

No. 804,029.

PATENTED NOV. 7, 1905.

A. H. NILSON & M. OLSON.
WIRE WORKING MACHINE.

APPLICATION FILED OCT. 4, 1904.

6 SHEETS—SHEET 1.

Fig. 1.

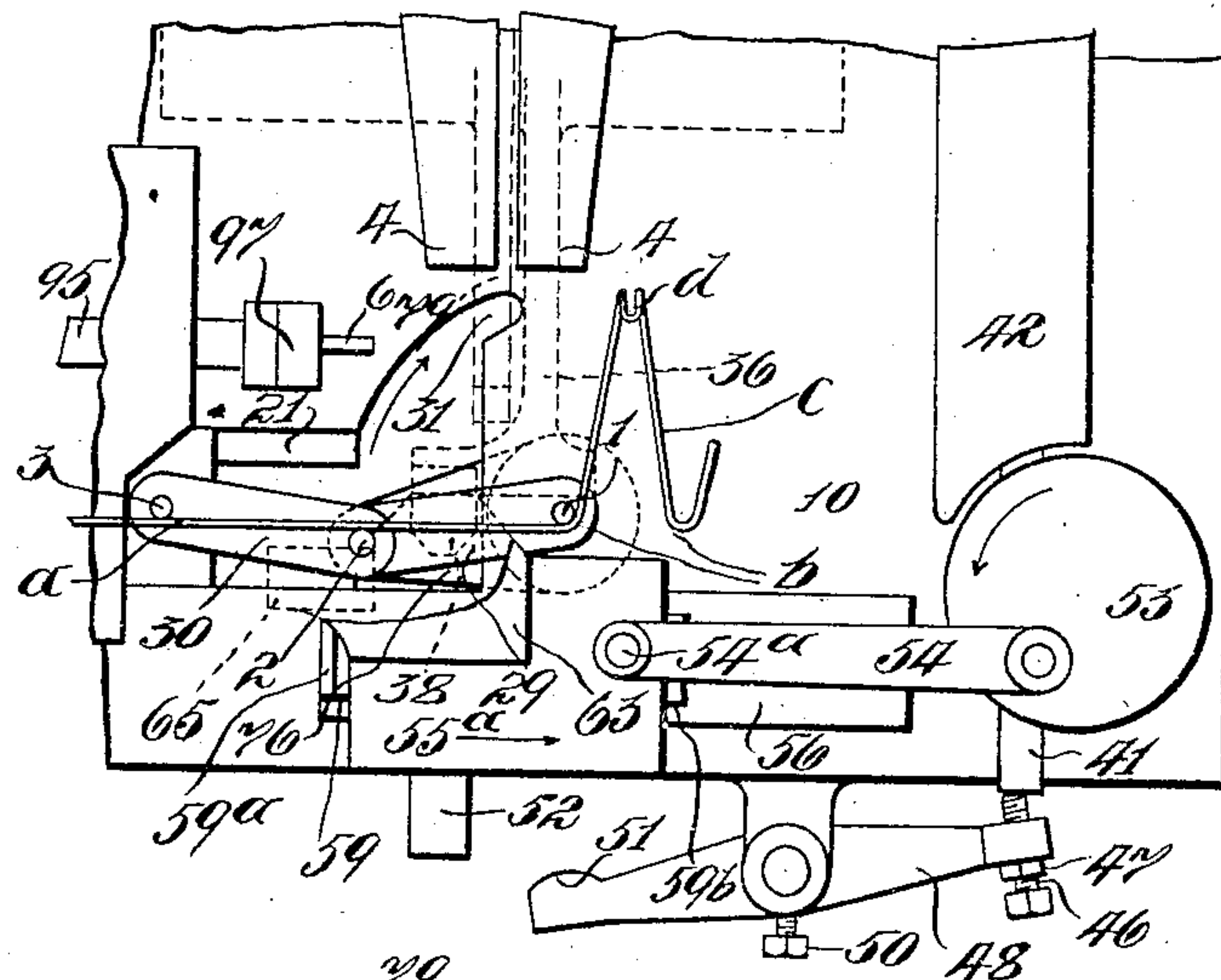


Fig. 2.

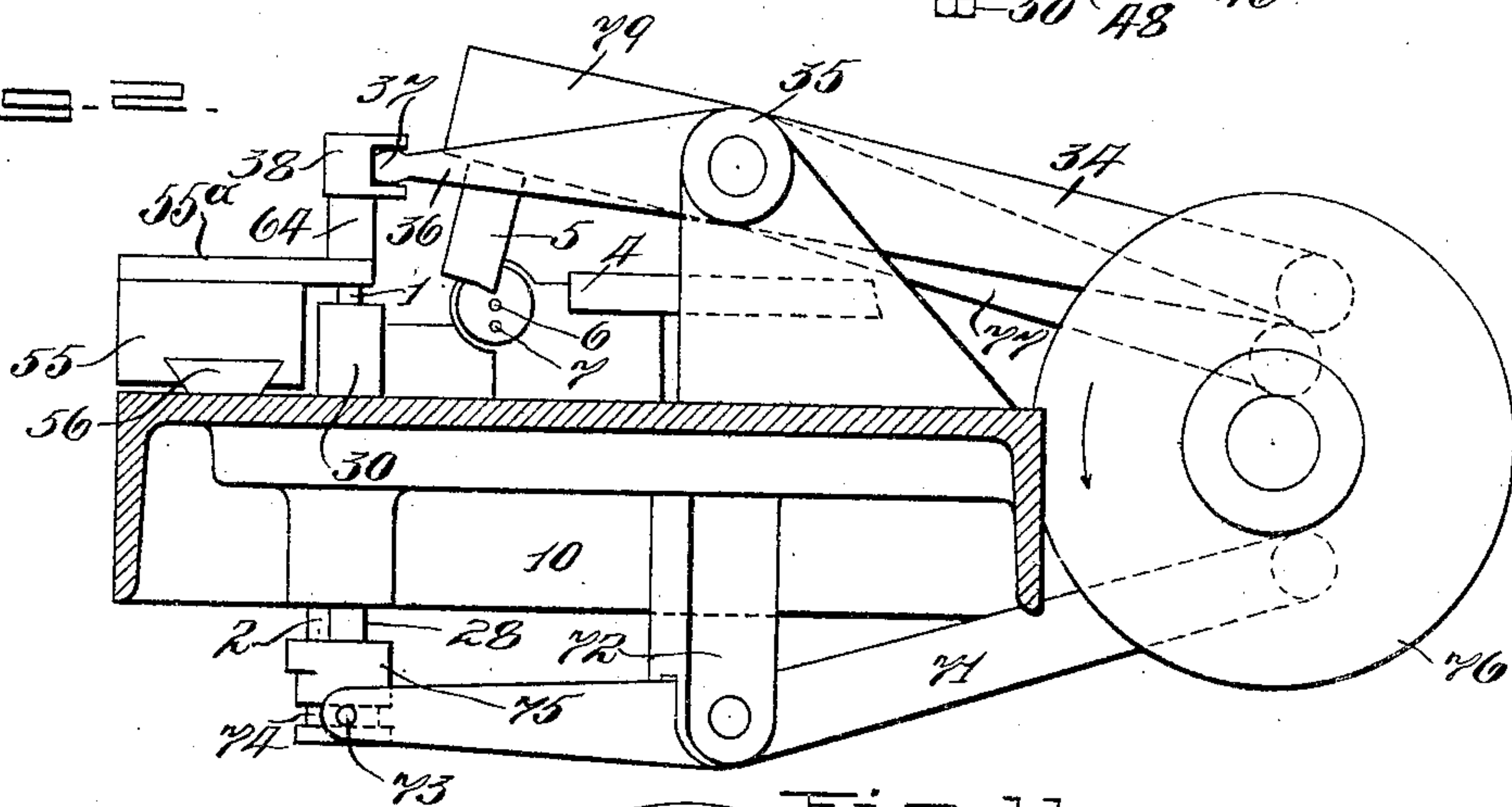


Fig. 10.

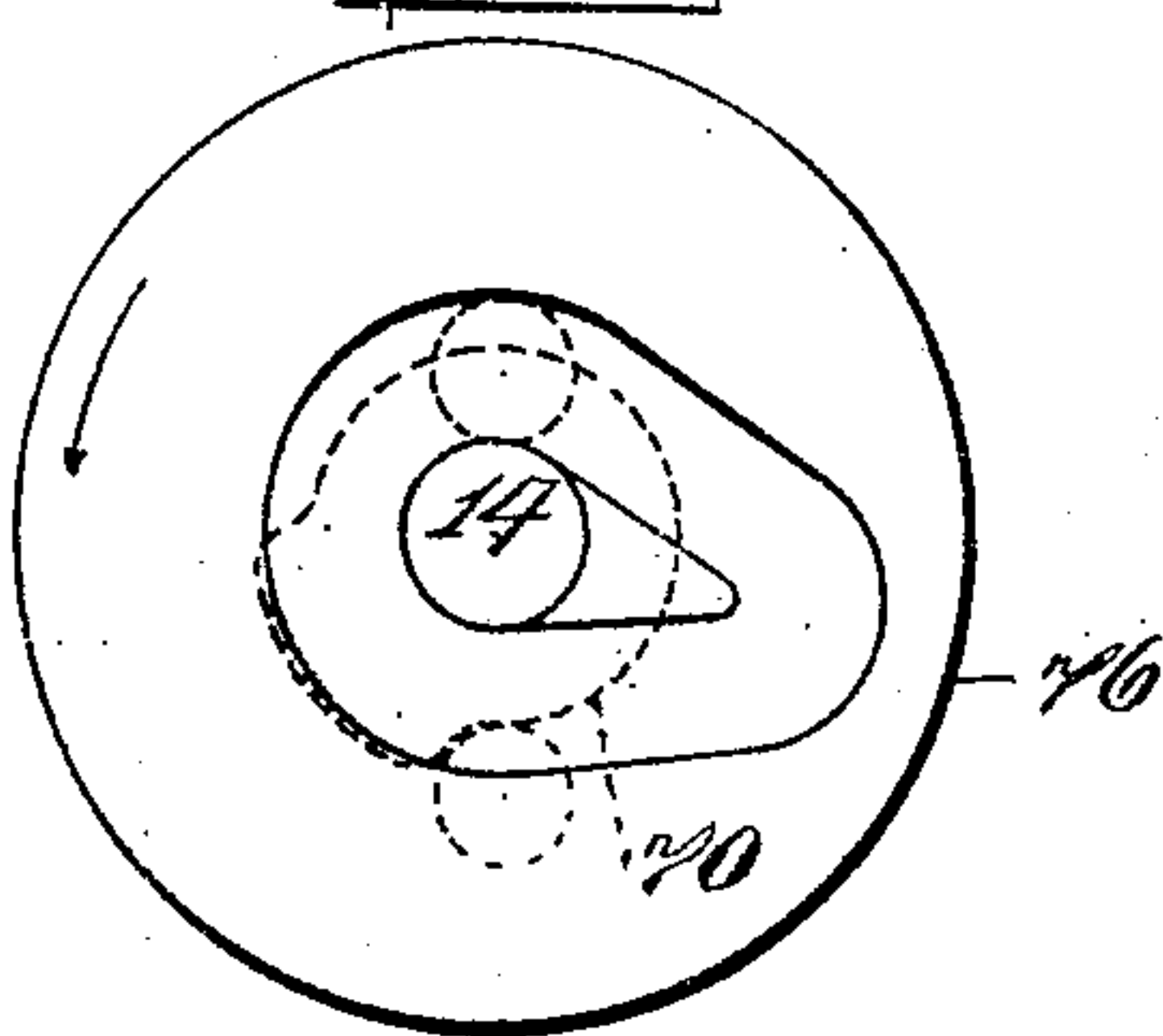


Fig. 11.

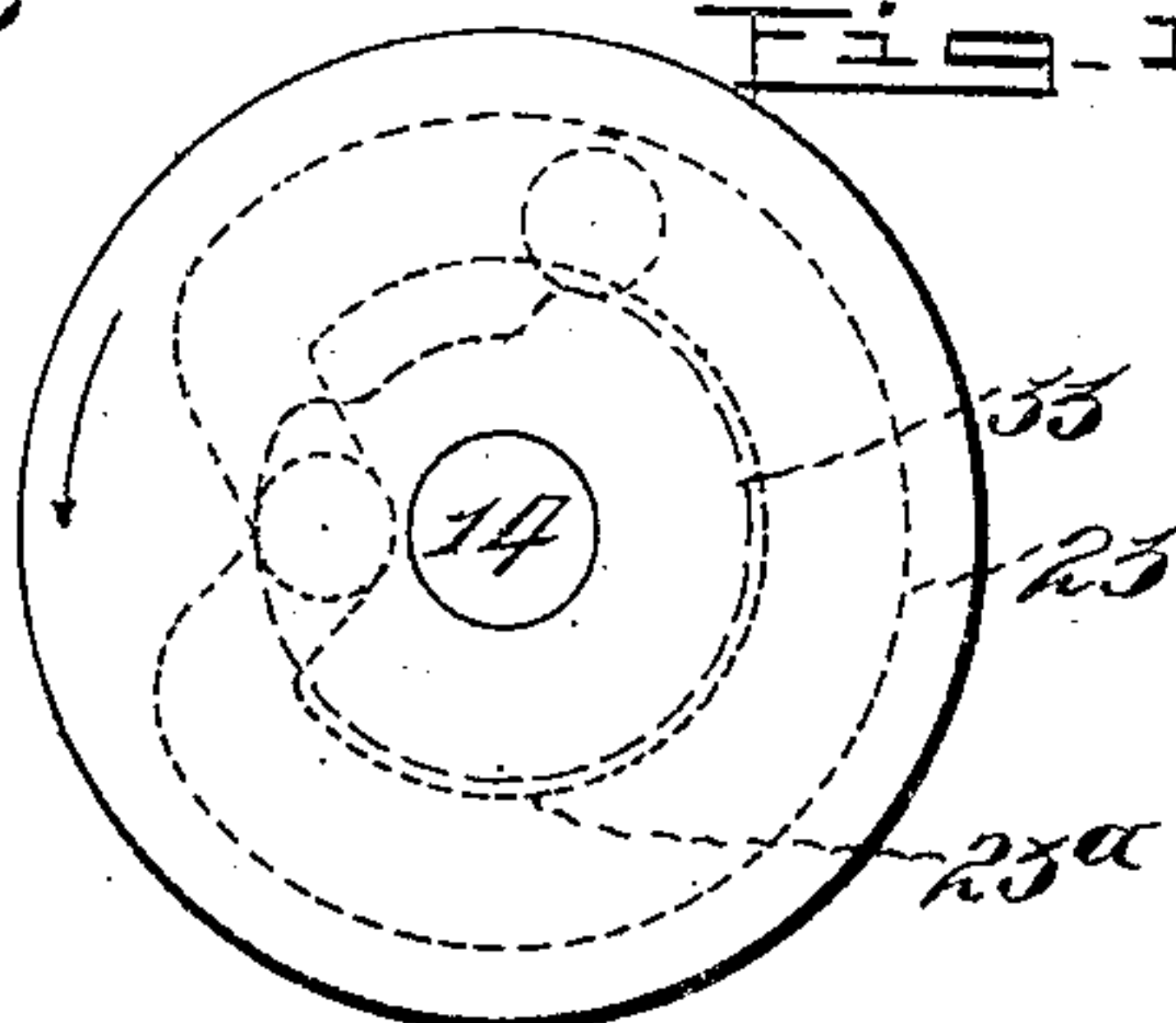


Fig. 12.

