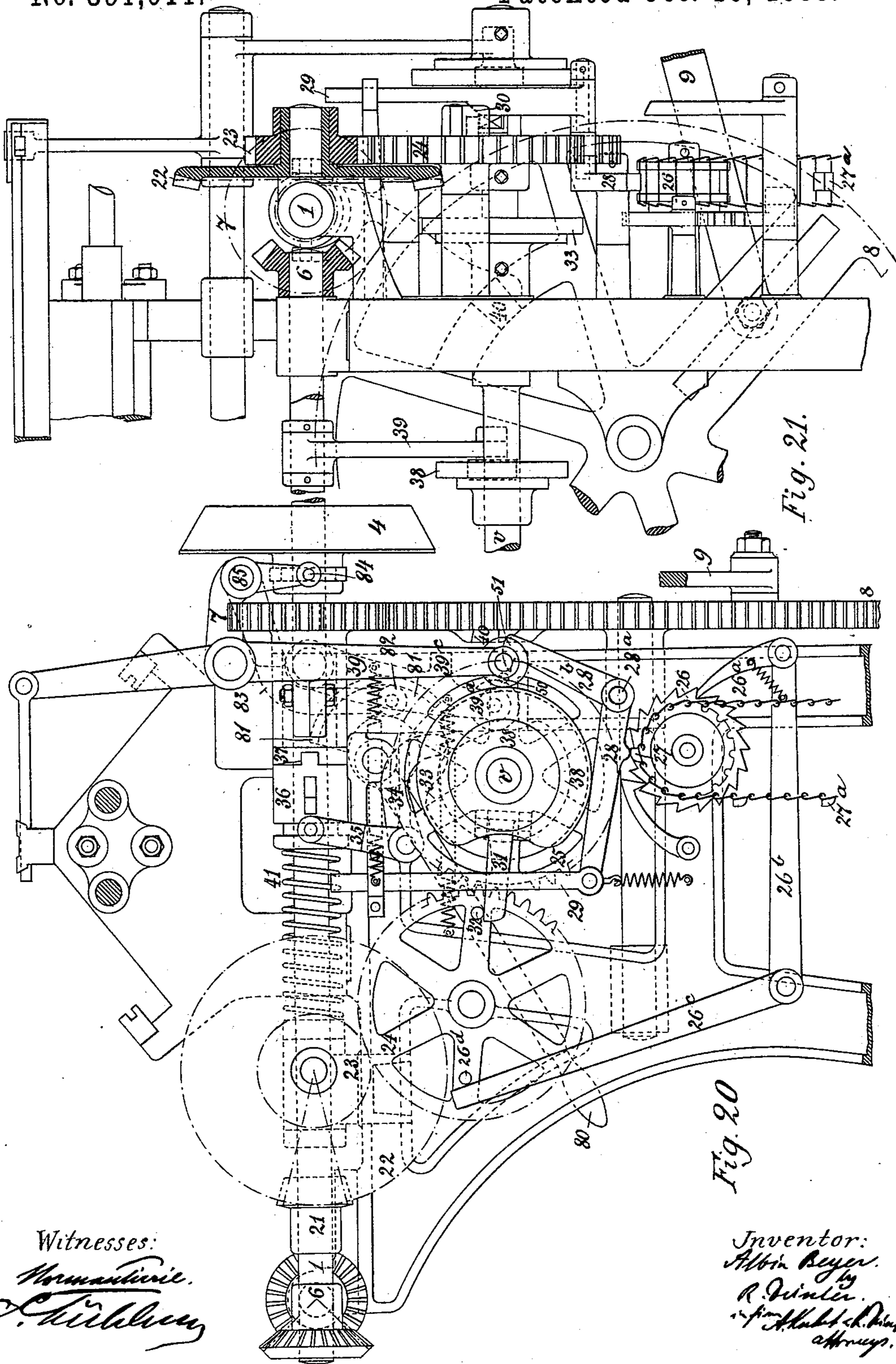
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10 Sheets—Sheet 8.

A. BEYER.
STRAIGHT KNITTING MACHINE.

No. 391,011.

Patented Oct. 16, 1888.



(No Model.)

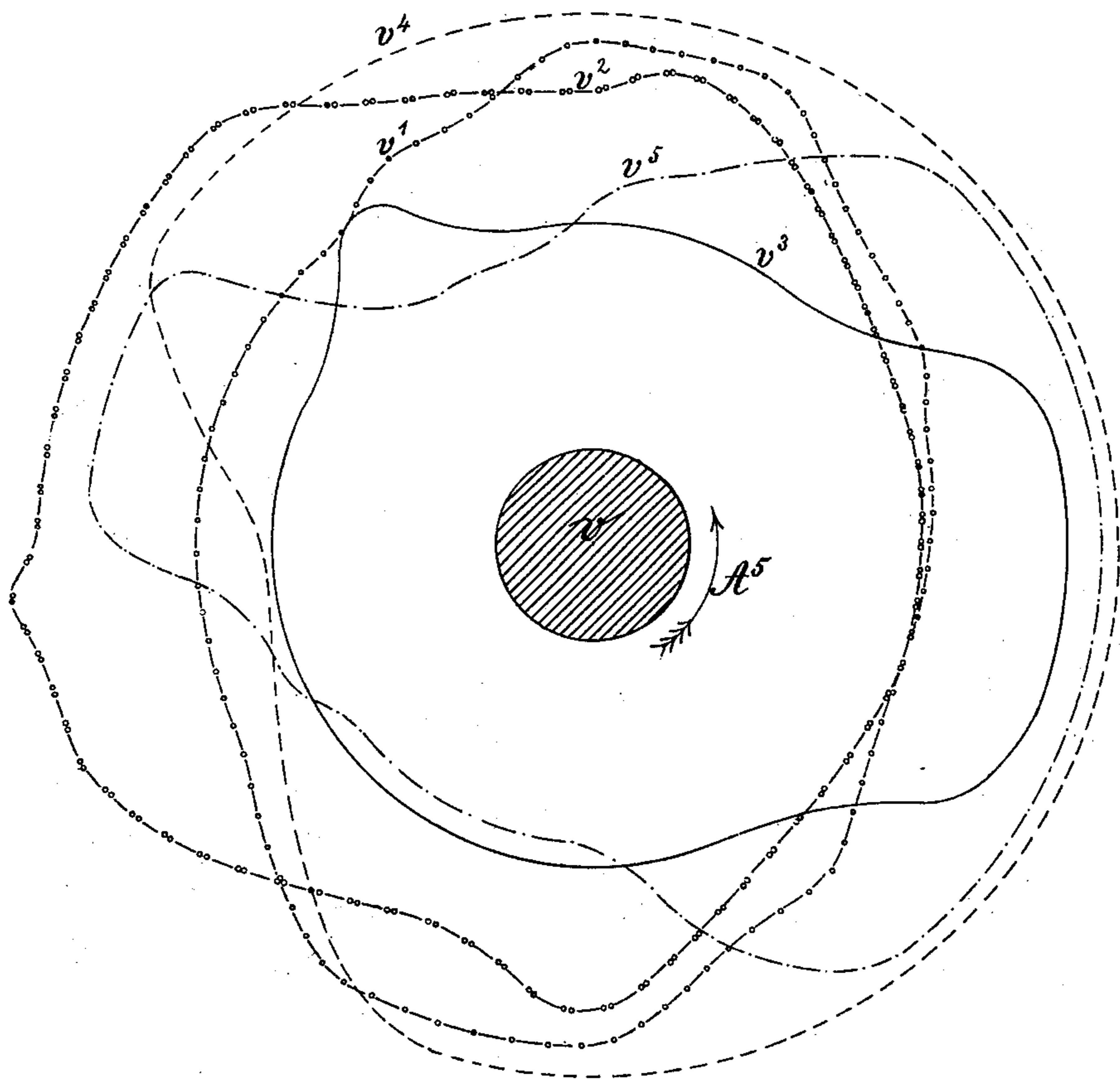
10 Sheets—Sheet 9.

