(No Model.) 11 Sheets—Sheet 1.

C. F. SMITH.

MACHINE FOR AUTOMATICALLY MANUFACTURING CHAIN FROM SHEET METAL.

No. 574,176. Patented Dec. 29, 1896.

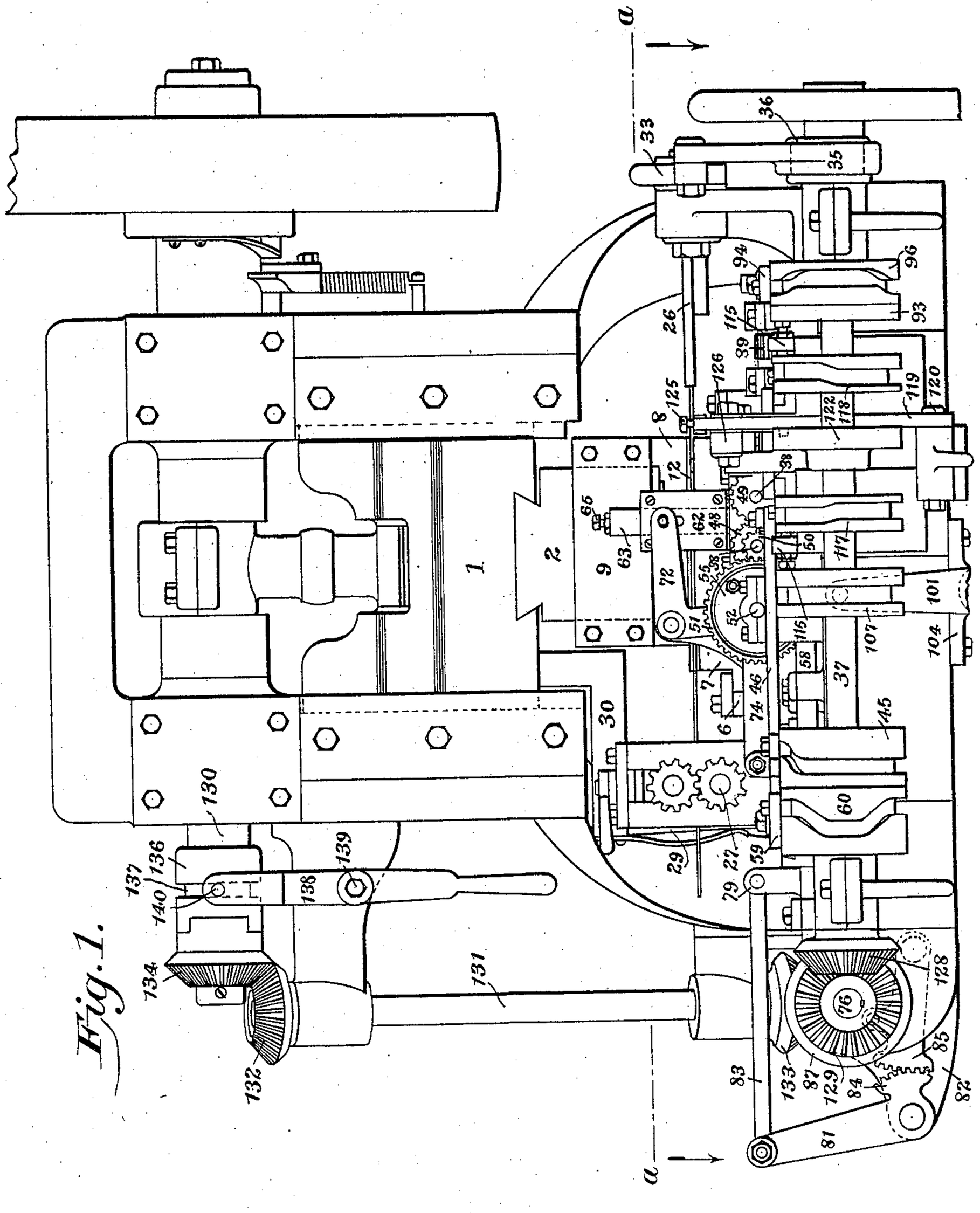

Fig. 1.

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(No Model.) 11 Sheets—Sheet 2.

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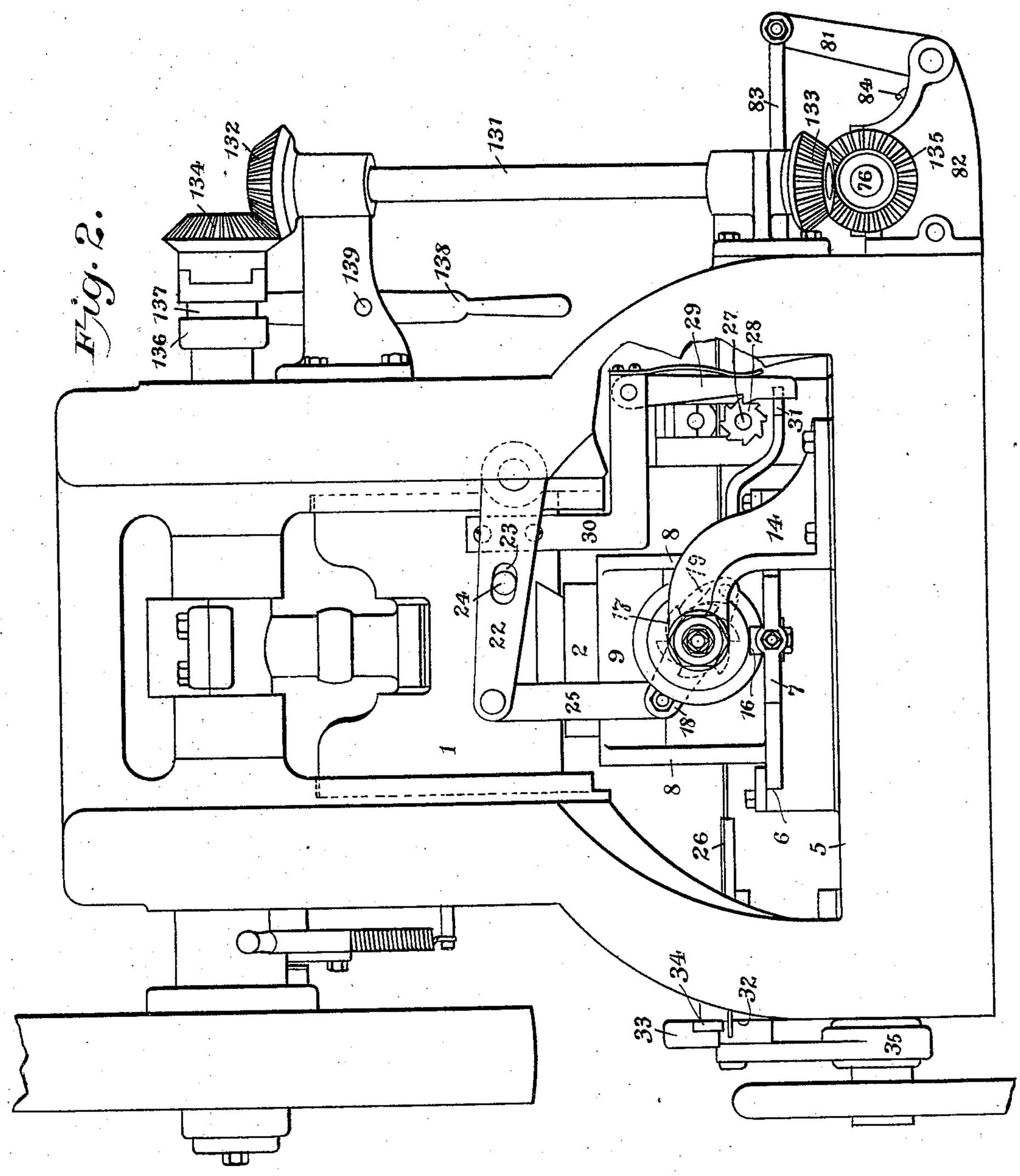
Fig. 2.