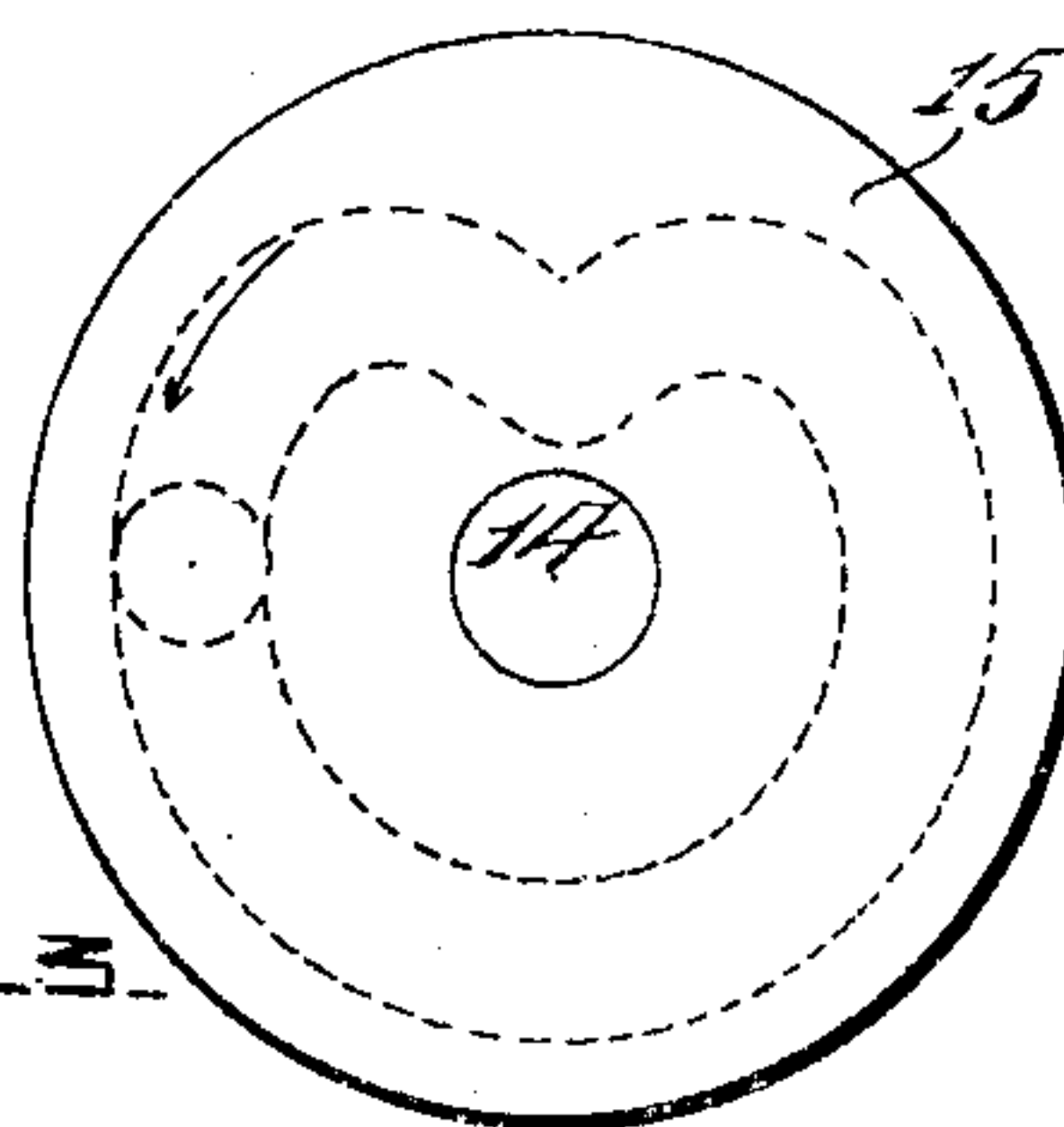
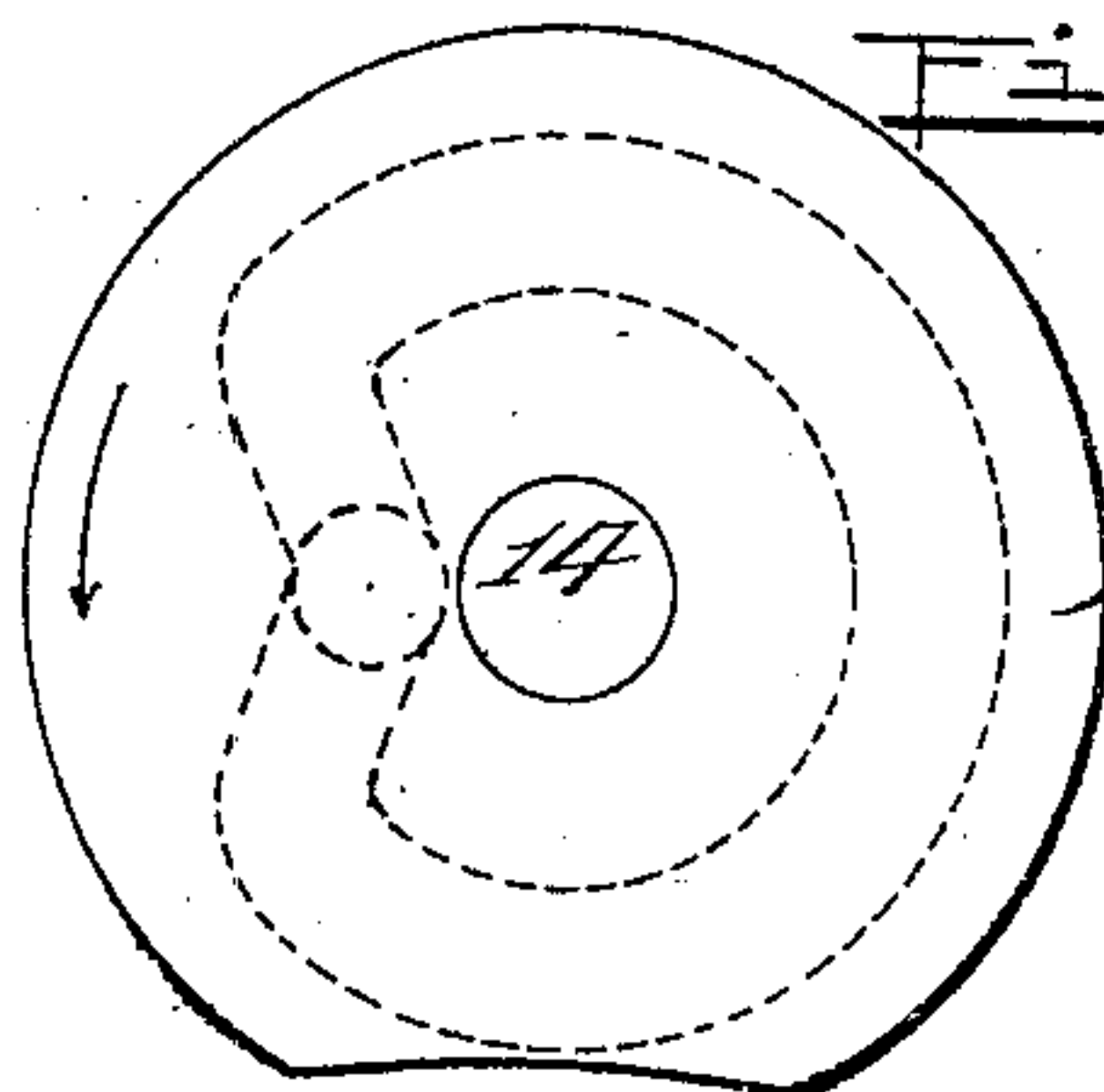


Fig. 13.



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6 SHEETS—SHEET 2.

Fig. 3.

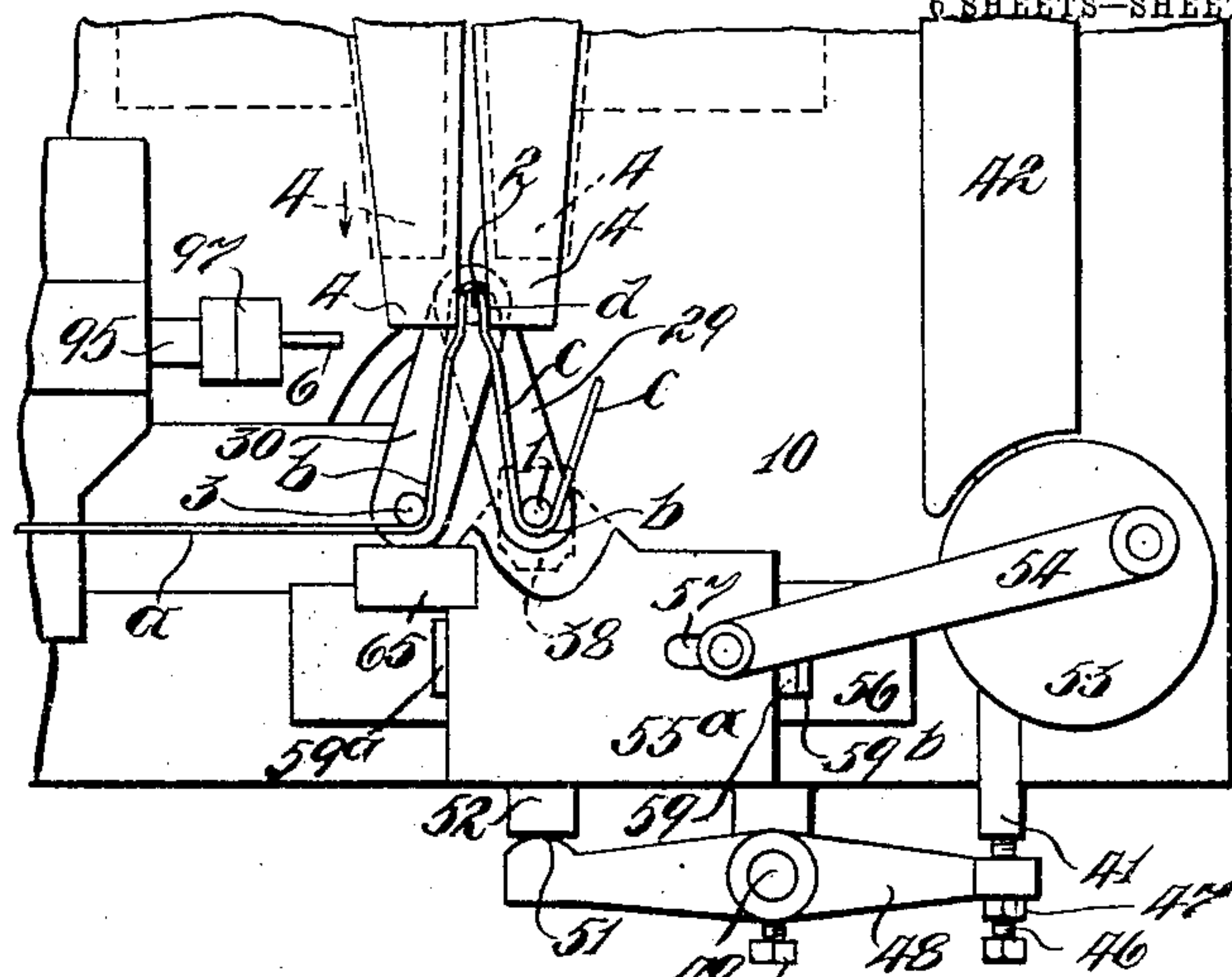


Fig. 4.