A. BEYER.
STRAIGHT KNITTING MACHINE.

No. 391,011.

Patented Oct. 16, 1888.

Fig. 22.



Witnesses:
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A. BEYER.
STRAIGHT KNITTING MACHINE.

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Patented Oct. 16, 1888.

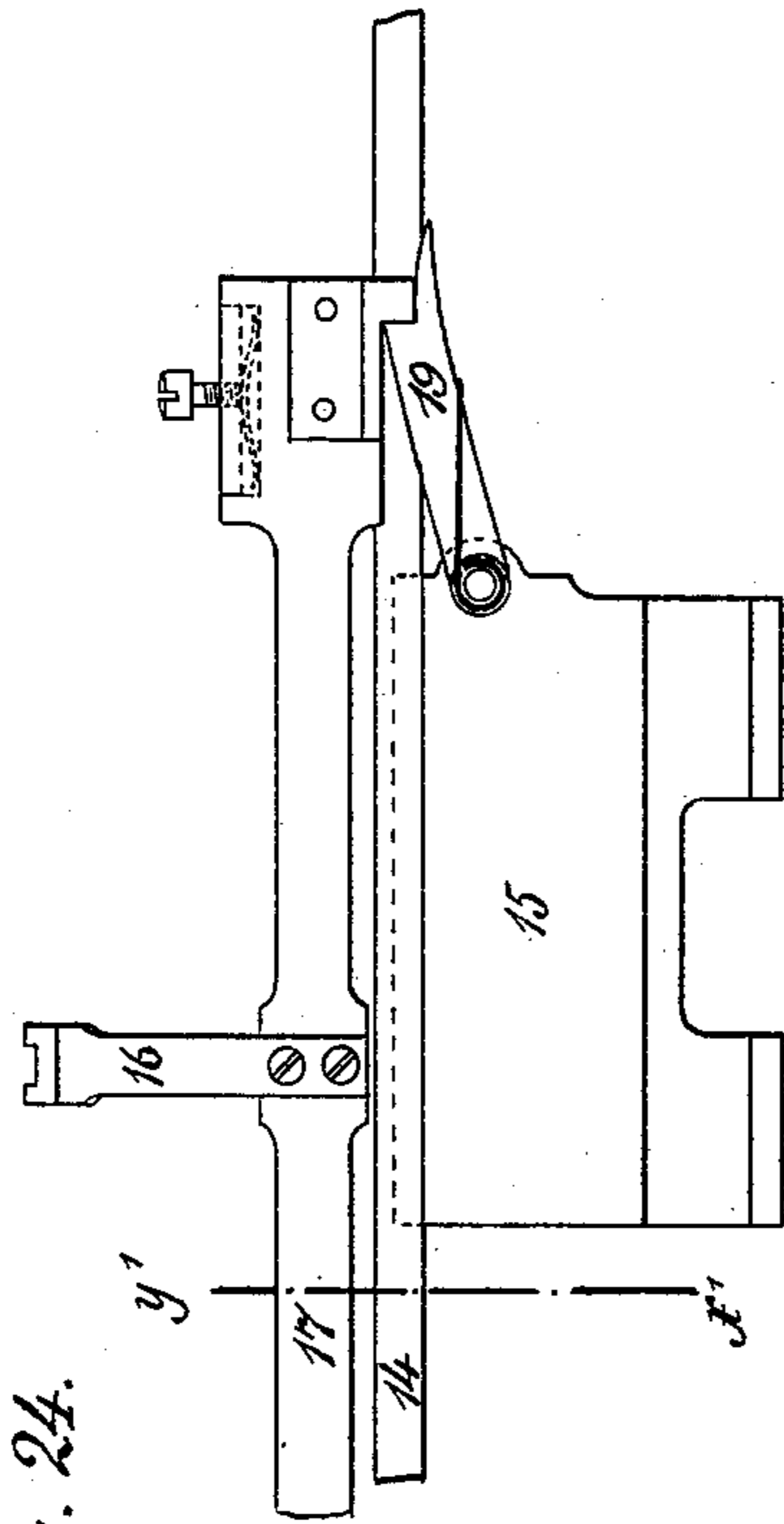


Fig. 24.