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(No Model.) 11 Sheets—Sheet 3.

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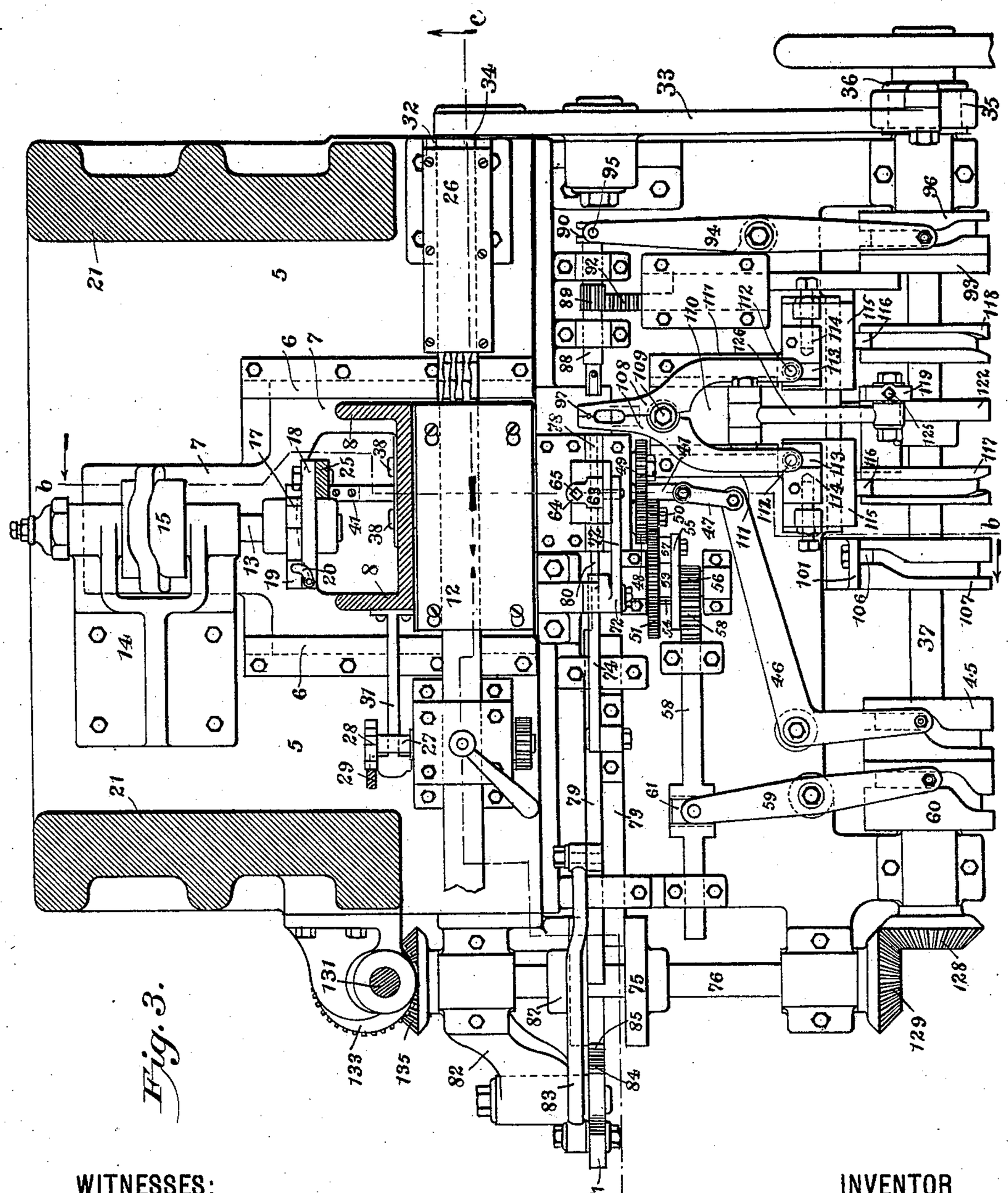

Fig. 3.

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(No Model.) 11 Sheets—Sheet 4.

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MACHINE FOR AUTOMATICALLY MANUFACTURING CHAIN FROM SHEET METAL.