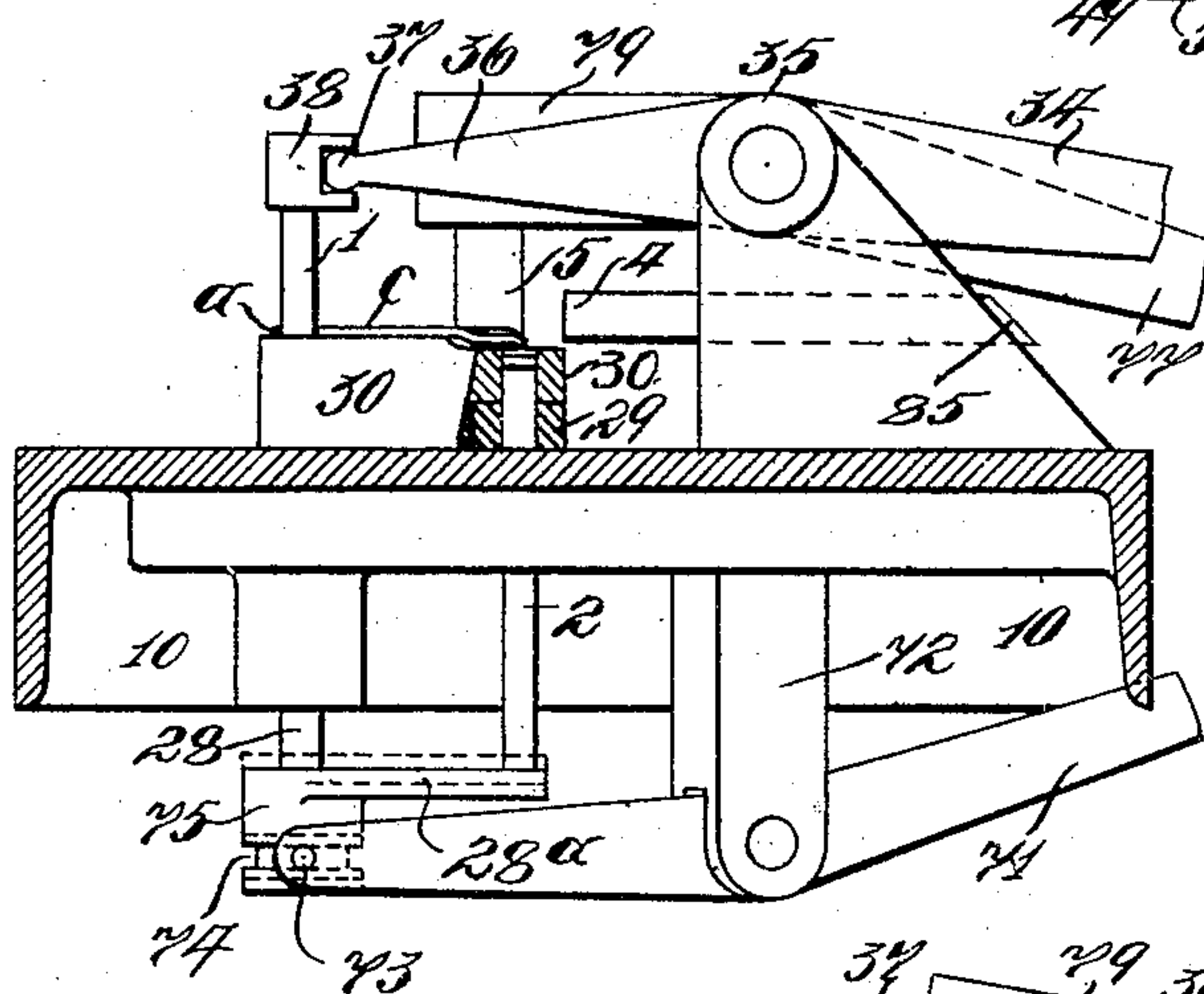
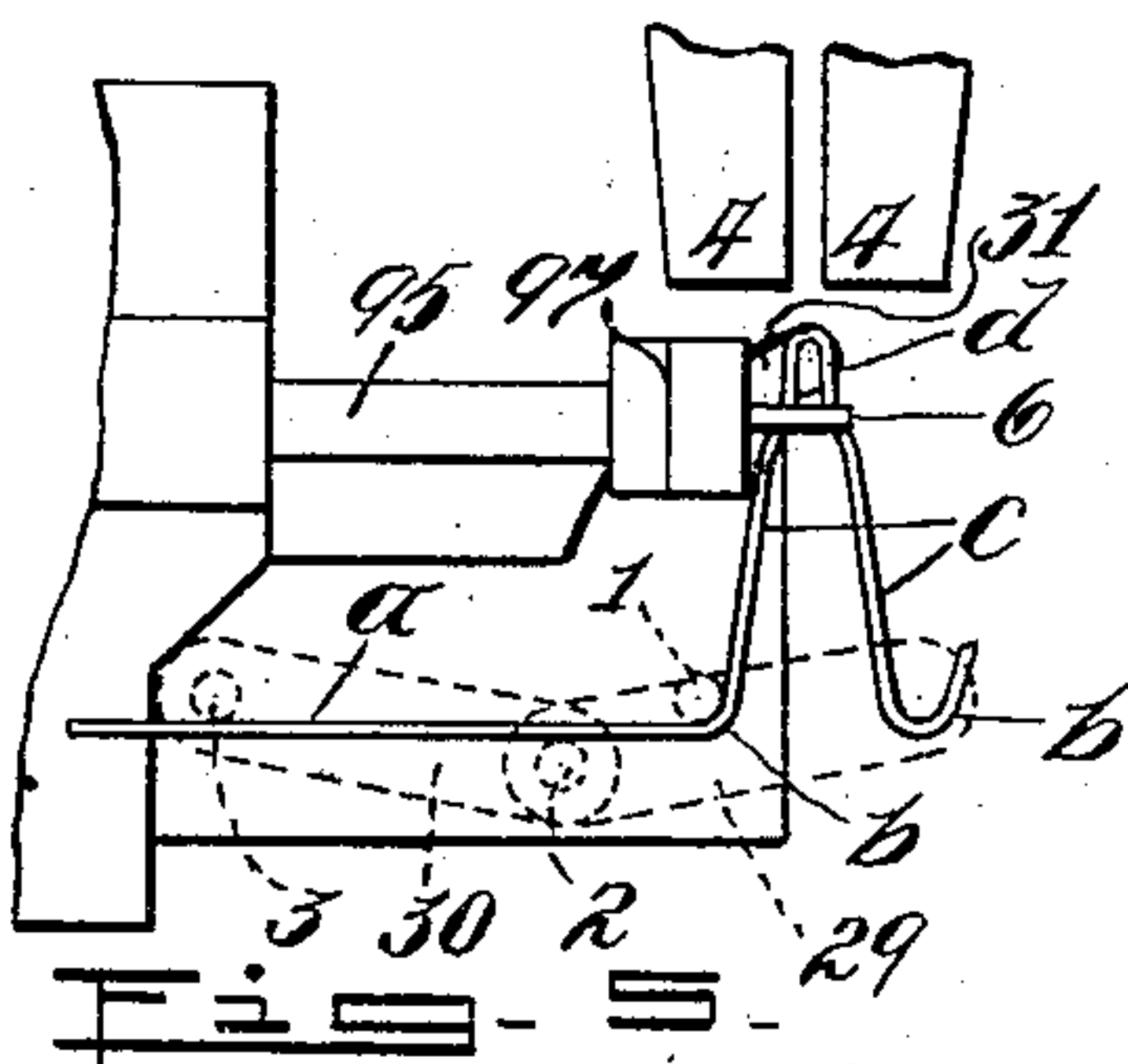
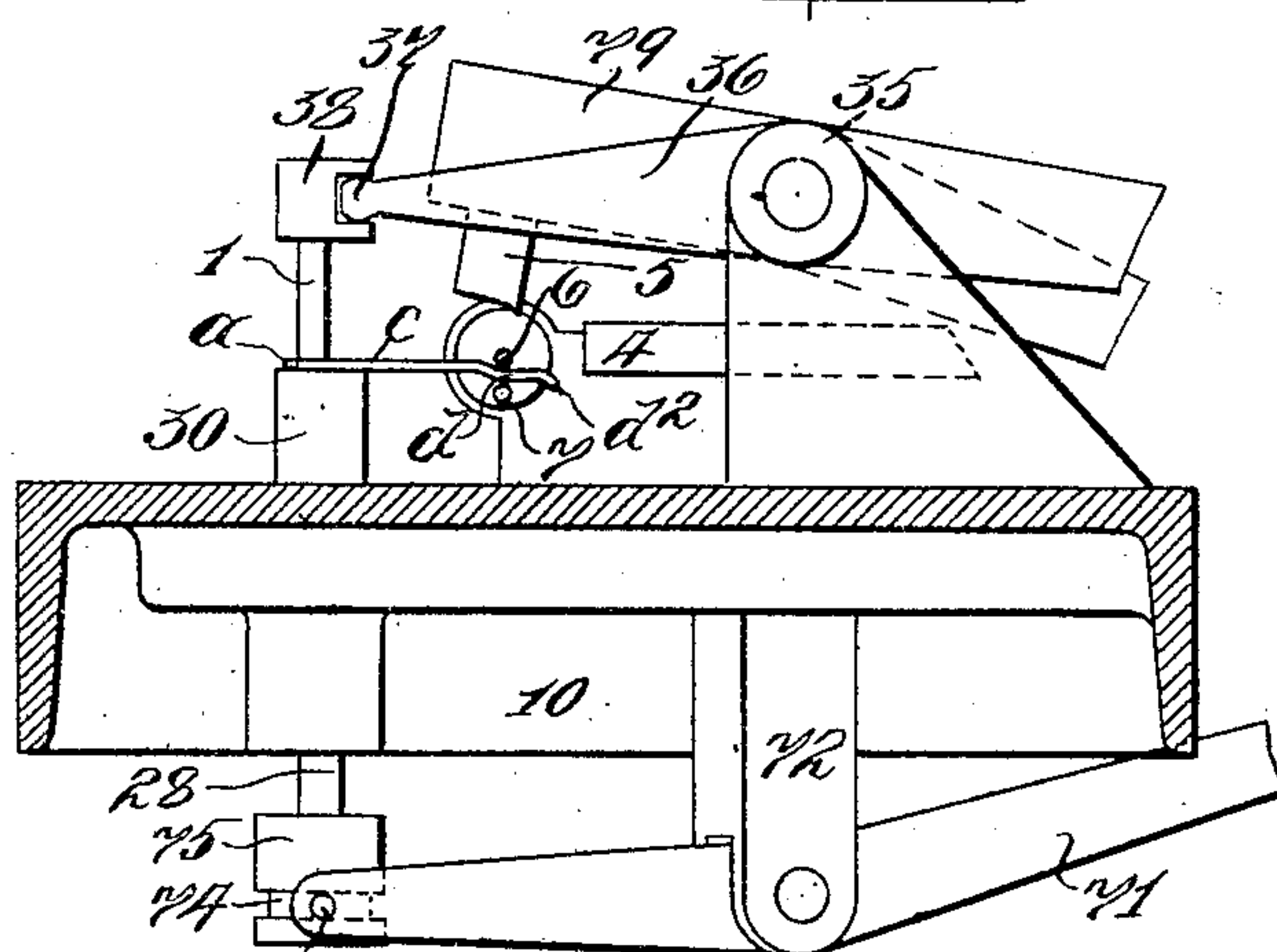
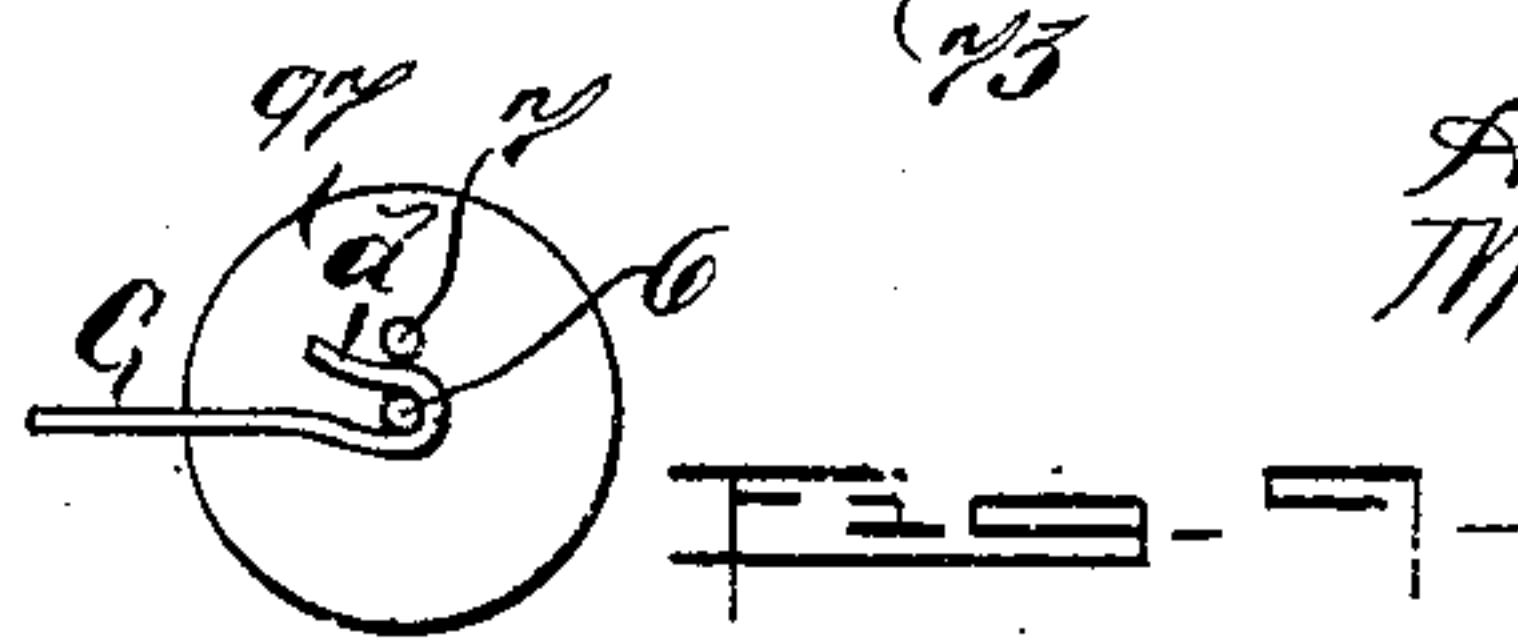


Fig. 5.