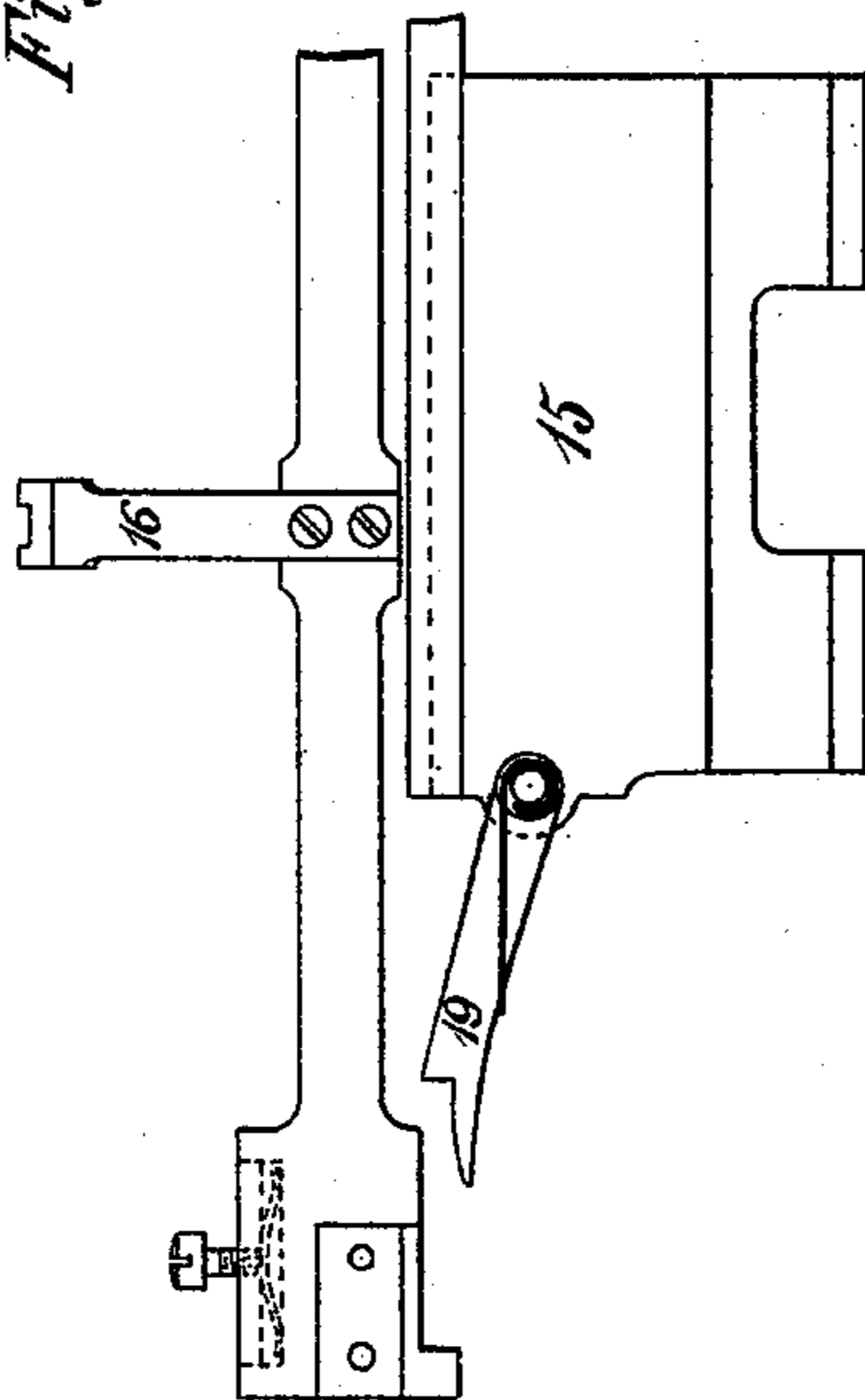


Fig. 25.