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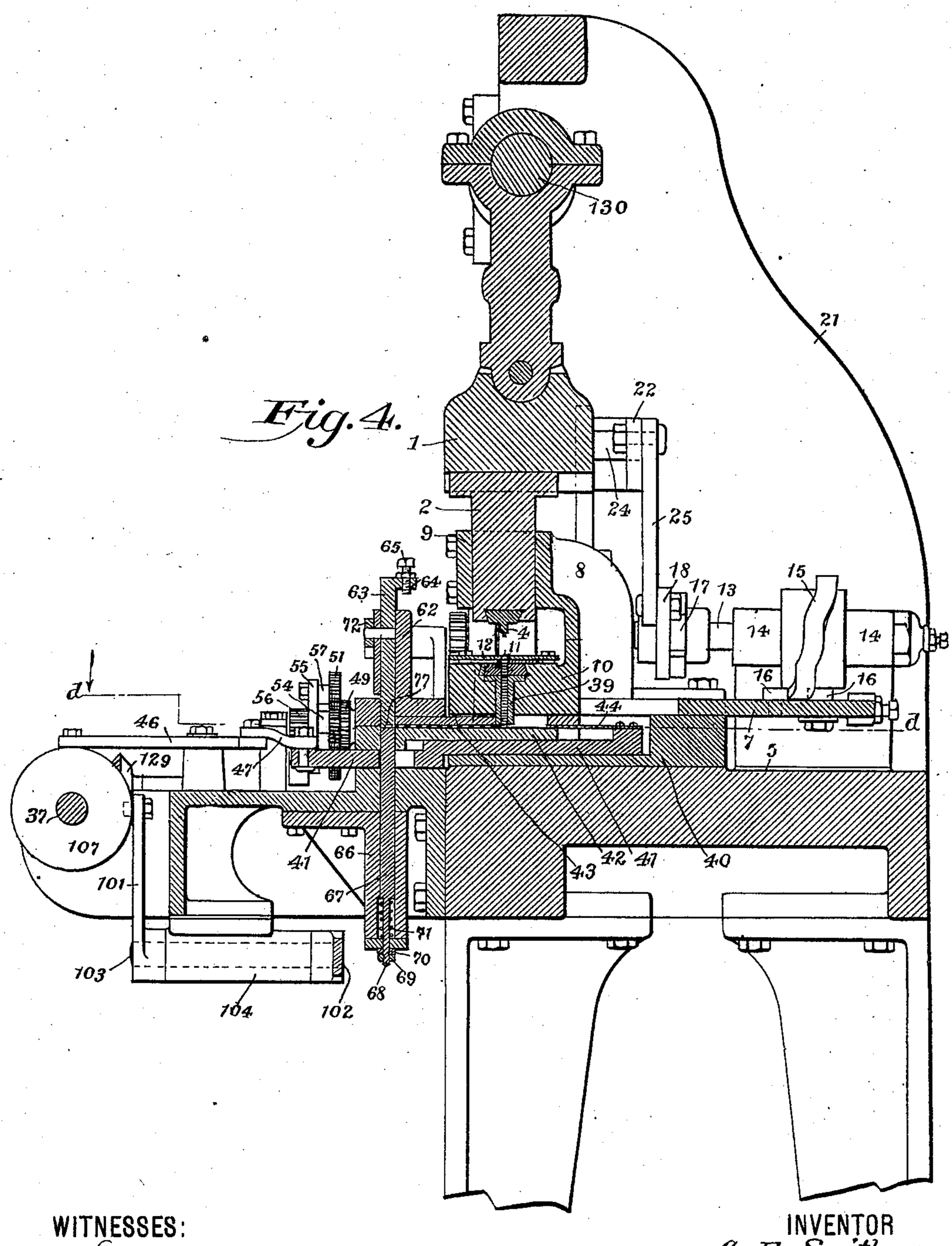
Fig. 4.



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(No Model.) 11 Sheets—Sheet 5.

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MACHINE FOR AUTOMATICALLY MANUFACTURING CHAIN FROM SHEET METAL.

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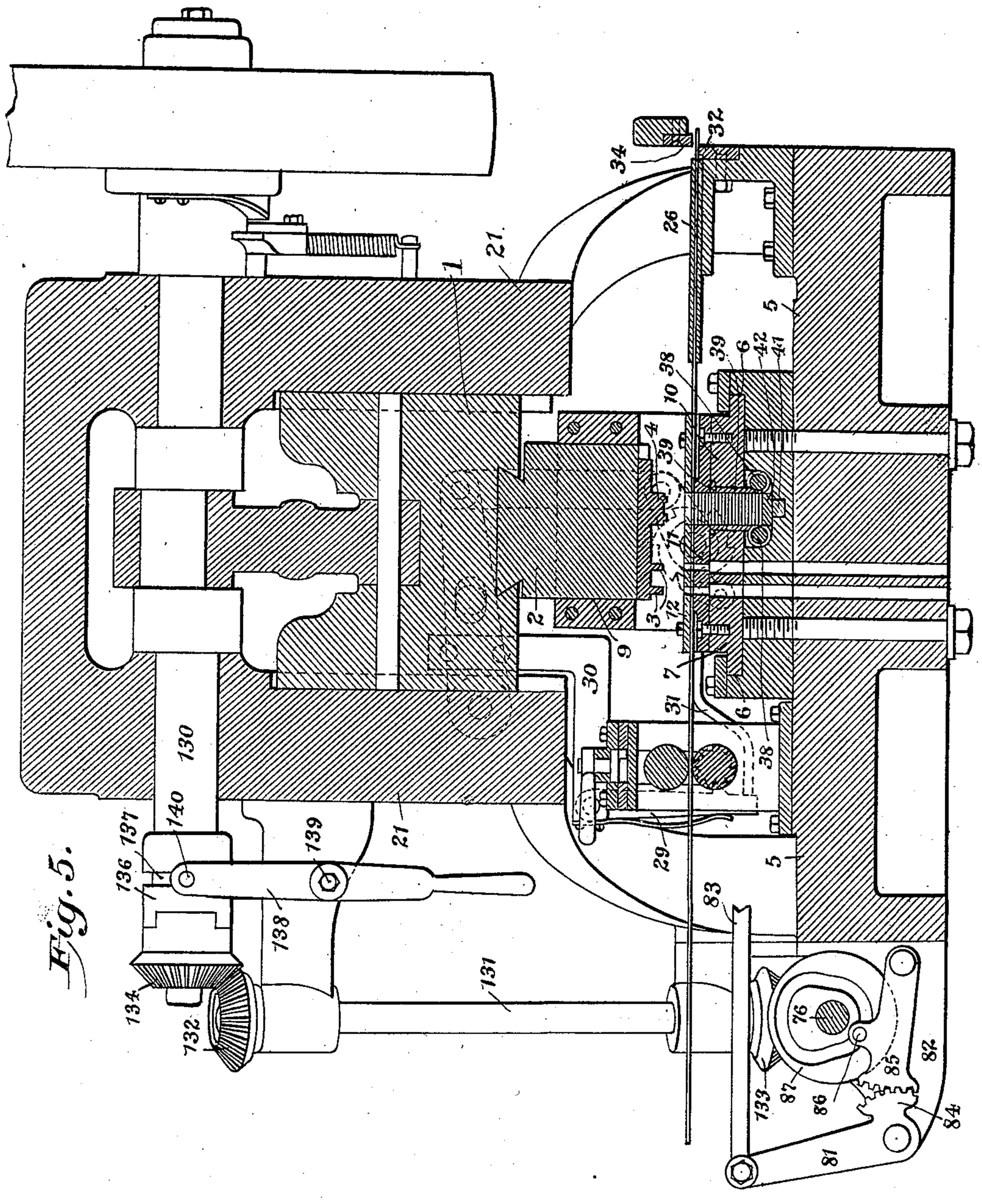

Fig. 5.

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(No Model.) 11 Sheets—Sheet 6.