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Fig. 7.

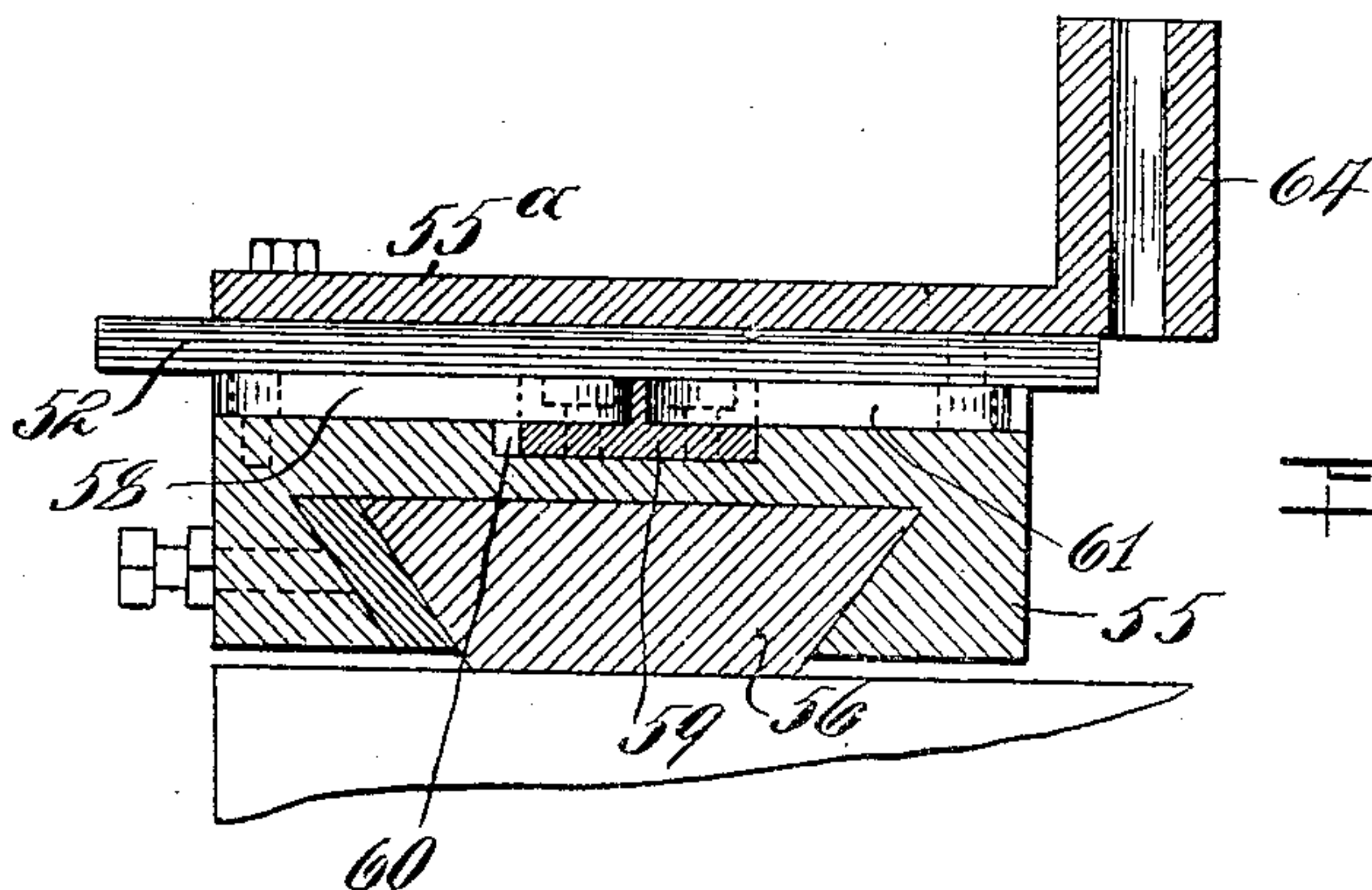
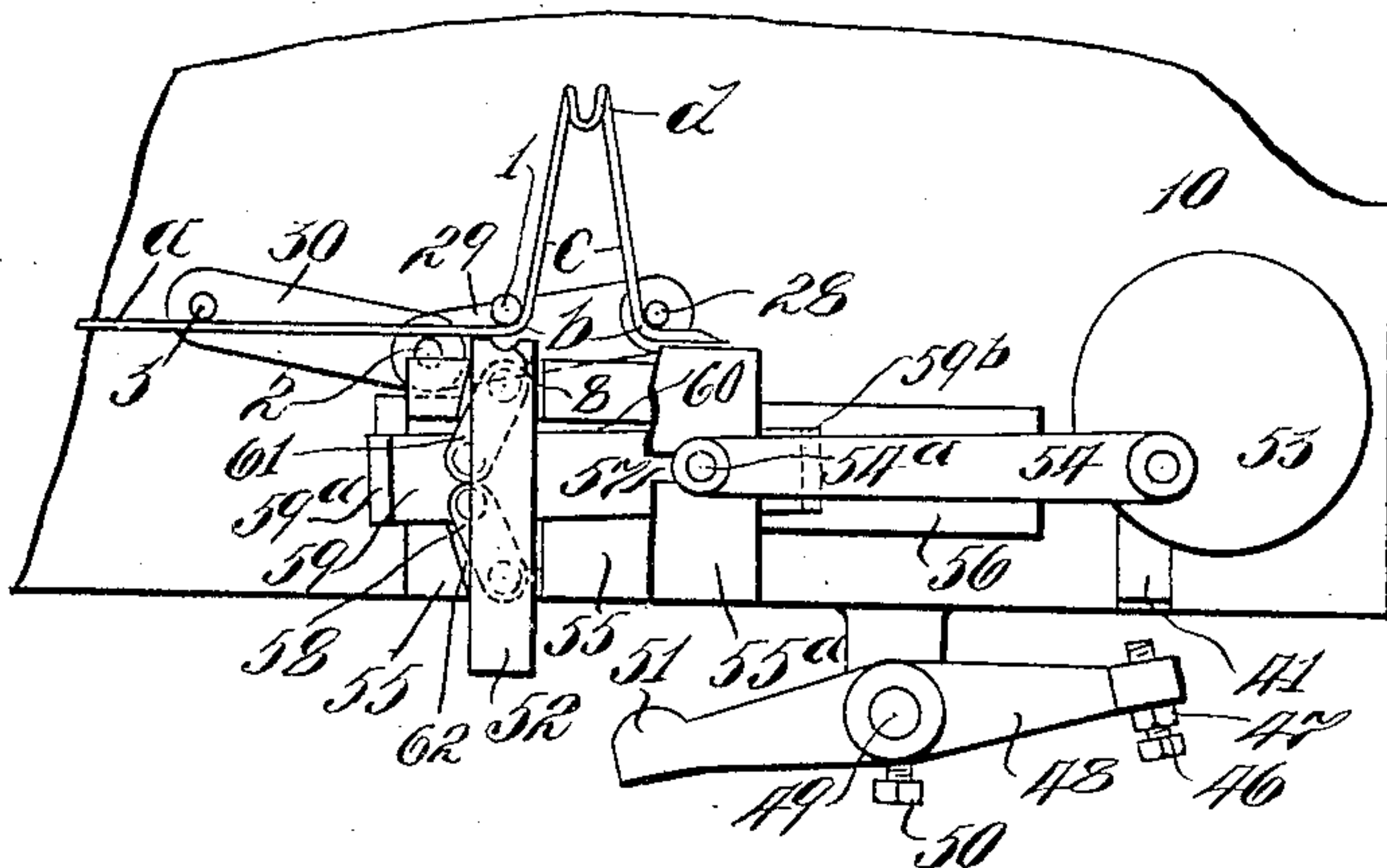


Fig. 21.

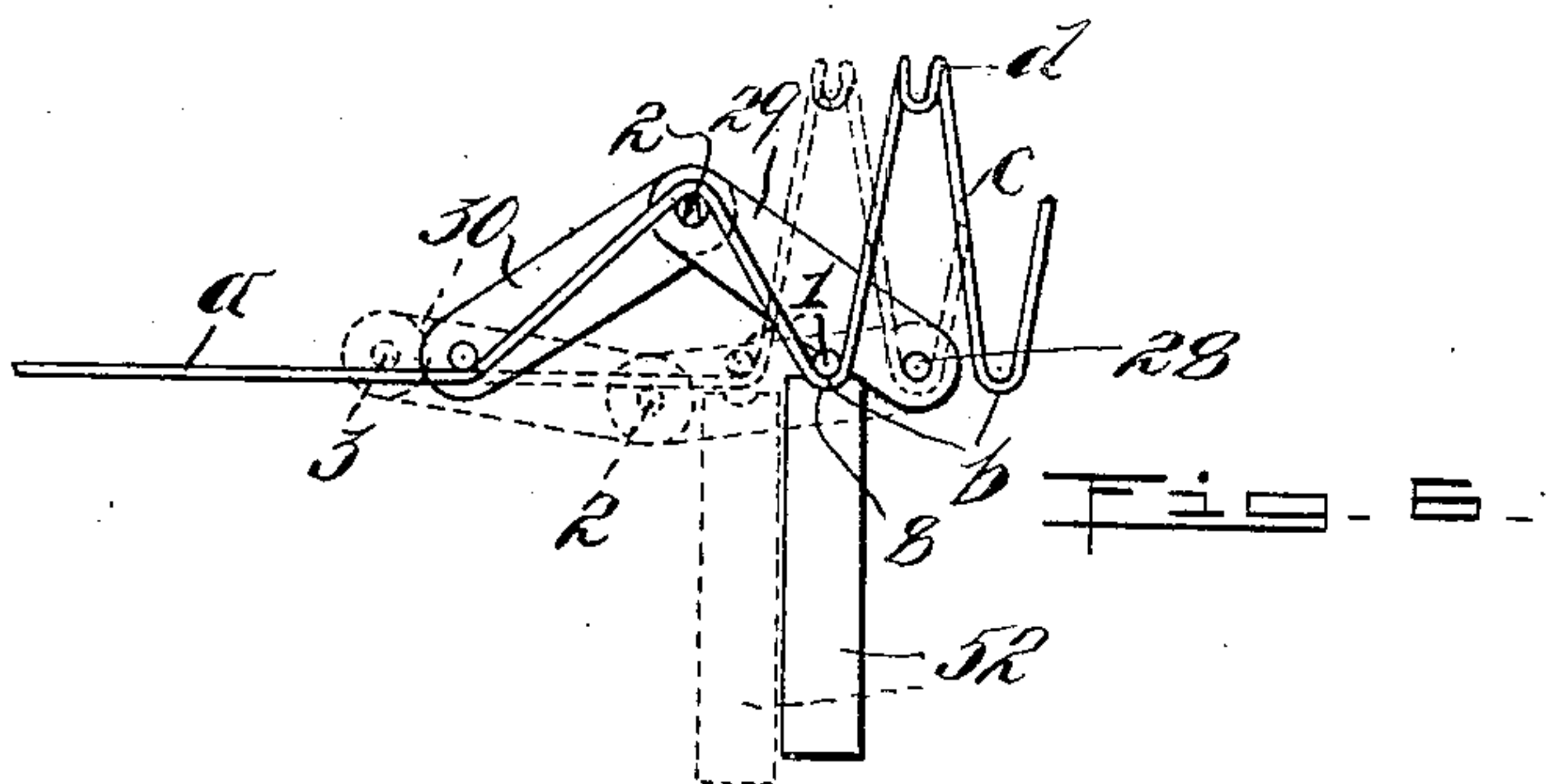


Fig. 8.

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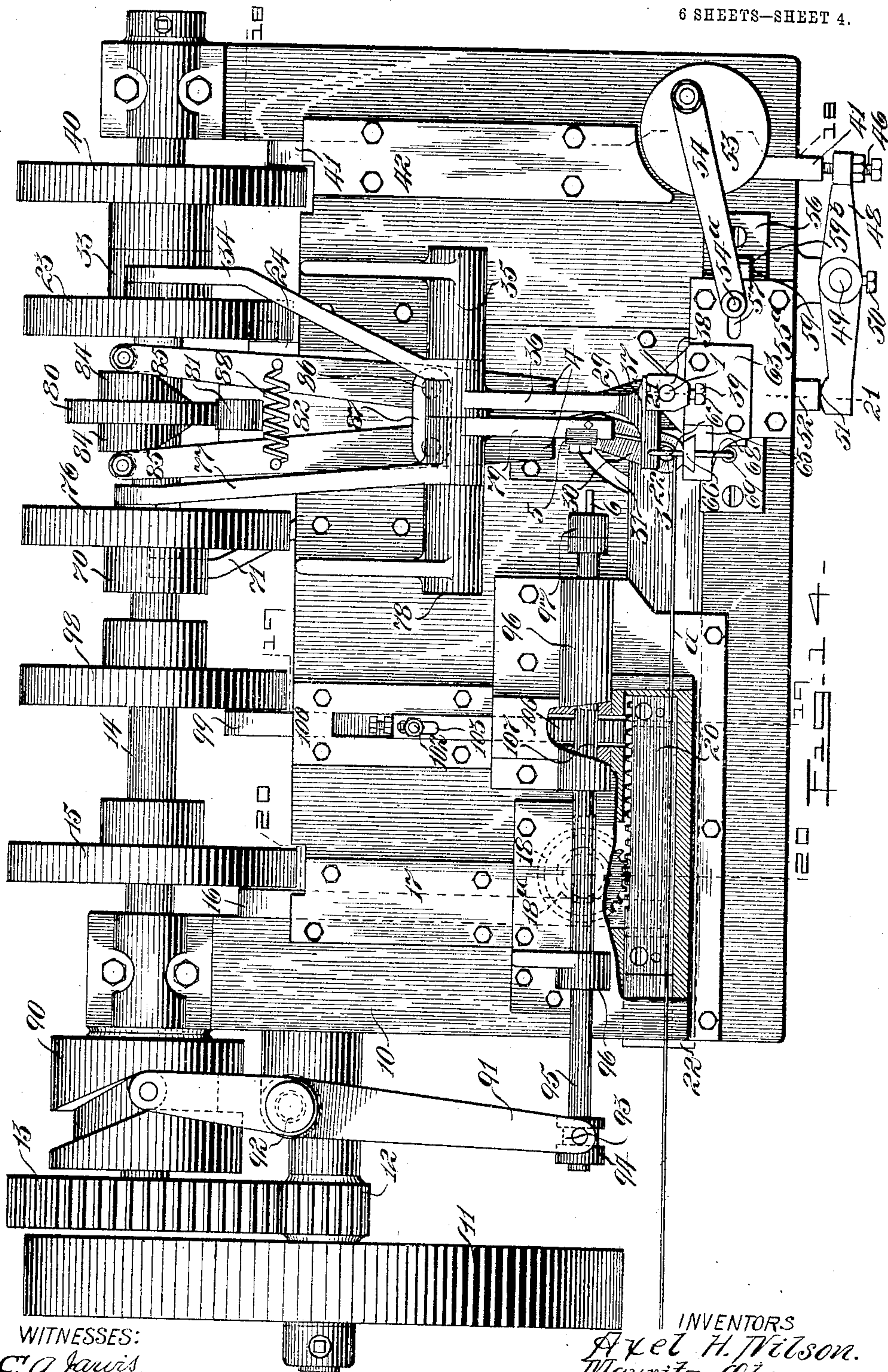
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6 SHEETS—SHEET 5.