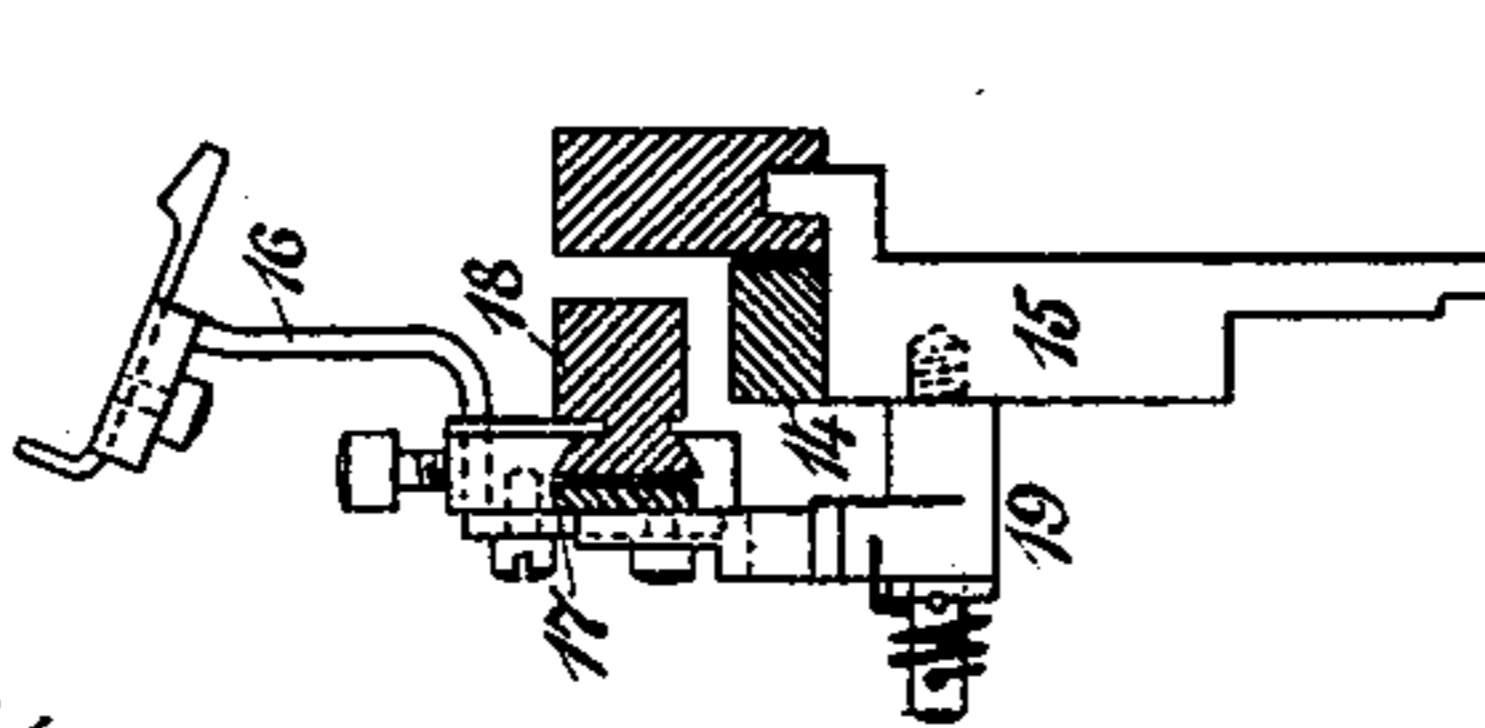


Fig. 23.

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Inventor:
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UNITED STATES PATENT OFFICE.

ALBIN BEYER, OF CHEMNITZ, SAXONY, GERMANY, ASSIGNOR TO ERNST JULIUS SEYFERT AND HERMANN DONNER, BOTH OF SAME PLACE.

STRAIGHT-KNITTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 391,011, dated October 16, 1888.

Application filed May 31, 1887. Serial No. 239,757. (No model.) Patented in Germany May 25, 1886, No. 38,715.

To all whom it may concern:

Be it known that I, ALBIN BEYER, a subject of the King of Saxony, in the German Empire, and a resident of Chemnitz, in the State of Saxony, Germany, have invented certain new and useful Improvements in Straight-Knitting Machines with Self-Acting Narrowing Apparatus, (for which I have obtained Letters Patent in Germany, No. 38,715, dated May 25, 1886;) and I hereby declare the following to be a full and clear description thereof, reference being had to the accompanying drawings, which form part of this specification.

The improvements described hereinafter, and shown in the drawings, relate to narrowing apparatus for knitting machines, and their purpose is to effect the automatic lessening of the number of working-needles and of the number of loops in a row directly from the rotating shaft of the knitting-machine and without any manual operation.

The improvements consist in part in the combination of peculiarly constructed and moved covering-needles with the common latched knitting-needles.

A characteristic feature of the improvements is that the knitting-needles from which the stitches have to be taken are forced upward by bars till the stitches lie on the latches of the needles. The latches being thereby thrown or clapped back, the hooks of the needles are opened and then the peculiarly-moved covering-needles catch in the opened hooks of the latch-needles and are coupled with them. They draw the latched needles from which the stitches have to be taken out of the row of the other latched needles till the stitches on them have slipped behind the latches.

These improvements are represented in Figures 1 to 25, Sheets I to XI, of the drawings.

Fig. 1, Sheet I, represents a sectional view of the well-known Lamb knitting-machine with the invention applied thereto, taken on line M M' of Fig. 2, Sheet II, looking to the left. Fig. 2, Sheet II, shows a front view of a knitting-machine with the narrowing apparatus applied thereto, the machine being shown as having four compartments or following "heads." Figs. 3 and 4, Sheet III, show parts of the needle-beds with the latched needles and the lower part of the covering-needles in a transverse cross-section through M² M³ of Fig. 2. Figs. 3 and 4 are sectional detail views, the former showing the needles uncoupled and the latter showing them in the position in which the covering-needles have caught by their grooves the hooks of the latch-needles, but before they get coupled with them. Fig. 5, Sheet III, is a side view of the knitting-machine and of the narrowing apparatus, viewed from the left of Fig. 2, and showing it on a larger scale, parts of the five cams $v^1 v^2 v^3 v^4 v^5$ being only shown by dotted lines. Fig. 6, Sheet IV, is the same side view as Fig. 5, but shows the narrowing apparatus out of action. Fig. 7, Sheet V, is a partial top view showing the transporting contrivance for the holders of the covering-needles. Only parts of one row of needles with covering-needles are shown in this figure. The other rows opposite to them are not shown, for sake of clearness. Fig. 8, Sheet V, shows in end view some parts of the same contrivances as in Fig. 7. Fig. 9, Sheet V, is a cross-section of the transporting apparatus through line M⁴ M⁵ of Fig. 7. Figs. 10 to 15, Sheets VI and VII, show in a transverse cross-section through line M² M³ of Fig. 2 the different positions of the latched needles, the covering-needles, and the slide-bars $r^3 R^3$ in the different phases of the narrowing process. Fig. 16, Sheet VI, shows the new covering-needle in a cross-section through line M⁶ M⁷ of Fig. 17, and Fig. 17 is a top view of it. Fig. 18, Sheet VI, shows a longitudinal section on an enlarged scale, the latched needle and the covering-needle coupled together, the latch a^3 being clapped back. Fig. 19 shows parts of the same contrivance in the same manner as in Fig. 18; but the latch a^3 is laid onto the hook a^2 . Figs. 20 and 21, Sheets VIII and IX, are a side view and a front view of the mechanisms for the coupling and uncoupling of the knitting-machine and of the narrowing apparatus, certain pinions being shown in cross-section. Fig. 22, Sheet X, shows the forms of the five cams which are fastened to the driving-shaft v . Fig. 23, Sheet XI, shows a cross-section through line H' Y', Fig. 24, and Fig. 24, same sheet, shows the same in side view. Fig. 25, same sheet, shows a top view of the bar 17 in the whole length.