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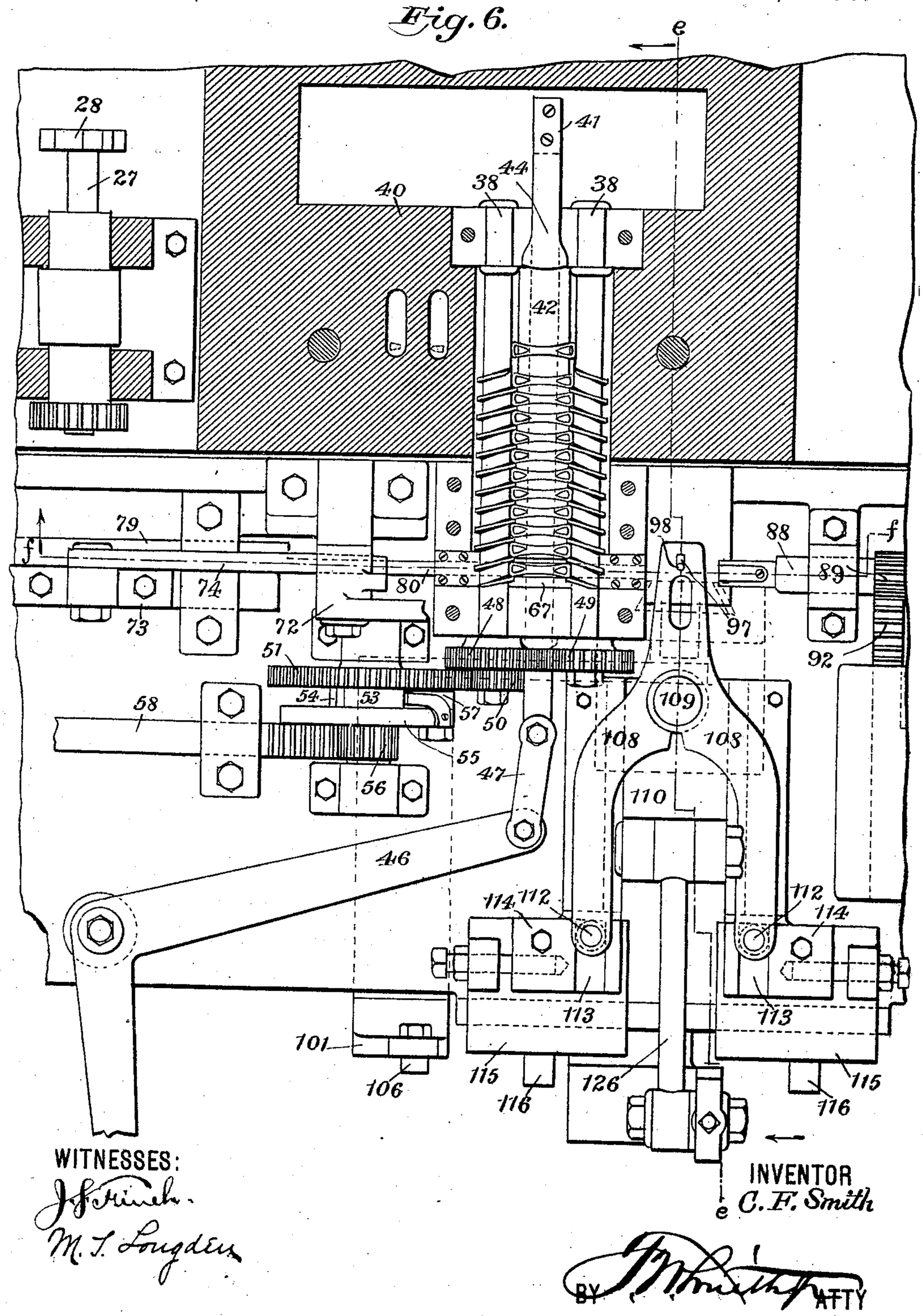
MACHINE FOR AUTOMATICALLY MANUFACTURING CHAIN FROM SHEET METAL.

No. 574,176. Patented Dec. 29, 1896.

Fig. 6.



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(No Model.) 11 Sheets—Sheet 7.

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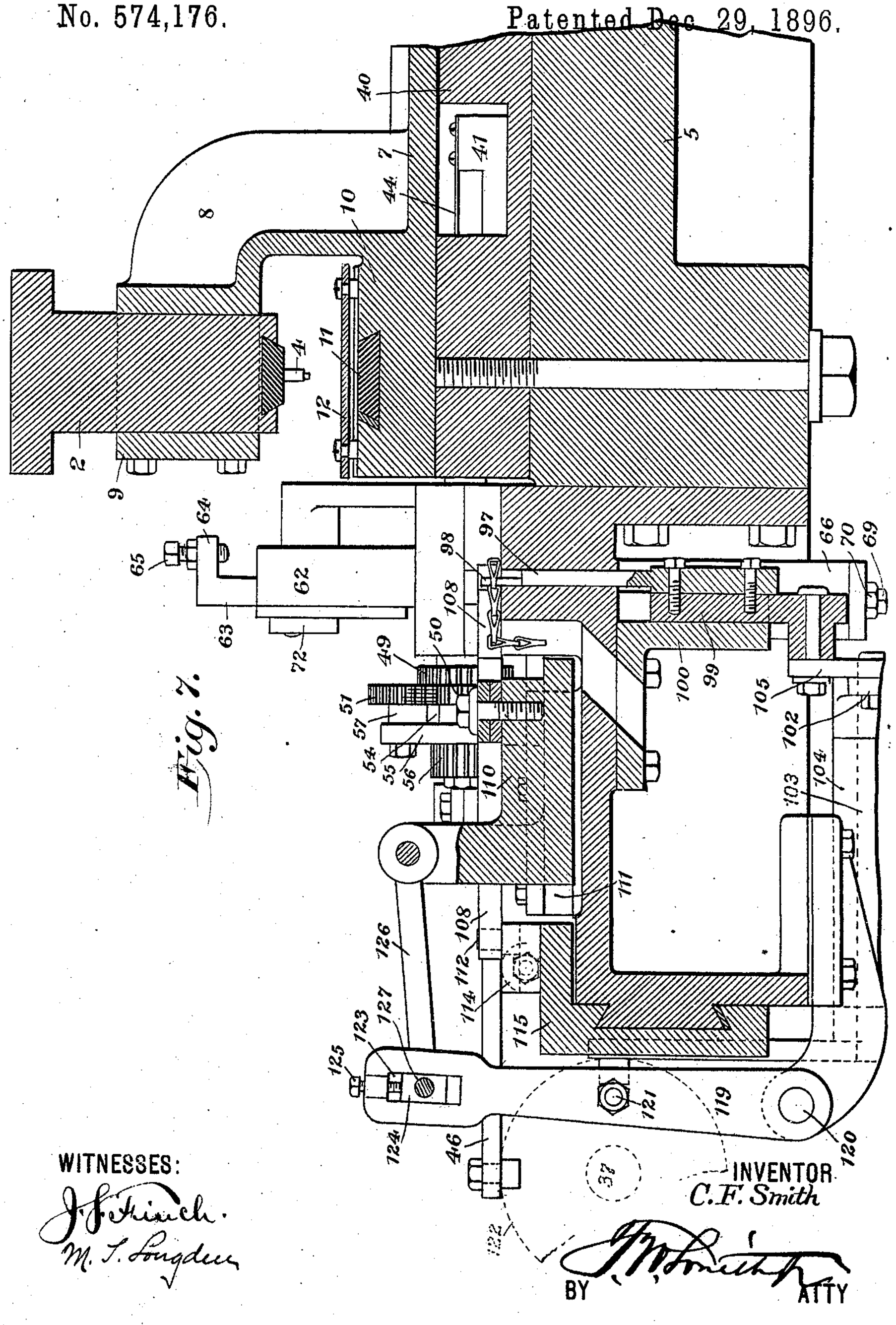

Fig. 7.