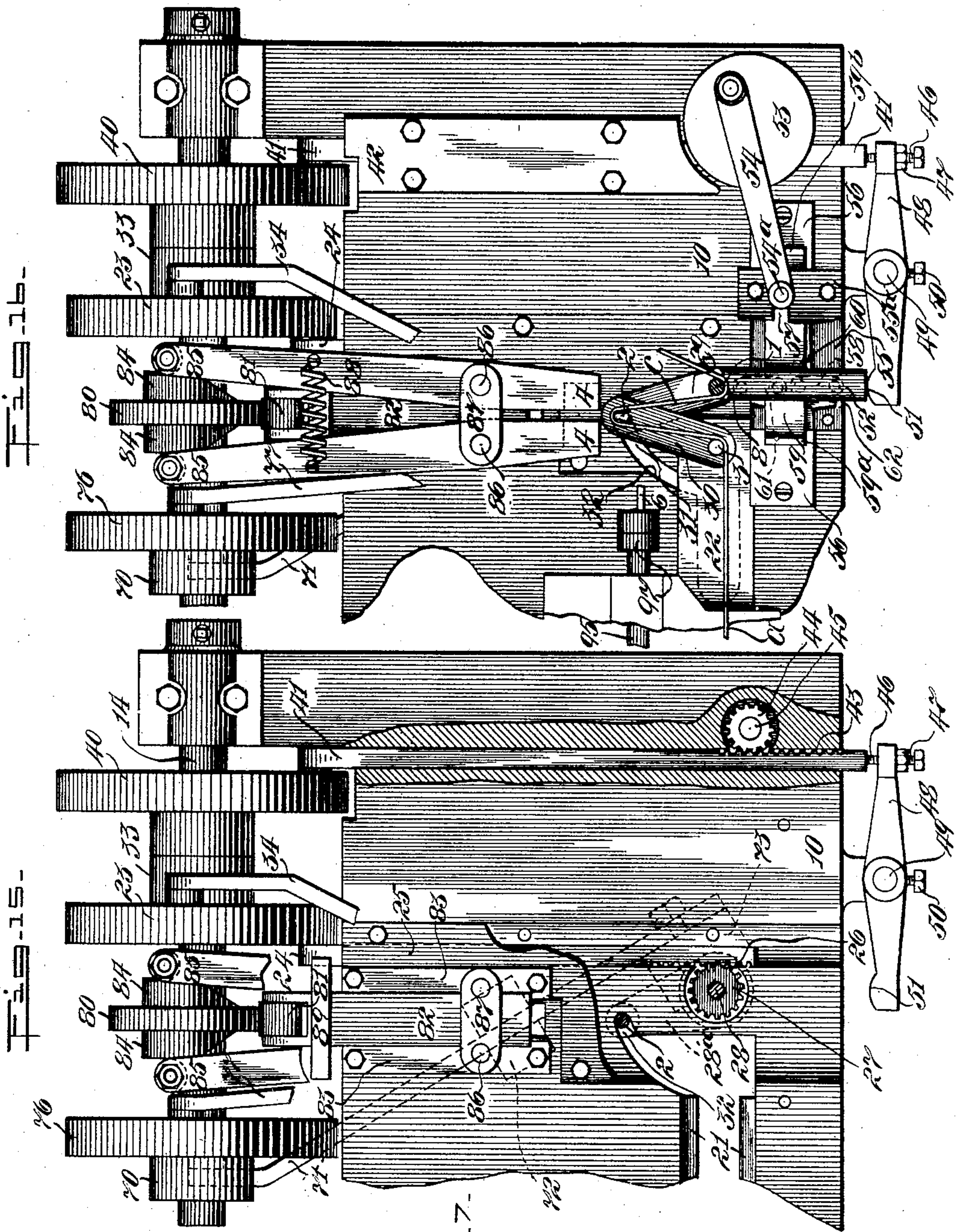


Fig. 16-

Fig. 15-

Fig. 17-

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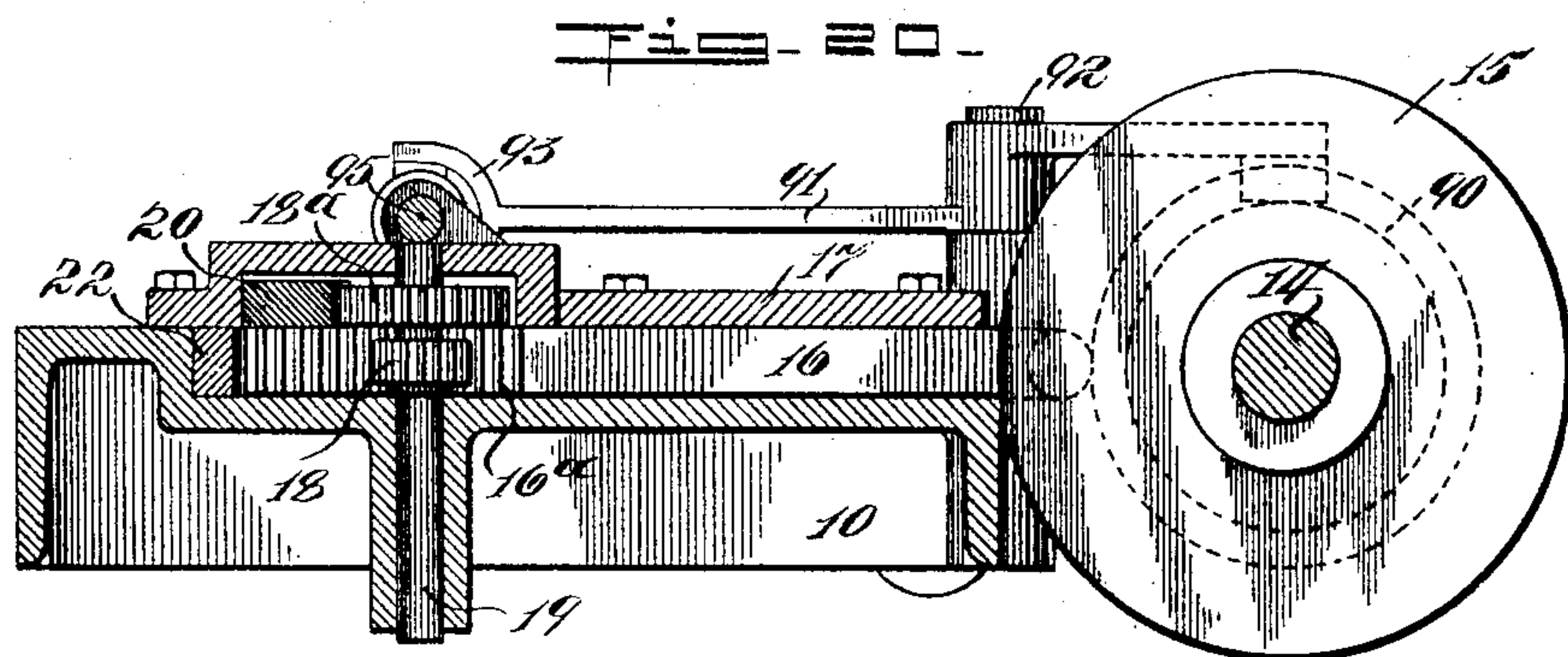
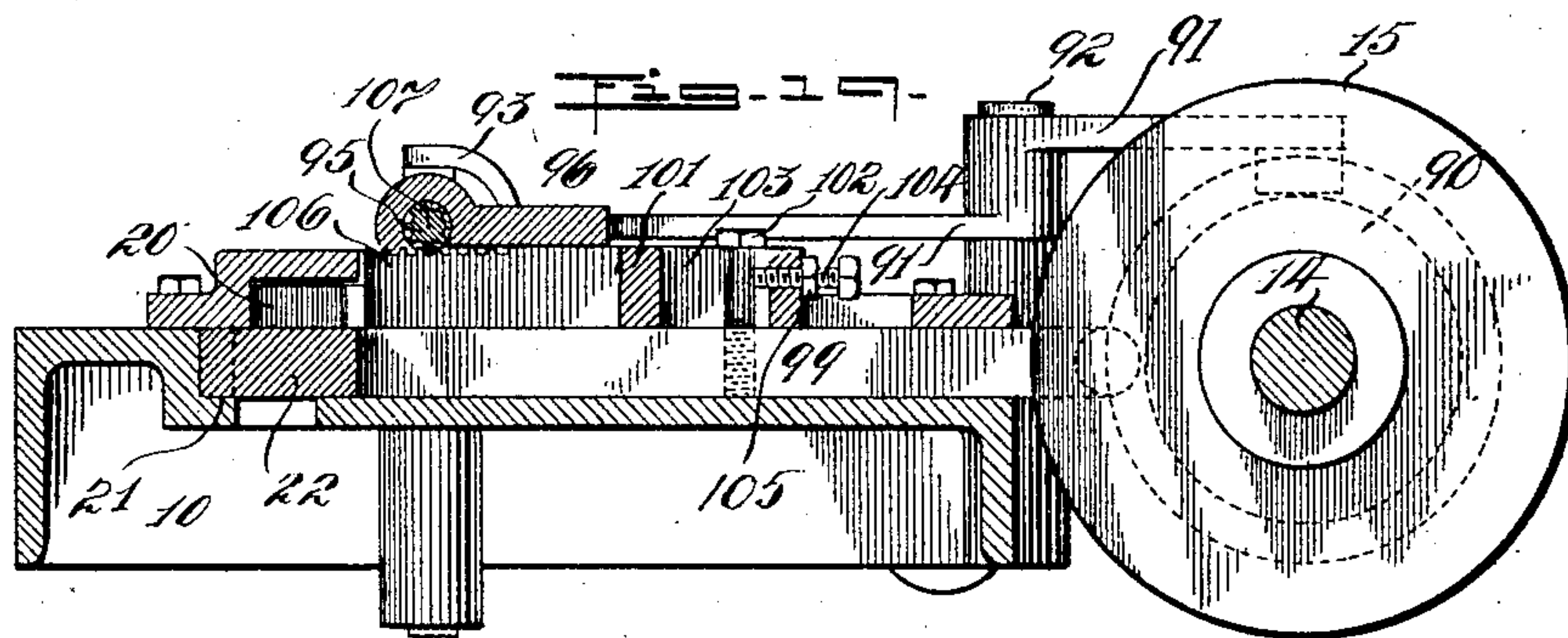
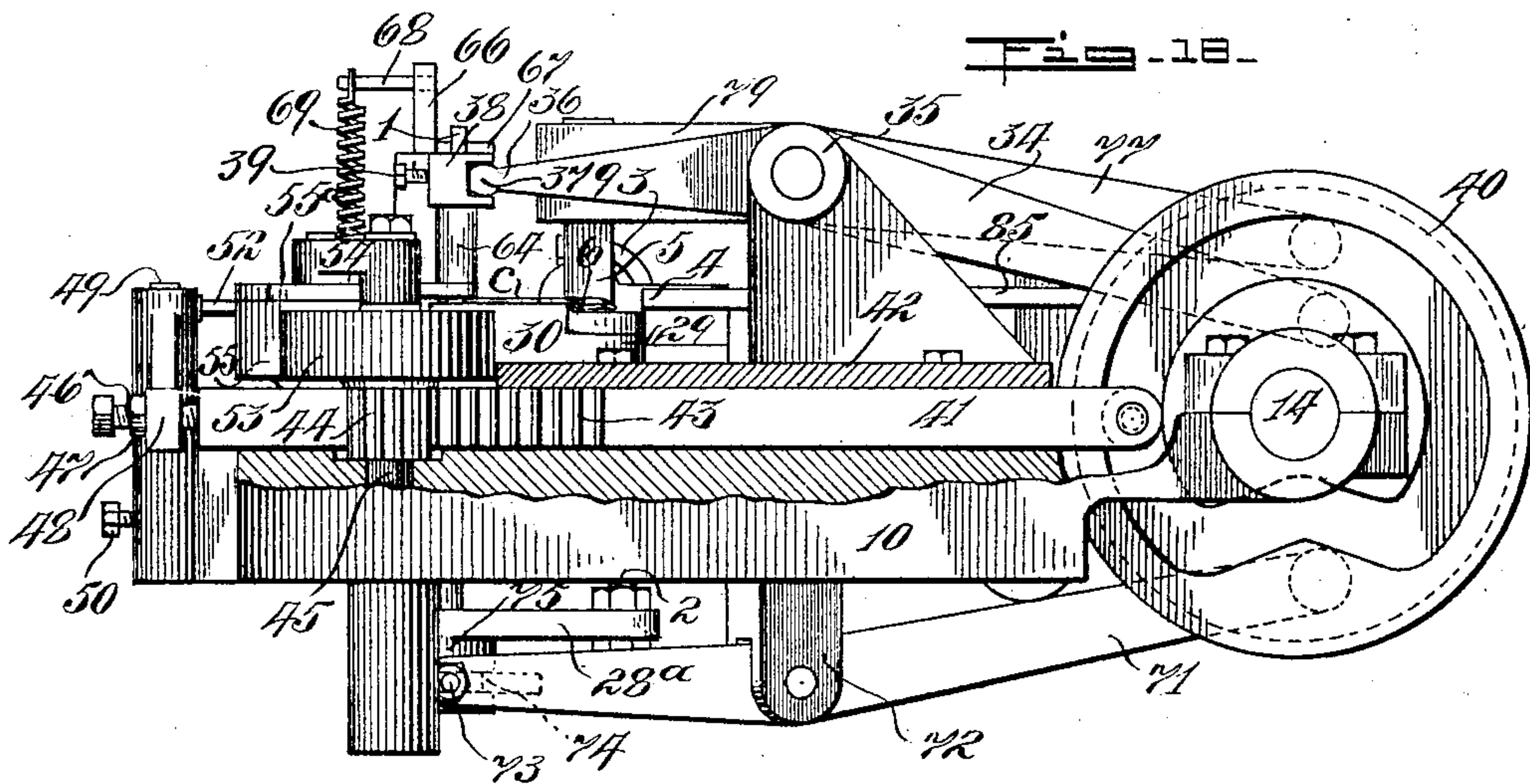
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6 SHEETS—SHEET 6.