The new covering-needle B, Figs. 16 to 19,

Sheet VI, has a shape somewhat similar to that of a common covering-needle or point-shifter, as generally known and used in frames with ordinary hook or spring needles. Its groove x , however, is rather larger and longer than in the former. Its lower end is not pointed, but sharpened to a flat edge, o^2 , for opening the latches, and near this end a hole, o , is cut through it, but only of a short length—say a little longer than the hook a^2 of the knitting-needle a . The long groove x and the short hole o distinguish the new covering-needle from that presented in the United States patent to Pepper, No. 180,785. Figs. 18 and 19 show the value of the short hole in enabling the covering-needle to give a to and-fro motion to the knitting-needle without touching the latch a^3 when it covers the hook a^2 . By this arrangement a short or narrow loop can be shifted from the knitting-needle to the covering-needle without being widened or broken, and the whole operation can be made in the most simple manner. Figs. 13 and 14 show the necessity of providing the covering-needle with a groove, x , of a certain length underneath, enabling it to clutch and couple the hooks of the latch-needles in different positions of the latter.

It is not possible to enter into a description of the nature of the narrowing apparatus before having remarked that the knitting-machine forming the basis of the narrowing apparatus is a common knitting-machine of the Lamb type. A number of rows of stitches are first formed by this knitting-machine, and after that the narrowing apparatus is set in action whenever required. It must be remarked, further, that it does not come into operation till a row of stitches has been formed by the knitting-machine and till the needles of the latter are in their original positions again.

The narrowing apparatus consists of the following parts: v is a shaft rotating in the direction of the arrow A^5 , Figs. 1 and 22, and as all motions of the narrowing apparatus are produced by this shaft it is termed the "narrowing-shaft." The cams $v^1 v^2 v^3 v^4 v^5$ are fastened on this shaft v . Fig. 22 shows the special forms of these cams, and Fig. 5 shows parts of them in connection with their levers. They move the different mechanisms in the following way: When the narrowing-shaft v rotates, the cam v^1 operates on the lever-arm r^1 , Figs. 5 and 6. The latter is pivoted at r , and is provided with a roller, r^{10} , upon which the cam acts. The motion of arm r^1 is transmitted by means of the connecting-bars $r^2 R^2$ to the levers $r^3 r^4 R^3 R^4$, Figs. 2, 5, and 6, which are fastened on the rocking shafts $c^2 C^2$. The rocking shaft r^5 runs through and rests loose in the levers r^4 , and a corresponding shaft, R^5 , is mounted in the same way in the left-hand-side levers R^4 of the apparatus. The levers $r^6 r^7$ are connected firmly with the rocking shaft r^5 and the levers $R^6 R^7$ with the shaft R^5 . On the ends of the levers $r^7 R^7$ are fastened grooved bars $r^8 R^8$, arranged along and above the needle-beds

J J'. The springs $r^{15} R^{15}$ draw the grooved bars constantly downward. These grooved bars $r^8 R^8$ each have a U-shaped form on the under side throughout the length thereof, and two ribs, $r^9 r^{10}$ and $R^9 R^{10}$, which rest on the needle-beds J J'. When the bars are depressed, these ribs shift and hold the feet of the latched needles, as described farther on. In rotating, the cam v^2 operates on the bell-crank lever $c c'$, which is mounted loose on the shaft C^2 . The arm c is pressed against the cam v^2 by means of the spring c^{20} . The two connecting-rods $g g'$ hang on the arms $d D$, which are mounted on rocking shafts $d^2 D^2$. On the same rocking shafts $d^2 D^2$ are fastened the arms $d' D'$, the upper ends of which form the bearings for the shafts $d^4 D^4$. These shafts $d^4 D^4$ have firmly mounted on arms $d^6 D^6$ thereon other shafts, $d^{4*} D^{4*}$, (see Figs. 5, 6, 7, and 8,) and form rocking frames, on which the holders $d^5 D^5$ of the covering-needles slide, as shown in Fig. 7. The covering-needles $b B$, Figs. 5 and 6, are fastened to these holders, which can be laterally moved. The rotating cam v^3 lifts the lever q^1 , Figs. 5 and 6, which is pivoted loosely at c^3 , and displaces the vertically-movable slide-block q^4 by means of its projection q^3 . The levers $r^6 R^6$ rest on the slanting surfaces of the slide-block q^4 . When the slide-block q^4 is lifted, these levers $r^6 R^6$ are also lifted and oscillate, as well as the arms $r^7 R^7$. When the slide-block q^4 is lowered, the lever ends $r^6 R^6$ sink in consequence of the pressure exercised on them by the springs $r^{15} R^{15}$. The rotating cams v^4 operate on the rollers K of the bell-crank levers $K^1 K^2$, which oscillate on the rocking shaft D^2 and move the wedges K^4 , Fig. 7. These wedges are each provided, as shown in Figs. 7, 8, and 9, with a slanting surface, K^5 , Figs. 7 and 9. The rollers K are held by springs K^3 against the cams v^4 . The wedges K^4 are mounted movably in the supports K^6 , Fig. 9, which are fastened to the frame of the machine. The racks K^7 are likewise movable in a longitudinal direction in the supports K^6 , and are constantly held against the wedges K^4 K^5 by the spiral springs K^8 . In addition to this, there are on the supports K^6 movable slides K^9 , which are provided with the pawls K^{10} , and with the arms $K^{11} K^{12}$. The narrowing-frames $d^4 d^6 d^{4*}$, Fig. 7, and $D^4 D^6 D^{4*}$ are arranged on both sides of the machine and carry the movable slides $K^{13} K^{13*}$.

In Fig. 7, K^{13} is shown on the right-hand, and K^{13*} on the left-hand, end of the machine, both on one side of the machine. The other side of the machine, which is not illustrated in Fig. 7, has the same mechanism. The slide K^{13} is in connection, by a bar, K^{14} , with the holders d^5 of the covering-needles, and the slide K^{13*} is in connection, by a bar, K^{15} , with the holders d^{5*} of the covering-needles, Fig. 2.

Fig. 2 shows that there are two covering-needle holders for each knitting-head H , which may be moved in opposite directions to one another, as shown by the arrows in Fig. 2.