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(No Model.) 11 Sheets—Sheet 8.

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MACHINE FOR AUTOMATICALLY MANUFACTURING CHAIN FROM SHEET METAL.

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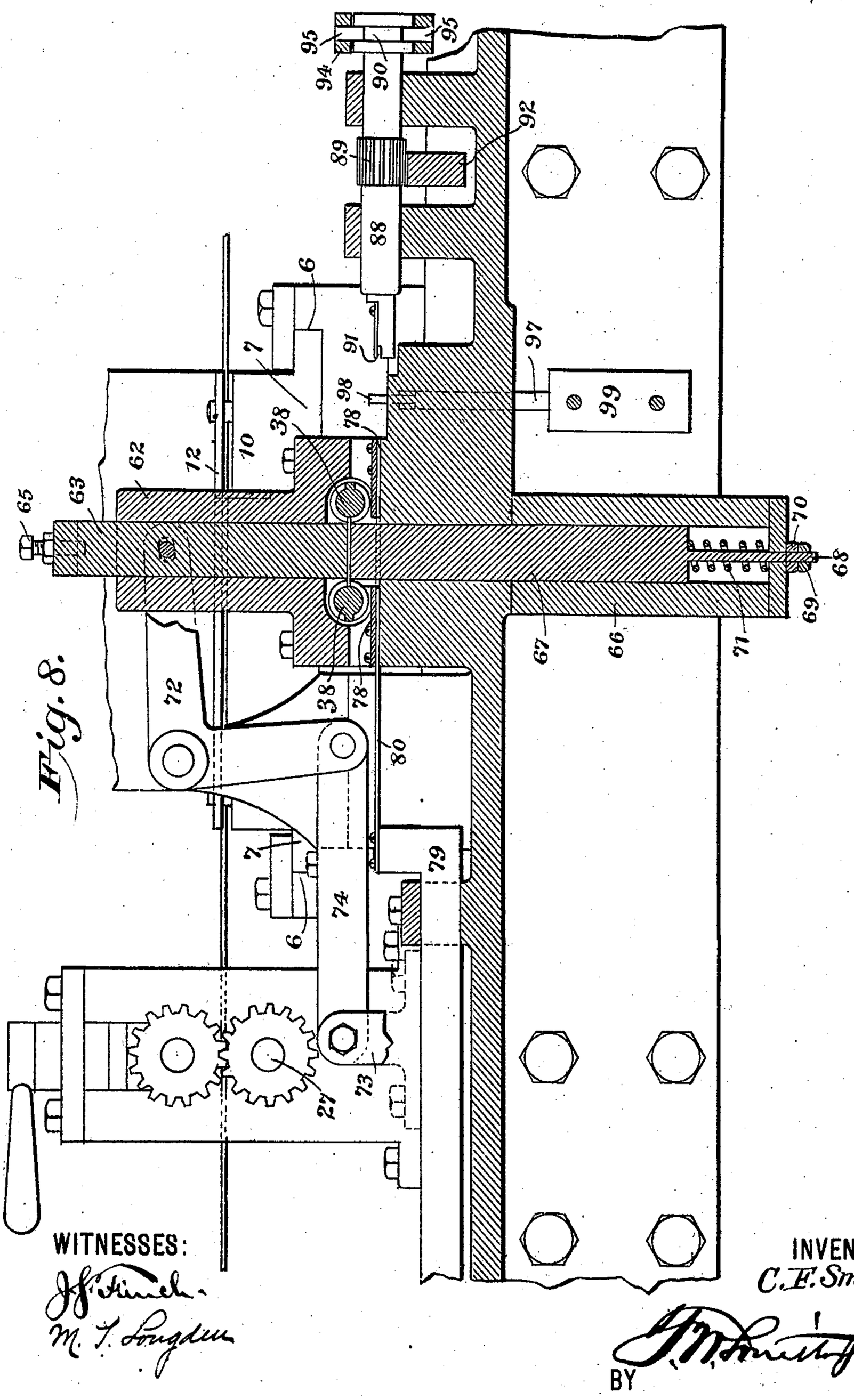

Fig. 8.

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(No Model.) 11 Sheets—Sheet 9.

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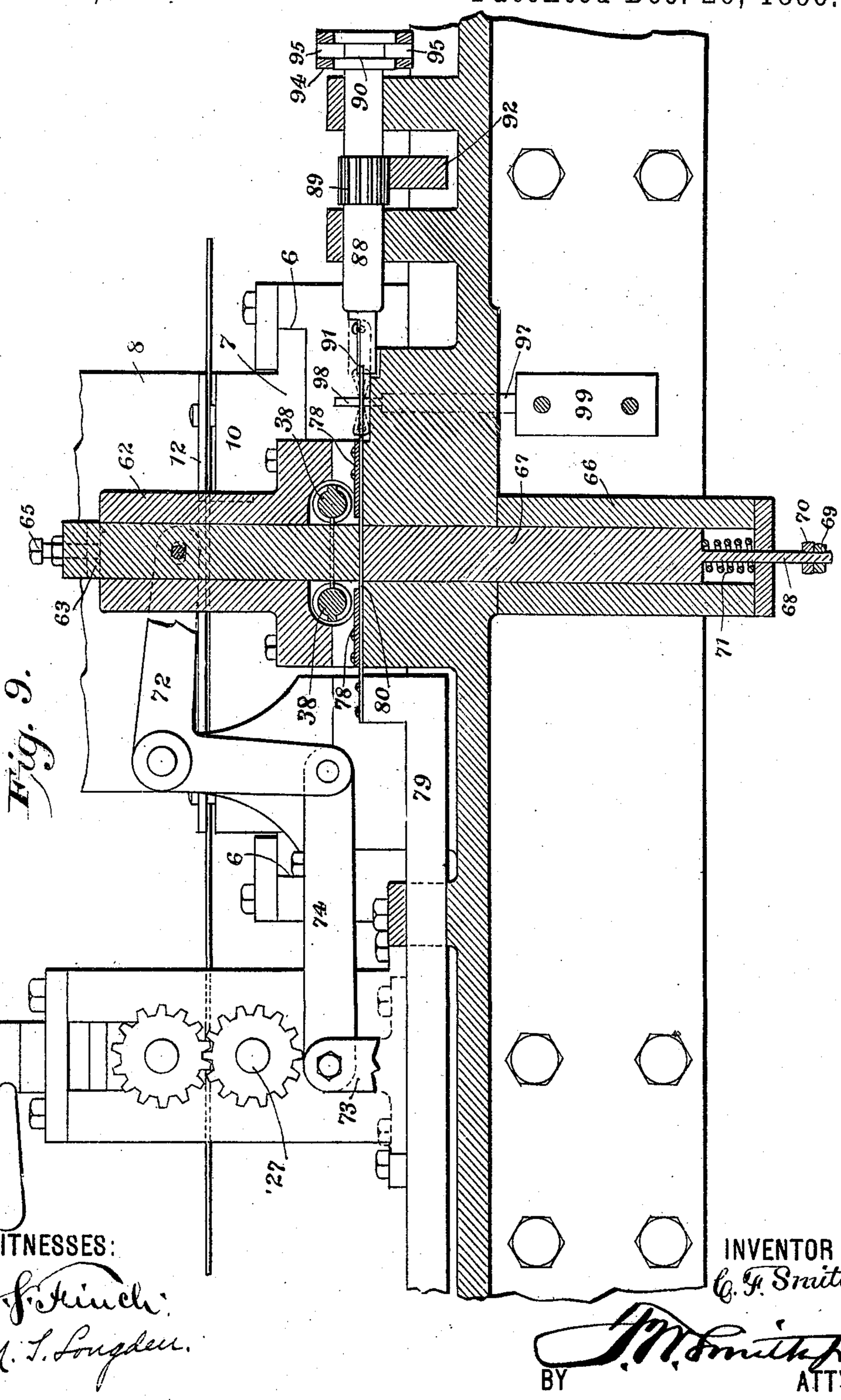