UNITED STATES PATENT OFFICE.

AXEL H. NILSON AND MAURITZ OLSON, OF BRIDGEPORT, CONNECTICUT,
ASSIGNORS, BY MESNE ASSIGNMENTS, TO INTERNATIONAL AUTOMATIC
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WIRE-WORKING MACHINE.

No. 804,029.

Specification of Letters Patent.

Patented Nov. 7, 1905.

Application filed October 4, 1904. Serial No. 227,088.

To all whom it may concern:

Be it known that we, AXEL H. NILSON and MAURITZ OLSON, citizens of the United States, and residents of Bridgeport, in the county of Fairfield and State of Connecticut, have invented a new and Improved Wire-Working Machine, of which the following is a full, clear, and exact description.

Our invention relates to a wire-working machine, and while the machine and the several features thereof are capable of performing certain operations to manufacture various articles from wire, it is designed especially for forming continuous zigzag pieces of wire having hooks, a number of said wires being capable of being connected together in such a manner as to make a fabric for beds and other purposes.

The invention will be illustrated and described with special reference to its use for making such an article; but it is to be understood that its usefulness is not limited thereto.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figures 1, 2, 3, 4, 5, 6, 7, and 8 are outline drawings representing the portions of the machine which come in contact with the wire in several different positions which they assume during the course of the operation of the machine, Figs. 1, 3, 5, 7, and 8 being plan views, and Figs. 2, 4, and 6 being vertical sectional views. Fig. 9 is a fragmentary view showing the operation of a detail. Figs. 10, 11, 12, and 13 are side elevations of certain cams which may conveniently be employed for causing the parts to perform the desired operations. Fig. 14 is a plan view of a preferred embodiment of the invention, showing the various devices for causing the parts shown in the first eight figures to operate in the desired manner. Fig. 15 is a view similar to Fig. 14 of one end of the machine, showing it with parts removed to expose the interior. Fig. 16 is a view similar to Fig. 15, but showing additional portions of the device in position. Fig. 17 is an end view, on an enlarged scale, of one of the elements of the device. Figs. 18, 19, and 20 are sectional views on the lines 18 18, 19 19, and 20 20 of Fig. 14; and Fig. 21 is a sectional view, on an enlarged scale, on the line 21 21 of Fig. 14.

Referring especially to the first eight figures, the general operation of the machine will be described. In these figures the wire to be operated upon is designated by the letter *a*, and in Fig. 1 one loop of the article to be produced is shown in the completed form. This loop is provided with bends *b* and with side members *c*. The side members are placed at an angle to each other and converge toward the end of the loop, in which is formed a hook *d*. It is the purpose of the machine to take a straight wire *a* from a straightening device (not shown) and bend it first into a simple loop, then into the form shown in Fig. 3, in which the outer end of the loop is compressed to a slight extent, then turn this end over, as shown in Figs. 5 and 7, to form the hook *d*, and finally to carry the loop along, as shown in Fig. 8, and at the same time start to make the next loop.

Fig. 1 shows the position which the parts assume before the bending device commences to operate. This bending device comprises three pins 1, 2, and 3. In the starting position, as shown in Fig. 1, the pins 1 and 3 are placed above the wire and the pin 2 below it. The pin 2 is rotated about the pin 1 as a center, and the pin 3 is drawn forwardly toward the pin 1 in a straight line. The result of this is shown in Fig. 3. When the loop is formed, a pair of jaws 4 4 is employed to compress the outer end of the loop, as also shown in Fig. 3. Then a die or hammer 5 is employed to press down the end of the loop, so as to turn it back, as shown in Fig. 4. The next operation consists in placing two pins 6 and 7 (see Figs. 5 and 6) one upon each side of the loop, near its end, and then twisting the pin 7, which is below the wire, around the pin 6 as a center to form the hook, as shown in Fig. 9. The loop and hook having been formed, the pin is raised out of engagement with one bend *b* and carried back to engage with the other bend, the pin 3 being withdrawn at the same time, as shown in Fig. 7. The pins 2 and 3 are meantime returned to their original positions, as shown in Fig. 1, the pin 2 turning about a stationary central axis coincident with the original position of the pin 1. The wire is then fed along a space equal to the width of the loop by aid of a clamp 8, (see Fig. 8,) which is brought up to clutch the wire between itself and the pin 1 and to finish the bend around the pin 1.

and finally the whole thing is forced to the right the desired distance. During this last operation a bend for the next loop is made by the pins 2 and 3 in the manner above mentioned. The figures which have been referred to above show certain operating means for enabling these operations to take place; but for the purposes of convenience we have illustrated in Figs. 14 to 21, inclusive, a more complete form of the device showing in detail a preferred mechanism for carrying out the invention. In these figures the frame of the machine is represented by 10. A driving mechanism consisting of a pulley 11, pinion 12, and gear 13 or any other convenient driving mechanism may be employed. The gear 13 is shown as mounted directly upon the main shaft 14 of the machine. This shaft 14 is provided with operating devices for causing the operations described to take place. For operating the pin 3 a cam 15 is provided. It has a groove in which engages the end of a slide 16, guided upon the frame of the machine in ways 17. This slide is provided with rack-teeth 16^a, which mesh with a pinion 18 upon a shaft 19. This shaft is also provided with a gear 18^a, meshing with a rack 20, which is thereby given a reciprocating motion in ways 21, mounted upon the frame of the machine. The rack is provided with an extension 22, upon which is mounted the pin 3, and it will be obvious that a rotation of the shaft 14 will cause the slide, and consequently the pin 3, to make one complete reciprocation. Another cam 23 is mounted upon the shaft 14 for oscillating the pin 2. It has engagement with a slide 24, which reciprocates in guide-ways 25 upon the frame of the machine. This slide is provided with a rack 26, which meshes with and operates a pinion 27, mounted upon a shaft 28, as indicated in Fig. 15. This shaft extends through the frame, and upon the bottom thereof is an arm 28^a, which carries the pin 2 upon its outer end and extends upwardly through the frame of the machine into position to engage the wire *a*, as described. Upon the shaft 28 is pivoted a link 29, which is also connected with the pin 2. It will be obvious that the two links 28^a and 29, both being secured to the shaft 28 and pivotally connected to the pin 2, will always remain in parallel position and operate simultaneously about the shaft 28 as a pivot. 30 is a link mounted above the frame and connecting the pin 2 with the pin 3. It will be understood that the rotation of the shaft 14 will cause the shaft 28 to be oscillated through a certain arc, and consequently will cause the pin 2 to move from the position shown in Fig. 1 to that shown in Fig. 3, the links 29 and 30 following it as indicated. The link 30 will also be operated upon by the rack 20 and its projection 22, and the cams 15 and 23 are so designed and set as to provide for this operation. The interior parts of the frame are provided with

slots 31 and 32 to permit the arcuate motion of the pin 2. It will be seen, therefore, that the parts of the machine so far described, being operated by the cams 15 and 23, will cause a wire, placed in the machine and secured against the pin 1, which is in exact axial alignment with the shaft 28, to be bent into a loop, as shown in Fig. 8. For raising the pin 1 out of engagement with the loop a cam 33, having an exterior cam-face for operating a lever 34, is also provided upon the shaft 14. This lever is pivoted in an extension 35 upon the frame of the machine and is provided with an arm 36 and a head 37 at the end of the arm. A projection 38 upon the head 37 is designed for holding the pin 1, which is attached to it by means of a screw 39 or other equivalent device. It will be understood that the operation of the lever 34 about its pivot will raise and lower the pin 1 for the purpose of disengaging the pin from the wire, so that the latter can be moved along after the loop is formed and for bringing it back into position again, ready to aid in forming the next loop.

Means for clamping the wire against the pin 1 and for moving the loop along after it has been made will now be described, although it is to be understood that in the preferred embodiment of our machine certain other operations take place—namely, those which are necessary for the forming of the hook *d*.

A cam 40 upon the shaft 14 operates a slide 41 in ways 42 upon the frame of the machine. This slide is indicated in Fig. 15 as provided with a rack-face 43, which engages with a pinion 44 upon a shaft 45. This slide also is connected, by means of a screw 46 and a check-nut 47, with a lever 48, pivoted at 49 to the frame of the machine and designed to be adjusted and secured by means of a screw 50. This lever is provided with a convex face 51, designed to engage with and operate a slide 52, upon which is mounted the jaw 8, which clamps the wire to the pin 1 and finishes the bends *b* of the wire. Upon the shaft 45, as shown in Fig. 18, is also provided a disk 53 for operating a link 54, and to which disk said link is eccentrically pivoted. 55 is a slidable frame, mounted on ways 56 and provided with a cover 55^a for protecting the parts which it carries. It also has a slot 57, in which a pin 54^a, connected to the link 54, is designed to reciprocate. 58 is a link pivoted to the slide 55 and to a second slide 59, which is pivotally connected to the pin 54^a and works in a slot 60 in the slide 55. 61 is a link similar to the link 58, pivotally attached to the slides 59 and 52. The slide 55 is provided with slots 62 for permitting the links 58 and 61 to swing upon their pivots. The slide 59 is provided with projections 59^a and 59^b, which project outwardly so as to engage the edges of the cover 55^a or other part of the slide. The operation of this part of the device is as follows: The reciprocation of the slide 41 by

means of the cam 40 will cause the oscillation of the disk 53 and the reciprocation of the slide 59, which is pivotally connected directly to the pin 54^a. The projections 59^a and 59^b upon the slide 59 will come in contact with the edges of the slide 55 at certain periods in the reciprocation of the slide 59 and will then pick up the slide and cause it to reciprocate for the rest of the stroke with the slide 59.

The effect of this operation will be as follows: Assuming the parts to be in the position shown in Fig. 14, a loop having been formed, the movement of the link 54 to the left will pull the slide 59 in the same direction and cause the toggle-lever formed by the links 58 and 61 to be released, thus forcing the slide 52 outward and causing the jaw 8 to be freed from the wire *a*. The further movement of the link 54 and slide 59 to the left will cause the slide 55 to be taken up with the slide 59 on account of the projection 59^b coming into contact with the edge of the cover 55^a. This causes the entire device, including the jaw 8, to move to the left a distance equal to the width of one loop. The pin 1, having previously been raised by the head 37, will also be carried along with the slide. The block 38 is mounted upon a plate 63, secured to the outside surface of the cover 55^a, and has a bushing 64 for guiding the pin in a vertical direction. It is to be understood that during this operation the pin 3 is being drawn back and the pin 2 is being oscillated in a backward direction on its pivot 28, so that these two pins will be in position to engage with the straight portion of the wire. The pin 2 is also drawn down out of contact with the wire by mechanism to be hereinafter described. The parts are now in the position shown in Fig. 7. When the eccentric pulls the slide to the right, the first effort will be to straighten the toggle levers 58 and 61, force the slide 52 inward, and cause the jaw 8 to clamp the bend *b* between itself and the pin 1 and finish the bend. When the projection 59^a comes into contact with the cover 55^a, the slide 52, carrying the jaw 8, pin 1, and wire *a*, will move to the right. The pins 2 and 3 will also be operated to form the next bend, as indicated in Fig. 8.

65 is a projection upon the plate 63 and is provided with a slide 66, upon which is mounted a pin 67, having a rear extension 68. A spring 69 is connected to the plate 63 and to the projection 68, so as to normally hold the slide 66 in its innermost position. The pin 67, however, projects over the head 37 upon the arm 36 and extends over the top of the pin 3. It will be understood that when the head 37 is in its lowest position the pin 67 will extend over the top of the pin 3 and prevent disengagement of the wire therefrom. Upon the raising of the head 37, however, the pin 67 is raised against the tension of the spring

69, so as to free the pin 3 and allow the other operations to take place.