If the rotating cams v^4 and their appur-

tenances have brought the wedges K^4 , which are arranged on both ends of the machine, into the positions shown in Fig. 7, the racks K^7 K^7 have been moved toward each other, and they have moved the slides K^9 K^9 . These slides K^9 K^9 have moved, by the projections K^{11} , the slides K^{13} K^{13} and the bars K^{14} K^{14} and the holders d^5 and d^{5*} of the covering-needles, Fig. 7. The covering-needles b b' , Fig. 7, have been displaced laterally in opposite directions. The same lateral movement of the covering-needles which has just been described for that part of the machine illustrated by Fig. 7, and which has been produced by the projections K^{11} of the slides K^9 , takes place in the same manner by the projections K^{12} K^{12} of the slides K^9 on the other side of the machine. When the wedges K^4 are moved back, the slides K^9 remain inactive in their position on supports K^6 , the racks K^7 slide along under them, being held by the springs K^8 against the wedges K^4 . The pawls K^{10} , which are mounted on the slides K^9 , slide during this motion over the racks K^7 and fall into other teeth of them. The rotating cam v^5 moves the lever g^2 upward, Figs. 2, 5, and 6. The latter is mounted loose and can turn on the pin c^9 . The projection p of the slide-block p' rests on the lever g^2 , the slide-block p' being movable in a vertical direction. The arms P^2 p^2 are mounted on the shafts d^4 D^4 , and turn these shafts d^4 D^4 , and with them the whole framing d^6 d^{6*} and D^6 D^{6*} , the lower ends of the arms p^2 P^2 resting on the slanting surfaces of the slide-block p' . By the lifting of the slide-block p' these frames d^4 d^6 d^{6*} D^4 D^6 D^{6*} are made to oscillate with the shafts d^4 D^4 by means of the levers p^2 P^2 . When the slide-block p' is lowered, the lever ends p^2 P^2 are drawn downward by the springs r^{16} R^{16} , and the frames move in the opposite direction.

The knitting-machine can be worked either by hand or power and works in the following manner: The driving-pulley 2, Fig. 1, with the fly-wheel 3 rotates loose on the shaft 1, and on the same shaft the toothed wheel 7, whose nave forms part of the coupling 36 37, also revolves. The part 36 of the coupling is held against part 37 by means of the spring 41. To begin the knitting operation, it is necessary to press the hand-lever 80, Fig. 20, in a downward direction, and by means of the cam 81 at the other end the cranked lever 83 84 is thereby caused to move round its center 85, and so the friction-cone 4 is brought in contact with the driving-pulley 2, and so the shaft 1 is caused to revolve, and with it the wheels 7 8 are brought into motion. By means of the connecting-rod 9, which is pivoted to wheel 8 and also to the arm 10 of the frame 10 11, the frame 10 11 is oscillated. The saddle 13^b is joined by the link 13^a to frame 10 11, and also has connected therewith the bars 14, which traverse the whole machine, and to these bars 14 are fastened the locks 15 of the knitting-machine. The saddle 13^b is guided by means of the two rods 12, and the locks 15 are moved to and fro by these

sliding bars 14, the needles being moved up and down by the cams 15^a, Fig. 2, in the well-known manner to form the meshes.

Figs. 23, 24, and 25, Sheet XI, show detail views of the mechanism for moving the locks and the thread-carriers, the locks 15 15 being fastened to the bar 14, which traverses the whole machine and is moved to and fro by the saddle 13^b and frame 11, Fig. 2, Sheet II. To the rod 17 are fastened the thread-carriers 16 16, the bar 17 being operated at every stroke of the machine by the catches 19, which are fitted to the end locks, 15 15.

Each stroke of the lever-frame 10 11 forms one row of loops, and after two strokes the ratchet-wheel 26 is moved the distance of one tooth by means of the bell-crank lever 26^b 26^c, Fig. 20, through the pin 26^d in the wheel 24, this wheel 24 being put in motion by the shaft 1 through the wheels 21, 22, and 23. By the turning of the ratchet-wheel 26 the chain lying on it, to which the stops 27 27^a are hooked fast, is moved up. The stop 27 presses against the lever 28, whereby the lever 28, pivoted on pin 28^a, is raised and the knitting operation of the machine put out of gear and the narrowing apparatus brought into work.

The narrowing process is brought into play in the following manner: The stop 27 lifts the lever 28 and draws back the hook 51, which is on the arm 28^b of lever 28, and thus leaves the pin 50 of the toothed wheel 25 free, this wheel 25 having a certain number of teeth left out opposite to the pin 50. At the same time the bar 29, pivoted to lever 28, having a part beveled at 30 on its back side, Fig. 21, pushes the hinged joint 31 in such a position that the pin 32 of the wheel 24 may catch on it and turn it, and with it the wheel 25, till the teeth of wheel 25 come in gear with the teeth of wheel 24 again. At this point the knitting operation must be stopped, and the stopping is accomplished in the following manner: On the shaft v are fastened the two cams 33 and 38, the former moving the bell-crank lever 34 35 and drawing the coupling 36 out of gear, while the latter, acting on roller 39^a, moves the lever 39, which is furnished with a projection, 39^c. This projection 39^c catches in the recess 40 provided for it in the wheel 8, and when this is accomplished the knitting operation is stopped and the machine commences the operation of narrowing, which is done by means of cams v' to v^5 fastened on the shaft v , Fig. 2.