Fig. 9.

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MACHINE FOR AUTOMATICALLY MANUFACTURING CHAIN FROM SHEET METAL.

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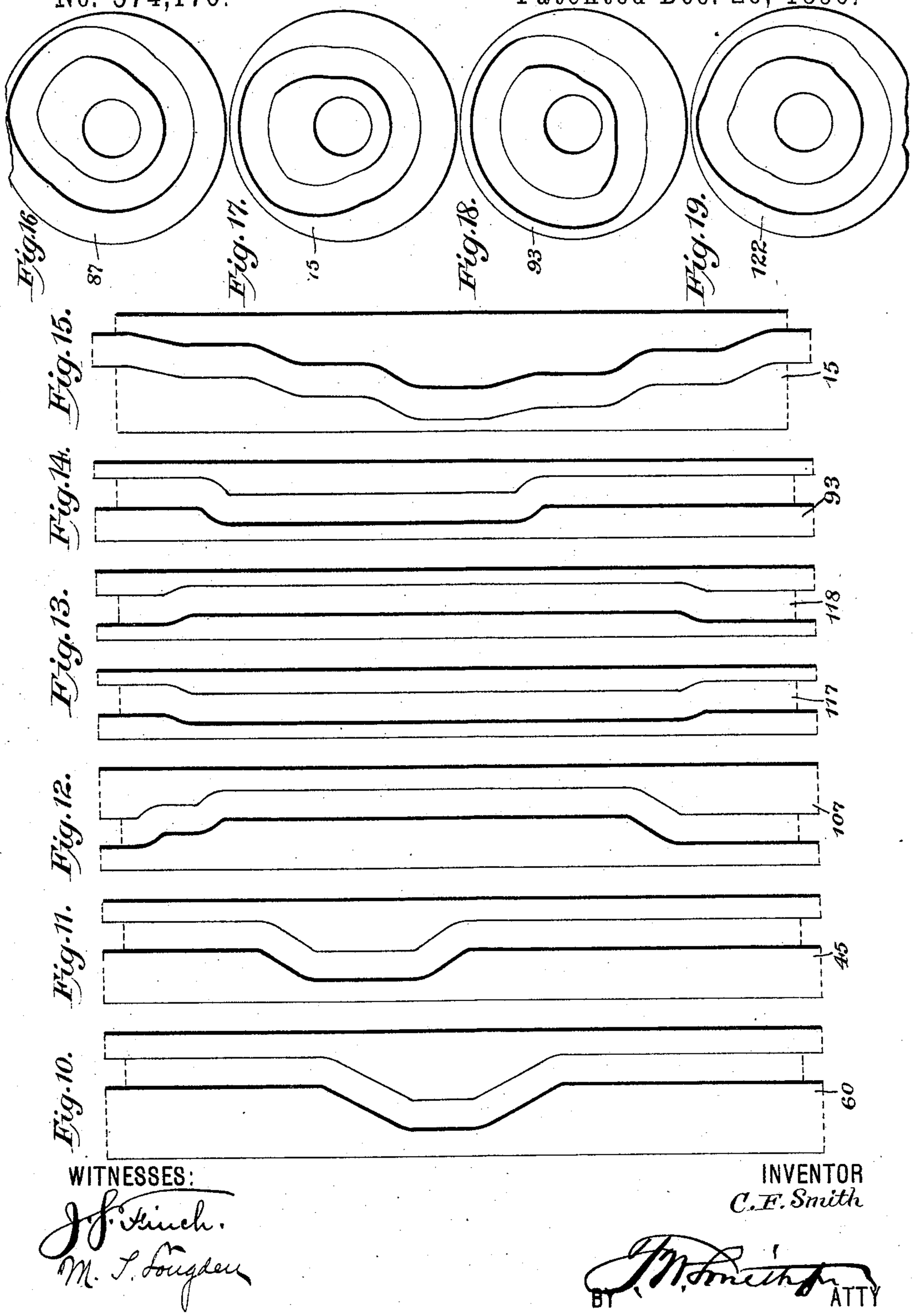

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(No Model.) 11 Sheets—Sheet 11.

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MACHINE FOR AUTOMATICALLY MANUFACTURING CHAIN FROM SHEET METAL.

No. 574,176. Patented Dec. 29, 1896.