As far as described the pin 2 remains in engagement with the wire while the latter is being transferred. Means for retracting the pin and disengaging it from the wire will now be described.

A cam 70, mounted upon the shaft 14 and engaging with a lever 71, pivotally mounted upon a projection 72 on the under side of the frame, operates a yoke 73, which engages in a groove 74 in a head 75, attached to the bottom of the shaft 28 and to the arm 28^a. It will be obvious that the pivotal motion of the lever 71 will cause a reciprocation of the pin 2 and will disengage it from the loop, as shown in Fig. 4. The operation so far described provides for the production of a plain loop and the transfer thereof to the rear in order to place the parts in such a position as to provide for forming the next loop.

The operation of the various parts for forming the hook upon the loop will now be described.

A cam 76, which may, if desired, be integral with the cam 70, is connected to a lever 77, which is pivoted in a projection 78 of the frame of the machine and is provided with an arm 79, carrying the die 5. The cams 70 and 76 are indicated by Fig. 10. It will be apparent from the shape of the die that the operation of the cam 76 and its connected parts will cause the extreme end of the loop to be bent downwardly, as shown in Fig. 4.

In order to pinch the end of the loop, as shown in Fig. 3, the following mechanism may be used: 80 is a cam upon the shaft 14, operating a roller 81 to cause a block 82 to slide back and forth in guides 83. 84 84 represent two cams operating upon the levers 85 85, pivoted at 86 to an extension 87 upon the block 82. At their inner ends these levers are furnished with the jaws 4. The cam 80 is designed to force the block 82 and the jaws 4 toward the loop into operative position. The cams 84 will then operate to force the jaws together, and when they release the jaws a spring 88, mounted upon the levers 85, forces them apart. The pin 2 is provided with a triangular portion 2^a, (see Fig. 17,) between which and the jaws 4 the loop is designed to be squeezed to cause it to assume the shape indicated in Fig. 3. The loop now having been formed except for the turning over of the hook, this operation will now be described. A cam 90 upon the shaft 14 operates a lever 91, pivoted to the frame at the point 92 and provided with a yoke 93, engaging in a groove 94 upon a shaft 95. This shaft is journaled in bearings 96 upon the top part of the frame of the machine and is provided with a head 97, in which the pins 6 and 7 are located, the pin 6 being preferably concentric with the shaft 95. It will be clear that the operation

of the cam 90 will reciprocate the shaft 95 and the pins 6 and 7, so as to bring the latter into position for engaging the loop, as indicated in Fig. 5.

5 For rotating the head 97 and causing the pins to perform the operation indicated in Fig. 9 the following mechanism is employed: A cam 98, mounted upon the shaft 14, operates a slide 99, working in ways 100 upon the
10 frame. A frame 101 is secured to the slide 99 by means of a bolt 102, adjustably mounted in a slot 103 in the frame 101. For the purpose of securing this adjustment and accurately positioning the two parts 99 and 101 with respect
15 to each other a screw 104 is provided, having a check-nut 105. The frame 101 is provided with a rack 106, which meshes with an elongated pinion 107 upon the shaft 95. It will be readily understood that the operation
20 of the eccentric 98 through the rack 106 and pinion 107 will cause the shaft 95 to be oscillated and the pins 6 and 7 to perform the operation indicated in Fig. 9 and bend over the loop to form a hook.

25 The operation of the whole machine will now be described. Starting with the parts as shown in Fig. 7, in which the loop has been formed, the hook turned, the parts for operating on the hook withdrawn, and the jaw 8
30 with the pin 1 moved back ready to grip the rear bend of the loop, the first operation will be to force the jaw into contact with the wire to grip it against the pin 1. The next operation will be to draw the slide 55 and its connected parts to the right, taking with them
35 the formed loop and wire. Simultaneously with this the link 29 is swung upwardly and the pin 3 forced inwardly by means of the cams 23 and 15, respectively. (See Fig. 8.)
40 This will form the new plain loop. The jaws 44 are now advanced by the cam 80 and block 82, and then they are swung on their pivots by the operation of the cams 84 84 around the triangular portion a^2 of the pin 2, thus pinching
45 the end of the loop together, as shown in Fig. 3. The cams 84 84 then permit the spring 88 to draw the jaws apart, and a spring (not shown) or other convenient device forces the roller 81 back upon the circular surface of
50 the cam 80 and withdraws the jaws entirely from the loop. The pin 2 is now withdrawn from engagement with the loop by means of the cam 70 and its connections, as indicated in Fig. 4, and the die 5 is brought down, by
55 means of the arm 79, operated by the cam 76, to give the slight reverse bend to the end of the loop. This is next withdrawn and the pins 6 and 7 advanced by the operation of the cam 90, so that the pin 6 assumes a position above
60 the wire and the pin 7 a position below it, the link 30 having been just previously to this operation drawn out of the way by the movement of the slide 22 and the shaft 28. The operation of the cam 98 then rotates the shaft
65 95 and causes the pins 6 and 7 to bend over

the end of the loop to form the hook. During this time the other cams have been operating with their concentric portions upon their various levers, so as to hold the latter in a stationary position, and after the pins 6 and 7
70 are withdrawn by means of the cam 90 the cam 33 comes into operative position, so as to withdraw the pin 1. Then the cam 40 operates to push back the slide 55, carrying the pin 1 and jaw 8, and finally it operates to grip
75 the wire and draw it to the right, as has been described. Then the other cams proceed to operate in their respective turns in the manner described above.

It is to be understood that the drawings represent merely a preferred form of machine which constitutes one embodiment of our invention and that the latter is not limited to the mechanism shown in the views of the complete machine nor to the outline views, many
85 modifications being obviously within the scope of the invention.

Having thus described our invention, we claim as new and desire to secure by Letters Patent—

1. In a wire-working machine, the combination of means for bending a wire into a succession of zigzag loops, means for then forming a hook on every alternate loop, and means for finally finishing the loop form of the other
95 loops.

2. In a wire-working machine, the combination of means for bending a wire into a flat body having loops alternately arranged at the opposite edges thereof, means for then forming
100 spring-hooks on the loops on one edge of the body, and means for finally finishing the loops on the other edge to preserve the loop form thereof.

3. In a wire-working machine, the combination of means for automatically bending the wire into a succession of zigzag loops, means for forming a hook on every alternate loop, and means for preserving the other loops in
105 loop form.

4. In a wire-working machine, the combination of means for automatically bending a wire into a flat body having loops alternately arranged at the opposite edges thereof, means for automatically forming spring-hooks on
110 the loops on one edge of the body, and means for preserving the other loops in loop form.

5. In a wire-working machine, the combination of means for forming a loop, means for slightly bending the end of the loop in a direction transverse to the plane of the loop and means for then bending the loop in the reverse direction to form a hook.
120

6. In a wire-working machine, the combination of means for forming a loop, means for slightly bending the end of the loop in a direction transverse to the plane of the loop and means for finally bending the loop in the reverse direction through an arc of about one
125 hundred and eighty degrees.
130

7. In a wire-working machine, the combination of means for successively bending a wire into a series of loops alternately extending in opposite directions, means for automatically slightly bending the ends of each of the loops extending in one direction and means for finishing the bends in the other loops to preserve them in loop form.

8. In a wire-working machine, the combination of means for successively bending wire into a series of loops alternately extending in opposite directions, means for automatically slightly bending in a direction transverse to the plane of the loops the ends of each of the loops extending in one direction, means for automatically forming a hook on the previously-bent loops and means for acting on the bends in the other loops to preserve them in looped form.

9. In a wire-working machine, the combination of means for forming a loop, means for thereafter slightly bending the end of the loop in a direction transverse thereto, means for squeezing together the members of the loop near the end thereof, and means for bending the loop in the reverse direction to form a hook.

10. In a wire-working machine, the combination of means for successively bending a wire into a series of loops alternately extending in opposite directions, means for automatically slightly bending the ends of each of the loops extending in one direction, means for automatically squeezing together the members of the bent loops near the ends thereof, and means for automatically forming a hook on said previously-bent loops.

11. In a wire-working machine, the combination of means for forming a loop, means for thereafter squeezing the ends thereof toward each other, and means for finally bending the end of the loop upon itself to form a hook.

12. In a wire-working machine, the combination of means for successively bending a wire into a series of loops alternately extending in opposite directions, means for squeezing together the ends of each of the loops extending in one direction, and means for automatically forming a hook on the loops the ends of which have been squeezed together.

13. In a wire-working machine, the combination of means for successively bending a wire into a series of loops alternately extending in opposite directions, means for slightly bending the ends of each of the loops extending in one direction, and means for squeezing together said bent ends.

14. In a wire-working machine, the combination of means for forming a loop, means for thereafter squeezing the ends of the loop together, means for then slightly bending the end of the loop, and means for finally clamping the loop and advancing it in the machine.

15. In a wire-working machine, the combination of means for forming a loop, means for

thereafter squeezing the ends of the loop together, and means for finally clamping the loop and advancing it in the machine.

16. In a wire-working machine, the combination of means for forming a loop, means for thereafter slightly bending the loop, means for squeezing toward each other the members of the loop to bring the strands into parallelism with and at a distance from each other, and means for bending the loop in a reverse direction to the first bend to form a hook.

17. In a wire-working machine, the combination of means for bending a wire into a series of loops alternately extending in opposite directions, means for slightly bending the ends of each of the loops extending in one direction, means for squeezing together the members of the bent loops, and means for forming a hook on said previously-bent loops.

18. In a wire-working machine, the combination of means for bending a wire to form a loop, means for slightly bending the end of the loop in one direction, means for squeezing toward each other the members of the bent loop to bring them into parallelism at a distance from each other, and means for finally forming a hook on said previously-bent loops extending in a direction opposite to that of the first bend.

19. In a wire-working machine, the combination of means for successively bending a wire into a series of loops, means for squeezing together the ends of certain of said loops, and means for forming a hook on each of the loops the ends of which have been squeezed together.

20. In a wire-working machine, the combination of means for bending a wire in reverse directions to form a loop, means for bending over the end of the loop after it is formed to form a hook, means for clamping one of the bends produced and finishing it, and means for advancing the loop in the machine.

21. A wire-working machine, comprising three pins, two of said pins being adapted to engage a wire on one side thereof, and the third to engage the wire on the other side at a point between the other two pins, means for giving an arcuate motion to said third pin about one of the other pins as a center, in a direction toward the wire, and means for moving one of the first-named pins in a straight line toward the one about which the third pin turns, said line being parallel with the original position of the wire.

22. A wire-working machine, comprising three pins, two of said pins being adapted to engage a wire on one side thereof, and the third to engage the wire on the other side at a point between the other two pins, means for giving an arcuate motion to said third pin about one of the other pins as a center, in a direction toward the wire, and means for moving one of the first-mentioned pins in a straight line toward the other of said first-mentioned pins.

23. A wire-working machine, comprising three pins, two of them being adapted to engage a wire on one side thereof and the third on the other side at a point between the first
5 two, means for moving said third pin toward the wire to form a loop, means for withdrawing two of said pins from contact with the wire, and means for engaging the wire about the pin remaining in contact with it, and moving
10 the wire along in the machine.

24. A wire-working machine comprising three pins, two of said pins being adapted to engage a wire on one side thereof, and the third to engage the wire on the other side at
15 a point between the other two pins, means for moving said third pin toward the wire to form a loop, means for withdrawing two of said pins from contact with the wire, and means for engaging the wire about the pin
20 remaining in contact with it, finishing the bend about that pin, and moving the wire along in the machine.

25. A wire-working machine comprising three pins, two of said pins being adapted to engage a wire on one side thereof, and the third to engage the wire on the other side at
25 a point between the other two pins, means for moving said third pin toward the wire to form a loop, means for withdrawing two of said pins from contact with the wire, a forming-clamp, means for forcing the clamp into engagement with the wire and causing it to clamp it between the clamp and the pin remaining in contact with the wire, and means
30 for moving the clamp and pin forward in the machine.

26. A wire-working machine comprising three pins, two of said pins being adapted to engage a wire on one side thereof, and the third to engage the wire on the other side at
40 a point between the other two pins, means for moving said third pin toward the wire to form a loop, means for withdrawing two of said pins from contact with the wire, a forming-clamp, means for forcing the clamp into engagement with the wire and causing it to clamp it between the clamp and the pin remaining in contact with the wire, means for moving the clamp and pin forward in the machine, means for loosening the clamp after its stroke in one direction is completed, and means for returning the clamp and pin to their original positions.

27. A wire-working machine comprising
55 three pins, two of said pins being adapted to engage a wire on one side thereof, and the third to engage the wire on the other side at a point between the other two pins, means for moving said third pin toward the wire to form a loop, means for withdrawing two of said pins from contact with the wire, a forming-clamp, means for forcing the clamp into engagement with the wire and causing it to clamp it between the clamp and the pin remaining in contact with the wire, means for
65 moving the clamp and pin forward in the machine, and additional means for securing the clamp against the wire and pin.

moving the clamp and pin forward in the machine, and additional means for securing the clamp against the wire and pin.

28. A wire-working machine, comprising a plurality of pins, means for moving one of
70 said pins toward a wire to form a loop, a forming-clamp, means for forcing the clamp into engagement with the wire and causing it to clamp the wire against one of said pins, and means for moving the clamp and said last-
75 mentioned pin forward in the machine.

29. A wire-working machine, comprising a plurality of pins, means for moving one of said pins against the wire to form a loop, a forming-clamp, means for forcing the clamp
80 into engagement with the wire and causing it to clamp the wire against one of said pins, means for moving the clamp and pin forward in the machine, means for loosening the clamp after its stroke in one direction is completed, and means for returning the clamp and pin to their original positions.