The way in which the narrowing apparatus is constructed and arranged is as described, and works as follows: When the narrowing process begins, the parts of the apparatus are in the position shown in Fig. 6. The cams v' v^2 first begin to operate. The first, v' , presses down the lever-arm r' with its roller r^{19} , turning the levers r^3 r^4 R^3 R^4 by means of the connecting-bars r^2 R^2 , so that the rocking shafts r^5 R^5 are forced to rise. On the other hand, the cam v^3 , in co-operation with the springs r^{15} R^{15} , makes the slide-block q^4 and lever ends r^6 R^6

$r^7 R^7$ descend. By means of these levers $r^6 R^6$
 $r^7 R^7$ the grooved bars $r^8 R^8$ are also made to
descend till their ribs $r^9 R^9$ rest on the
needle-beds $J J'$ and encircle or cover the feet
5 $a' A'$ of the knitting-needles $a A$. When the
lever-arm r' is forced farther down by the cam v' ,
the levers $r^3 R^3$ move farther round, and
by this means the needles $a A$ are forced up-
ward till they occupy the position shown in
10 Figs. 4 and 5. The hooks $a^2 A^2$, Fig. 4, of the
knitting-needles then project out of the needle-
beds $J J'$ and the stitches of the knitting
lie on the opened latches $a^3 A^3$ of the knitting-
needles. During this motion of the cams v'
15 and v^3 the cam v^2 has turned the bell-crank le-
ver $c c'$ in such a way that the lever-arm c' has
sunk and the arms $d d' D D'$ have been turned
by the connecting-bars $g g'$. The arms $d' D'$
have been moved toward each other by this
20 motion of the cam v^2 . By means of the arms
 $p^2 P^2$ and slide-block p' and spiral springs r^{16}
 R^{16} the covering-needles $b B$ have been moved
above the latched needles. (See Figs. 3 and
5.) The cam v^5 then allows the slide-block p'
25 and the arms $p^2 P^2$ to descend still farther, the
springs $r^{16} R^{16}$ causing this movement, and also
causing the covering-needles $b B$ to sink so far
that the grooves x of the latter encircle and
catch the hooks of the knitting-needles $a A$
30 and lay themselves on them, Fig. 4.

In the following description those knitting-
needles seized by the covering-needles are
marked a for the sake of clearness, while the
remaining knitting-needles are marked $a A$,
35 Figs. 10 and 15.

Owing to the effect of the cam v^2 and spring
 c^{20} on the lever $c c'$, the bars $g g'$, the arms $d d'$
 $D D'$, and the covering-needles $b B$ are forced
upward. The covering-needles slide upward,
40 with their grooves x resting on the knitting-
needles, till the hooks of the knitting-needles
slip into the holes o of the covering-needles.
The knitting-needles are then coupled with the
covering-needles, as shown in Fig. 18, and
45 therefore, when the latter are forced farther
upward, they draw the knitting-needles up
with them. The stitches on these needles
finally slip behind the latches (see Fig. 10) of
the needles a .

It must be remarked here that all needles
 $a A$ of the two rows of needles are shoved
upward by the ribs $r^9 R^9$ till the stitches have
slipped on the opened latches of the knitting-
needles, Figs. 3 and 4. On the other hand, the
55 number of the covering-needles is small, and
it is only on the needles seized by them that
the stitches slip behind the latches, as in Fig.
10. The covering-needles $b B$ and the grooved
bars $r^8 R^8$ then descend, those knitting-nee-
60 dles which were forced upward by the ribs r^9
 R^9 and that are not seized by the covering-
needles being forced down again by the ribs
 $r^{10} R^{10}$ till their stitches have slipped into
the hooks again; but the latches of those
65 needles coupled to the covering-needles are
thrown over the covering-needles by this

downward motion and the stitches slip over
them onto the shafts of the covering-needles,
Fig. 11. The needle-beds $J J'$ prevent the
stitches from slipping downward on needles a . 70
These motions are effected in the following
way: The motion of the grooved bars $r^8 R^8$ is
caused by the cam v' , in connection with the
lever r' , roller r^{19} , connecting-rods $r^2 R^2$, levers
 $r^3 R^3$ $r^4 R^4$, and springs $r^{15} R^{15}$. The motion of 75
the covering-needles is caused by the cam v^2 ,
in connection with the lever $c c'$, the connect-
ing-rods $g g'$, the arms $d d' D D'$, the levers $p^2 P^2$,
and the springs c^{20} and $R^{16} r^{16}$. After the stitches
have been transferred from the knitting-nee- 80
dles a onto the covering-needles $b B$ the nee-
dles $a A$ and the bars $r^8 R^8$ remain inactive in
the position shown in Fig. 11; but the needles
 a are forced by the cam v^2 and its appurte-
nances still farther downward till their feet 85
touch the inner edge of the ribs $r^9 R^9$, Fig. 12.
As the needles $a A$ have remained in the posi-
tion shown in Figs. 11 and 12, an intermediate
space, δ , is thus formed between their feet and
those of the needles a , (from which the stitches 90
have been removed.)

The covering-needles $b B$ then make a com-
bined or twofold motion. They first descend
a little farther, (the needles a cannot be forced
farther down as their feet rest on ribs $r^9 R^9$), 95
this motion being effected by the cam v^2 and
its appurtenances; secondly, the covering-nee-
dles are lifted a little from the needles a by the
motion of the cam v^5 and its appurtenances.
The covering-needles are thus uncoupled from 100
the needles a , Fig. 13, and the hooks $a^2 A^2$ have
been brought out of the holes v by this com-
bined or twofold motion. The covering-nee-
dles are then forced farther down by means of
the cam v^2 and its appurtenances, the covering- 105
needles, with their grooves, sliding along the
hooks of the knitting-needles and throwing back
the latches of them (see Fig. 13) in descending.
For this reason the covering-needles must be
provided with a flat edge, o^2 , Fig. 17. The 110
stitches are now on the covering-needles. The
descending motion of the latter ceases and the
slide-block p' is lifted higher by the cam v^5 and
its appurtenances. By this means the arms p^2
 P^2 are raised and the covering-needles (bear- 115
ing the stitches) are lifted entirely off the knit-
ting-needles and brought into the position
shown in Fig. 14. When the covering-needles
have reached this position, the cam v^4 , with its
appurtenances, begins to act and forces the 120
slide K^9 to move sidewise. The holders $d^5 D^5$,
with the covering-needles, are displaced in a
lateral direction by the co-operation of the
parts $K^{11} K^{12} K^{13} K^{14}$, &c., Fig. 7. The cover-
ing-needles now stand with their stitches ex- 125
actly over the knitting-needles, but laterally
displaced, as is shown in Fig. 7.