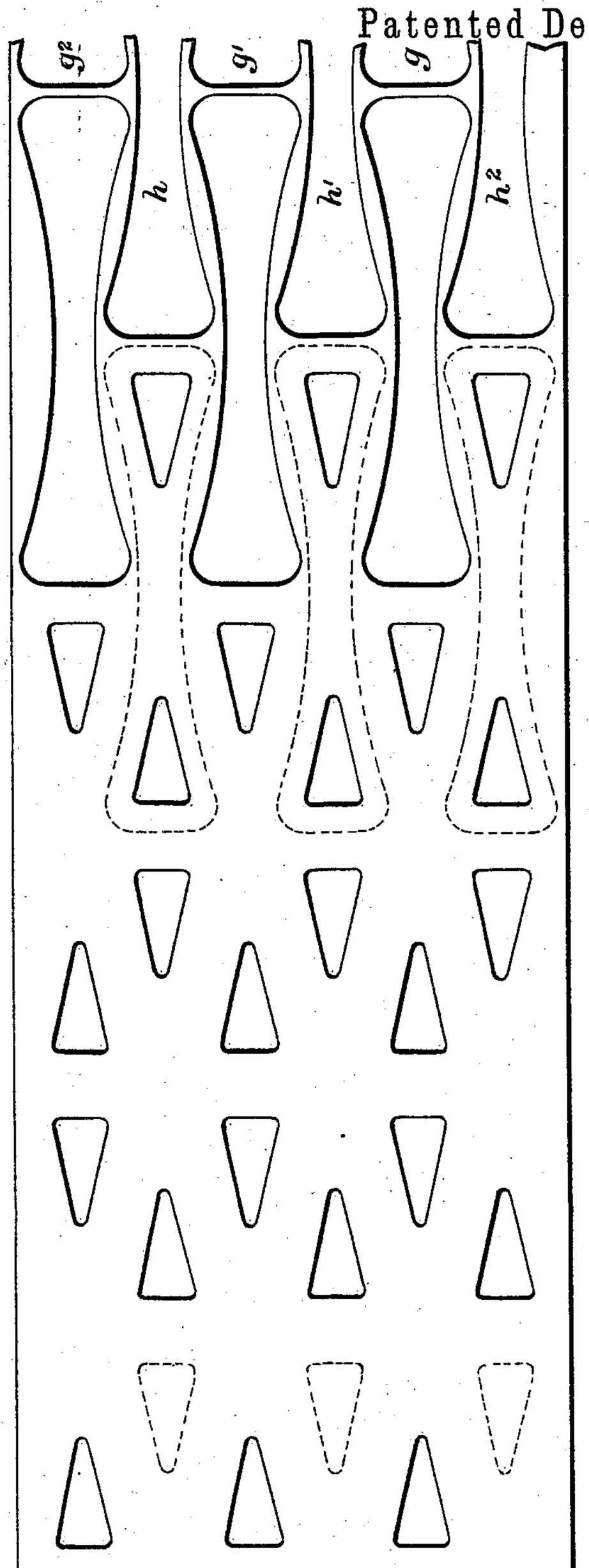

Fig. 20.

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UNITED STATES PATENT OFFICE.

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MACHINE FOR AUTOMATICALLY MANUFACTURING CHAIN FROM SHEET METAL.

SPECIFICATION forming part of Letters Patent No. 574,176, dated December 29, 1896.

Application filed April 9, 1896. Serial No. 586,851. (No model.)

To all whom it may concern:

Be it known that I, CHARLES F. SMITH, a citizen of the United States, residing at Bridgeport, in the county of Fairfield and State of Connecticut, have invented certain new and useful Improvements in Machines for Automatically Manufacturing Chain from Sheet Metal; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention has reference to machines for automatically manufacturing chain from sheet metal, the latter being fed into the machine in the form of long strips or ribbons, while the chain itself is made from blanks having eyes cut out at each end and then doubled at their middle portions, so as to bring these eyes into registration, the blanks for succeeding links being inserted through the eyes of previously-formed links.

The objects of my invention are, first, to greatly increase the output of machines of this description without increasing the wear and tear on the machine, such as ordinarily would attach to the latter; second, to economize in the use of sheet metal, in that comparatively little scrap remains after the blanks have been cut out; third, to increase the tensile strength of the links, in that the blanks are cut out from the metal strip lengthwise of the latter, or, in other words, in the direction of the grain of the metal; fourth, to perform the several blanking-out, bending, and threading operations by instrumentalities that are operated from separate cams or cam-surfaces, so that speed may be attained without any likelihood of breakage that cannot readily be repaired, and, fifth, to entirely disassociate the instrumentalities for cutting out the blanks from the mechanisms for feeding the blanks and for forming the links of the completed chain.

In the accompanying drawings, which form a part of this application, Figure 1 is a front elevation of my improved machine; Fig. 2, a rear elevation; Fig. 3, a section at the line *a a* of Fig. 1; Fig. 4, a section at the line *b b* of Fig. 3; Fig. 5, a section at the line *c c* of Fig. 3; Fig. 6, a section at the line *d d* of Fig. 4; Fig. 7, a section at the line *e e* of Fig. 6; Fig. 8, a section at the line *f f* of Fig. 6. Fig. 9 is a view similar to Fig. 8, but showing the position of the parts after a link-blank has been pushed forward and threaded through the eyes of a previously-formed link. Figs. 10, 11, 12, 13, 14, and 15 are detailed developments of the several peripheral cams which are used in my improvement. Figs. 16, 17, 18, and 19 are detail elevations of the several face-cams which are used; and Fig. 20 is a detail broken view of the metal strip, showing the manner of cutting out the blanks from such strip.

Similar numbers and letters of reference denote like parts in the several figures of the drawings.

In order that the detailed description of the construction and operation of the several parts of my improvement may be better understood, I will first briefly outline the general character of my improved machine, its mode of operation, and the several steps whereby the completed chain is produced from the metallic strip or ribbon.

My improvement comprises two separate and distinct sets of mechanism, namely, a vertically-reciprocating press-gate, which carries the punches for cutting out the eyes and the link-blanks, which gate is operated in the usual manner from a power-shaft, and the mechanisms for feeding the blanks and for properly handling said blanks until they form a part of the completed chain.

The only part of my improvement with which this press-gate is directly associated is the means for feeding the metal strip or ribbon, this being effected through suitable connections between said gate and the feeding system, whereby the metal strip is advanced step by step, and the means whereby the punches and dies are laterally shifted intermediate of consecutive steps in the advance of the metal strip. After the strip has been advanced one of these steps the punches and dies are shifted and a blank is cut, and said punches and dies are then again shifted laterally, when a third blank is cut, so that it will be seen that the blanks are cut three abreast throughout the metal strip. The strip is now advanced another step, and the lateral

shifting of the punches and dies again takes place in the opposite direction and said punches and dies cut out another series of three links, and the operation thus continues, the links being cut out three abreast, commencing first at one side of the strip and then at the other.

The dies for cutting out the link-blanks and the punches for cutting out the eyes are so disposed relatively that when a blank is cut out by the dies the punches cut the eyes for alternate blanks, as is quite common in machines of this description.

When the blanks are cut out, they drop within a well one upon the other, and the lowermost blank rests upon the bottom of the well. A finger is then operated to push out this lowermost blank and to deliver the same so that its extremities are grasped by the threads of two screw conveyers, one of which is a right-hand screw and the other a left-hand screw. These screws are operated intermittingly to carry these blanks step by step, and as the machine continues to operate the screws get full of the link-blanks, that is to say, there is a blank embraced between the consecutive and opposite threads throughout the length of the screws. At the outer end of these screws and between the latter is a vertically-reciprocating carrier, which is properly recessed to receive the blanks, and the link-blank in the extreme outer ends of the screws is fed by the latter directly into the recess in this carrier, which latter then descends until the blank is brought lengthwise into a feed-way, whereupon the carrier dwells until a push-finger drives out this link-blank and in so doing feeds it through the eyes of a previously bent and formed link. When a blank is thus fed through the eyes of a previously bent and formed link, such blank is horizontally disposed, and means are now employed for turning such blank up in a vertical plane, whereupon a bending-tool and a mandrel cooperate to form the blank into U shape and subsequently to completely finish the link and to hold the latter with its eyes in position to receive the next blank.