30. A wire-working machine, comprising a pair of links, three pins, the first of said pins constituting a pivotal connection between adjacent ends of the links, and the second and third pins serving as pivots for the two links at their outer ends, and means for swinging one of said links about its outer end as a center.
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31. A wire-working machine, comprising a pair of links and three pins, the first of said pins constituting a pivotal connection between adjacent ends of said links, and the second and third pins serving as pivots for
100 the two links at their other ends.

32. A wire-working machine, comprising a pair of links and three pins, the first of said pins constituting a pivotal connection between adjacent ends of said links, and the
105 second and third pins serving as pivots for the two links at their other ends, the second pin being temporarily mounted on a stationary axis, and the third pin on a reciprocable axis.
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33. A wire-working machine, comprising a pair of links and three pins, the first of said pins constituting a pivotal connection between adjacent ends of said links, and the second and third pins serving as pivots for
115 the two links at their other ends, the second pin being temporarily mounted on a stationary axis, and the third pin on a reciprocable axis, means for oscillating one of the links about the axis of said second pin, and means
120 for reciprocating said third pin.

34. A wire-working machine, comprising a pair of links and three pins, the first of said pins constituting a pivotal connection between adjacent ends of said links, and the second
125 and third pins serving as pivots for the two links at their outer ends, said first pin being adapted to engage the wire on one side thereof, and said second and third pins on the other side, means for oscillating one of the links
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about the axis of the second pin and thereby giving said first pin an arcuate motion, and means for reciprocating said third pin toward the second pin.

5 35. A wire-working machine, comprising a pair of links and three pins, the first of said pins constituting a pivotal connection between adjacent ends of said links, and the second and third pins serving as pivots for the two
10 links at their other ends, said first pin being adapted to engage the wire on one side thereof, and said second and third pins on the other side, means for oscillating one of the links about the axis of the second pin and thereby
15 giving said first pin an arcuate motion, means for reciprocating said third pin toward the second pin, and means for thereafter withdrawing said first and second pins in contact with the wire.

20 36. A wire-working machine, comprising a pair of links and three pins, the first of said pins constituting a pivotal connection between adjacent ends of said links, and the second and third pins serving as pivots for the two
25 links at their outer ends, said first pin being adapted to engage the wire on one side thereof, and said second and third pins on the other side, means for oscillating one of the links about the axis of the second pin and thereby
30 giving said first pin an arcuate motion, means for reciprocating said third pin toward the second pin, and means for thereafter withdrawing said first and second pins axially in opposite directions in contact with the loop
35 thus produced.

37. A wire-working machine, comprising a pair of links and three pins, the first of said pins constituting a pivotal connection between adjacent ends of said links, and the second
40 and third pins serving as pivots for the two links at their outer ends, said first pin being adapted to engage the wire on one side thereof, and said second and third pins on the other side, means for oscillating one of the links
45 about the axis of the second pin and thereby giving said first pin an arcuate motion, means for reciprocating said third pin toward the second pin, means for thereafter withdrawing said first and second pins axially in opposite
50 directions in contact with the loop thus produced, and means for withdrawing said third pin in a direction at right angles to the direction of motion of the other two pins.

38. A wire-working machine, comprising a
55 pair of links and three pins, the first of said pins constituting a pivotal connection between adjacent ends of said links, and the second and third pins serving as pivots for the two links at their outer ends, said first pin being adapt-
60 ed to engage the wire on one side thereof, and said second and third pins on the other side, means for oscillating one of the links about the axis of the second pin and thereby giving said first pin an arcuate motion, means for re-
65 ciprocating said third pin toward the second

pin, means for thereafter withdrawing said first and second pins axially in opposite directions in contact with the loop thus produced, means for withdrawing said third pin in con-
70 tact with the loop, and means for then moving said second pin back and inserting it in the place of the third pin.

39. A wire-working machine, comprising a pair of links and three pins, the first of said pins constituting a pivotal connection between
75 adjacent ends of said links, and the second and third pins serving as pivots for the two links at their outer ends, said first pin being adapted to engage the wire on one side thereof, and said second and third pins on the other side,
80 means for oscillating one of the links about the axis of the second pin and thereby giving said first pin an arcuate motion, means for reciprocating said third pin toward the second pin, means for thereafter withdrawing said first
85 and second pins axially in opposite directions in contact with the loop thus produced, means for withdrawing said third pin in contact with the loop, means for then moving said second pin back and inserting it in the place of the
90 third pin, and means for finally moving the second pin forward with the loop.

40. In a wire-working machine, the combination of a pair of links and three pins, the first of said pins constituting a pivotal connection between adjacent ends of said links, and the second and third pins being pivotally connected to the two links at their other ends, a slide on which said third pin is mounted, and means for reciprocating said slide toward and
100 from the second pin.

41. A wire-working machine, comprising three pins, two being adapted to engage a wire on one side and the other to engage the wire on the other side at a point between the other
105 two, means for giving an arcuate motion to said third pin about one of the other pins as a center for forming a loop, and means for pinching together the two members of the loop near the outer end thereof.
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42. A wire-working machine, comprising three pins, two being adapted to engage a wire on one side, and the other to engage the wire on the other side at a point between the other
115 two, means for giving an arcuate motion to said third pin about one of the other pins as a center, for forming a loop, and means for pinching together the two members of the loop near the outer end thereof; said last-named means comprising a pair of jaws, and
120 means for moving said jaws toward and from each other.

43. In a wire-working machine, the combination of three pins, two adapted to engage the wire on one side, and the third to engage
125 it on the other side at a point between the other two pins, means for moving said third pin toward the wire so as to carry the wire before it and form a loop, and means for pinching together the two members of the
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loop near the outer end thereof; said last-named means comprising a pair of pivoted jaws, and means for simultaneously swinging said jaws together upon their pivots.

5 44. A wire-working machine, comprising a pair of links pivoted together, one of said links being pivoted to a stationary part of the machine, a pin mounted at each of said pivotal points, and a pin mounted on the other link
10 beyond the point at which it is pivoted to the first link.

45. A wire-working machine, comprising a pair of links pivoted together, one of said links being pivoted to a stationary part of the
15 machine, a pin mounted at each of said pivotal points and a pin mounted on the other link beyond the point at which it is pivoted to the first link, means for swinging the first link about its stationary pivot, and means for
20 moving the outer end of the other link toward said pivot in a straight line.

46. A wire-working machine, comprising a slide, means for reciprocating the slide, a pair of levers pivotally mounted upon the slide,
25 each having an arm and a jaw at opposite ends, and a cam having two faces, one adapted to operate upon each lever-arm to force said jaws apart.

47. A wire-working machine, comprising a
30 main shaft, three cams thereon, a slide having engagement with one of said cams whereby the slide is reciprocated, a pair of levers pivotally mounted upon said slide near the outer end thereof, each lever having a jaw
35 upon its outer end, a spring connecting said levers together at a point part way between their inner ends and the points at which they are pivoted to the slide, and means upon the inner ends of the levers for engaging with
40 the other two cams.

48. A wire-working machine, comprising three pins, two of said pins being adapted to engage a wire on one side, and the third to engage it on the other at a point between the
45 other two, means for giving an arcuate motion to said third pin about one of the other pins as a center, in a direction toward the wire, whereby a loop is formed, means for pinching together the two members of the
50 loop near the outer end thereof, and means for slightly bending the pinched end of the loop.

49. A wire-working machine, comprising three pins, two of said pins being adapted to
55 engage a wire on one side, and the third to engage it on the other at a point between the other two, means for giving an arcuate motion to said third pin about one of the other pins as a center, in a direction toward the
60 wire, whereby a loop is formed, means for pinching together the two members of the loop near the outer end thereof, and means for slightly bending the pinched end of the loop; said last-named means comprising a die
65 and mechanism for operating the die.

50. A wire-working machine, comprising a pair of links, three pins, two of said pins constituting pivots for the two links at their outer ends, a third pin constituting a pivotal connection between the adjacent ends of said
70 links, two of said pins being adapted to engage a wire upon one side thereof, and the third pin the other side and between the other two pins, means for forcing said third pin in a direction toward the wire for the purpose of
75 forming a loop, a die having a curved operating-face, and means for forcing the die against the wire when the latter is supported by one of said links.

51. A wire-working machine comprising
80 three pins, two of said pins being adapted to engage a wire on one side thereof, and the third to engage the wire on the other side at a point between the other two pins, means for moving said third pin toward the wire to form
85 a loop, means for withdrawing two of said pins from contact with the wire, a forming-clamp, means for forcing the clamp into engagement with the wire and causing it to clamp it between the clamp and the pin re-
90 maining in contact with the wire, means for moving the clamp and pin forward in the machine, means for loosening the clamp after its stroke in one direction is completed, means for returning the clamp and pin to their origi-
95 nal positions, and means for slightly bending the end of the loop produced.

52. A wire-working machine, comprising a pair of links and three pins, the first of said pins constituting a pivotal connection between
100 adjacent ends of said links, and the second and third pins serving as pivots for the two links at their outer ends, said first pin being adapted to engage the wire on one side thereof, and said second and third pins on the
105 other side, means for oscillating one of the links about the axis of the second pin and thereby giving said first pin an arcuate motion, means for reciprocating said third pin toward the second pin, means for thereafter
110 withdrawing said first and second pins axially in opposite directions in contact with the loop thus produced, means for withdrawing said third pin in contact with the loop, means for then moving said second pin back and inserting
115 it in the place of the third pin, and means for slightly bending the end of the loop produced.

53. A wire-working machine, comprising three pins, two of said pins being adapted to en-
120 gage a wire on one side, and the third to engage it on the other at a point between the other two, means for giving an arcuate motion to said third pin about one of the other pins as a center, in a direction toward the wire, whereby a loop is formed, means for pinch-
125 ing together the two members of the loop near the outer end thereof, means for slightly bending the pinched end of the loop, and means for finally bending the loop over in the reverse direction to form a hook.
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54. A wire-working machine, comprising three pins, two of said pins being adapted to engage a wire on one side thereof and the third to engage the wire on the other side at a point between the other two pins, means for giving an arcuate motion to such third pin about one of the other pins as a center, for bending the wire to form a loop, means for pinching together the two members of the loop near the outer end thereof, means for slightly bending the pinched end of the loop, and means for finally bending the loop over in the reverse direction to form a spring-hook; said last-named means comprising a pair of pins adapted to engage the loop on each side thereof, and means for oscillating one of said pins.

55. In a wire-working machine, the combination of means for forming a loop, means for slightly bending the end of the loop, means for pinching together the two members of the bent end of the loop, and means for bending the end of the loop in the reverse direction to form a spring-hook; said last-named means comprising a pair of pins, one adapted to engage the loop above it, and the other below it, and means for oscillating the one of said pins engaging the wire below it, about the other as a center.

56. A wire-working machine, comprising a main shaft, a plurality of cams thereon, a slide having engagement with one of said cams for reciprocating the slide, a pair of levers pivotally mounted upon said slide, each lever having a jaw, and means upon said levers for engaging with other cams on said shaft.

57. A wire-working machine, comprising a plurality of pins, means for giving motion to one of them in a direction toward a wire for forming a loop, means for pinching together the two members of the loop near the outer end thereof, and means for slightly bending the pinched portion of the loop.

58. A wire-working machine, comprising a plurality of pins, means for moving one of said pins against a wire for forming a loop, means for pinching together the two members of the loop near the outer end thereof, and means for slightly bending the pinched ends of the loop, said last-named means comprising a die and mechanism for operating the die.

59. A wire-working machine comprising a plurality of pins adapted to engage a wire on opposite sides, means for forcing one of the pins toward the wire between the other pins to form a loop, a die having a curved operating-face adapted to engage a flat side of the loop, and means for forcing the die against the wire after the loop is formed.

60. A wire-working machine, comprising a plurality of pins, means for moving one of said pins with relation to the others to form a loop in a wire, means for withdrawing all but one of said pins from contact with the

wire, a forming-clamp, means for forcing the clamp into engagement with the wire and clamping the wire against the pin remaining in contact therewith, means for moving the clamp and pin forward in the machine, means for loosening the clamp after its stroke in one direction is completed, means for returning the clamp to its original position, and means for slightly bending the end of the loop.

61. A wire-working machine, comprising a plurality of pins, means for moving one of said pins with respect to the others for forming a loop in a wire, means for pinching together the two members of the loop formed, near the outer end thereof, means for slightly bending the pinched end of the loop, and means for finally bending the loop over in the reverse direction to form a hook.

62. A wire-working machine, comprising a plurality of pins, means for moving one of said pins with respect to the others, for forming a loop from a length of wire, means for pinching together the two members of the loop, means for slightly bending the pinched portion of the loop, and means for finally bending the loop over in the reverse direction to form a spring-hook, said last-named means comprising a pair of pins adapted to engage the loop one on each side thereof, and means for oscillating one of said pins about a center.

63. A wire-working machine, comprising a main shaft, a plurality of power-transmitting devices thereon, an oscillatable pin, a second pin capable of reciprocation, a reciprocating pin, a clamp, a reciprocating slide on which said clamp is mounted, a pair of jaws, a reciprocating slide on which said jaws are mounted, a bending-die, a pair of pins, a rotatable shaft on which said pins are mounted, and connections from said operating devices to said other elements, for oscillating said first-mentioned pin, reciprocating the two reciprocable pins, operating the clamp, reciprocating both of said slides, moving said jaws and said die, and rotating said last-mentioned pair of pins.

64. A wire-working machine, comprising a shaft, a plurality of power-transmitting devices thereon, an oscillatable pin, a second pin capable of reciprocation, a reciprocable pin, a clamp, a reciprocating slide on which said clamp is mounted, and connections from said power-transmitting devices to the other elements mentioned, for oscillating said first-mentioned pin, reciprocating the two reciprocable pins, operating the clamp and reciprocating said slide.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

AXEL H. NILSON.
MAURITZ OLSON.

Witnesses:

JOHN WIKEMAN,
JACOB NELSON.