In order to explain the narrowing process
more minutely, an example of this lateral dis-
placement will be now described. Let it be 130
supposed that by the process already described
the stitches have been taken off the needles a'

to a^5 of Fig. 7. Their latches have been opened by the prior-described operations, and their stitches are at this time on the covering-needles 1' to 5'. The covering-needles (shown in Fig. 7) have, for instance, been moved sideways by a space occupied by two needles, so that no covering-needles stand over the first two knitting-needles, a' and a^2 . The next three knitting-needles have covering-needles above them, and the next two knitting-needles, $a a A A$, have also covering-needles above them.

The further narrowing process is as follows: The latches of all the working knitting-needles are still open, and now the covering-needles 1' to 5' descend and are laid with their grooves upon the hooks of the knitting-needles $a^3 a^4 a^5 a a a$ by the operation of the cam v^5 and its appurtenances. Then the cam v^2 acts with its lever c and spring c^{20} , and causes the covering-needles 1' to 5' to move upward again; the hooks of the knitting-needles $a^3 a^4 a^5$ fall into the holes o of their covering-needles. The knitting-needles $a^3 a^4 a^5$ are thus coupled with their covering-needles 1' 2' 3' and are drawn upward till these needles are in the same position as the needles $a a a$. Then the hooks of the two next knitting-needles $a a$ fall into the holes o of the covering-needles 4' 5', and the latter are likewise coupled with the knitting-needles. It must be noticed that only the two needles a' and a^2 have remained in their low position, Fig. 15, for they have not been affected by the motion of the covering-needles just described. At the same time that the upward motion of the covering-needles begins the grooved bars $r^8 R^8$ also begin to move, and in the following way: The bars $r^8 R^8$ are lifted from the feet of the knitting-needles, advance a little, and descend again onto the needle-beds J J' into the position, Fig. 15. The feet of the needles $a' a^2$ that have remained stationary are thus brought under the ribs $r^9 R^9$. (See Fig. 15.) The motion just described is caused by the cams v' and v^3 in connection with their appurtenances. The bars $R^8 r^8$ slide upward on the needle-beds J J', and the working knitting-needles $a^3 a^4 a^5 a a a$ are thereby forced upward. The covering-needles move upward at the same time, whereby the stitches on the covering-needles slip downward on the knitting-needles a^3 to $a^5 a a$. The stitches have thus passed over the opened hooks of the needles $a^3 a^4 a^5 a a$; the stitches of those covering-needles 4' 5' are stitches transferred onto $a a$, whereas the stitches of the covering-needles 1' 2' 3' have slipped into the empty hooks of the knitting-needles $a^3 a^4 a^5$. The operation just described is carried out by the combined effect of the cam v' and its appurtenances on the bars $r^8 R^8$, and by the effect of the cam v^2 and its appurtenances on the covering-needles. After this the covering-needles perform another twofold combined motion. They are first forced downward a little by the cam v^2 and its appurtenances, and then they are re-

moved (lifted) a little off the knitting-needles by the cam v^5 and its appurtenances. The uncoupling of the covering-needles and the knitting-needles has been carried out thereby. The narrowing-needles then return to the position shown in Figs. 1 to 6. At the same time the bars $r^8 R^8$ are moved downward by the cam v' and its appurtenances, and draw the needles $a^3 a^4 a^5 a a a$ into their lowest position, Fig. 6—that is to say, they are drawn back till the stitches are in the hooks again. By means of this motion the lower edges of the ribs $r^9 R^9$ press the empty needles a' and a^2 entirely down under the cams 15^a of the locks, Fig. 2, so that they cannot come into any further action. After this the continued effect of the cams v' and v^3 and their appurtenances lifts the bars $r^8 R^8$ completely off the feet of the needles and off the needle-beds J J', and they are brought back into their point of rest. (See Fig. 6.) It must be mentioned still that the narrowing apparatus carries out all the operations described during one revolution of the narrowing-shaft v .

It is evident that this apparatus can work with one row of needles only, if such be substituted for double row shown and described.

Having now fully described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. A covering-needle, B, having a groove, x , and near to its lower end a hole, o , in combination with a latch-needle, a , for the purpose of guiding and catching the hook a^2 of the latch-needle and for moving the latch-needle to and fro by means of the covering-needle.

2. The combination, with a row of latch-needles, of the covering-needles, each having a groove on its under side and a hole near its end, the head d^5 , the frame $d^4 d^6 d^{4*}$, the lever p^2 , the slide-bar $p p'$, means for raising said bar, levers d' , and means for moving said levers, whereby the covering-needles may be coupled with the latch-needles and uncoupled therefrom, and whereby while coupled the latch-needles may be moved endwise, substantially as described.

3. The combination, with the two rows of latch-needles, of the two rows of covering-needles, each having a groove on its under side and a hole near its end, the heads carrying said covering-needles, the two rocking frames $d^4 d^6 d^{4*} D^4 D^6 D^{4*}$, devices for rocking said frames upon their pivots, the levers $d d' D D'$, the connecting-rods $g g'$, the levers $c c'$, and the actuating-cam, substantially as described.

4. The combination, with two rows of needles, of two rows of covering-needles, heads carrying said covering-needles, slides connected with said heads, the rocking frames $d^4 d^6 d^{4*} D^4 D^6 D^{4*}$, on which said heads are mounted, the slide K^9 , having arms $K^{11} K^{12}$, adapted to move the heads of both rows of covering-needles at the same time, and devices for moving said slide inwardly, substantially as described.

5. The combination, with the grooved bars

$r^8 R^8$, of the levers $r^6 r^7 R^6 R^7$, rock-shafts $r^5 R^5$, the springs $r^{15} R^{15}$, the slide p' , and devices for raising said slide, substantially as described.

5 6. The combination, with the grooved bars $r^8 R^8$, of the levers $r^6 r^7 R^6 R^7$, the springs $r^{15} R^{15}$, the slide p' , devices for raising said slide, the rock-shaft $r^5 R^5$, the levers $r^3 r^4 R^3 R^4$, the connecting-rods $r^2 R^2$, the lever r' , and the actu-

ating-cam for said lever, substantially as described. 10

In witness whereof I have hereunto set my hand in presence of two witnesses.

ALBIN BEYER.

Witnesses:

P. MÜHLNER.

B. ROE.