I will first describe in detail the link-cutting devices and the instrumentalities for feeding the metal strip and for shifting the punches and dies.

1 is an ordinary press-gate, and 2 is a subpress-gate carried by the gate 1, but capable of a free sliding movement from front to rear within suitable ways formed in the bottom of the gate 1. To this subpress-gate are secured the punches 3 for cutting out the eyes of the blanks, and the dies 4 for cutting out the blanks themselves.

5 is the bed of the machine, to which are secured ways 6, within which is arranged a large slide 7, capable of reciprocating freely in a direction from front to rear of the machine. Rising from this slide so as to be practically integral therewith is a standard 8, the upper portion whereof is formed into a housing 9, within which the gate 2 fits, while immediately beneath this housing and integral with said standard is the die-block 10, upon which latter is secured the die 11, with which the punches and dies coöperate when cutting out the blanks. 12 is an ordinary stripper bolted to the die-block and extending immediately above the die.

At the rear of the machine a shaft 13 is journaled within a bracket 14, which rises from the bed, and tightly mounted on this shaft is a peripheral cam 15, which extends between two antifriction-rolls 16, carried on the upper surface of the rear of the slide 7, as clearly shown at Fig. 4. Tightly secured around the shaft 13 near its forward extremity is a ratchet-wheel 17, and loosely mounted around this shaft is a rocker-bar 18, to which latter is pivoted a pawl 19, backed by a spring 20, which pawl normally engages with the teeth on the ratchet. Pivoted to the press-frame 21 is a lever 22, in about the central portion whereof is an elongated slot 23, through which extends a stud 24 from the press-gate 1, as shown in dotted lines at Fig. 5 and in solid lines at Figs. 2 and 4. To the extreme end of this lever 22 is pivoted a link 25, which depends vertically and is pivoted at its other end to the rocker-bar 18.

From the construction above described it will be clear that when the press-gate descends the rocker-bar will be operated to cause the pawl to act on the ratchet-wheel 17, whereby the cam 15 is rotated. This rotation of the cam 15 between the rolls 16 will effect the reciprocatory movements of the slide 7, and the cam is so formed that the slide is shifted first in one direction one short step and two long steps, and then in the other direction likewise one short step and two long steps.

The metal strip passes between feed-rolls through the space between the stripper 12 and die 11, and the scrap which remains after the blanks have been cut out passes through a housing 26, secured to the bed at the opposite side of the machine, where it is disposed of in the manner presently to be explained.

The clearance between the edges of the metal strip and the side walls of the space between the stripper and die is such that the forward and backward reciprocation of the standard 8 will not in the slightest degree disturb said strip.

The construction and operation of the feed-rolls are very ordinary and are common in machines of this class, and I will not enter into any description thereof.

The shaft 27 of the lower feed-roll projects laterally, and on this shaft is tightly mounted a ratchet-wheel 28.

29 is an ordinary spring-backed pawl, which is pivoted to an elbow 30, depending from the press-gate, and engages with the ratchet 28, so as to operate the feed-rolls on the upward stroke of the press-gate.

31 is a trip secured to the standard 8 and

extending laterally beyond the vertical plane which the pawl 29 occupies when in engagement with the ratchet 28. The line of movement of this trip when the standard reciprocates is in a horizontal plane athwart the pawl, and the opposite sides of this trip are beveled, as shown at Fig. 3. When the trip is carried against the pawl, it will throw the latter backward against the resiliency of its spring and will prevent said pawl from engaging with the ratchet until the trip has been carried beyond said pawl, so that the latter will by reason of its resilient action assume its normal position. Likewise when the trip is carried in the reverse direction it will again throw the pawl backward, so that the latter cannot engage with the ratchet until such trip has again passed beyond the pawl. The width of the operating-face of this trip is such with respect to the distance throughout which said trip is carried by the movements of the slide that it will have passed beyond the pawl at the end of each complete movement of the slide, that is to say, when the slide has reached each of the terminals in its forward and backward movements the pawl will be in engagement with the ratchet to feed the metal strip.

Referring to Fig. 20, we will suppose that the upper press-gate has been operated to cut out the blank *g*. On the next downward movement of the upper press-gate the cam 15 now operates to draw the slide rearward a long step, whereupon the blank *g'* is cut out. At the succeeding downward movement of the press-gate the cam operates to draw the slide rearward another long step, whereupon the blank g^2 is cut out at the edge of the metal strip. As the upper press-gate now ascends the pawl 29 will be in engagement with the ratchet 28, and the intermittent advance of the metal strip through the machine is accordingly effected. At the next descent of the upper press-gate the cam 15 operates to shift the slide forward a short step in the return direction and the blank *h* is cut out. At the next descent of this press-gate the cam advances the slide forward a long step and the blank *h'* is cut out. At the succeeding descent of this press-gate the cam operates to advance the slide another long step and the blank h^2 is cut out at the opposite edge of the strip. The pawl is now again in engagement with the ratchet, and when the press-gate ascends the next intermittent advance of the metal strip takes place, and when the press-gate again descends the cam will operate to retract the slide a short step prior to cutting out a succeeding blank and repeating the operations above described.

It will thus be readily seen that the blanks are cut out of the strip three abreast and that the pawl engages with the ratchet to advance the metal strip on the upward stroke of the press immediately following the cutting out of the blanks which correspond with g^2 and h^2, as designated in Fig. 20.

A shear-block 32 is secured at the extreme edge of the bed, immediately beneath the housing 26, and a lever 33 is pivoted to the bed of the machine and provided at its inner end with a knife 34, capable of shearing close to said block. The rear extremity of this lever is pivoted to a strap 35 around an eccentric 36, which latter is upon the main shaft 37 of the machine. The function of this lever 33 is of course to chop up the metal strip into small pieces, which latter are very convenient for handling and packing, but of course this construction may be disposed of and the scrap folded or rolled in the usual manner.

As before set forth, the blanks, as fast as they are cut out, drop into a well, whence they are conveyed to the devices for delivering the blanks in succession to the link-forming mechanism, and I will now describe the instrumentalities which I employ for effecting this purpose.

Journaled within suitable bearings on the bed of the machine are two screws 38, one of which is a right-handed screw, while the other is a left-handed screw, the threads on these screws being separated by a distance just equal to the width of the extremities of the blanks. These screws are horizontally disposed, and the number of spirals which the thread on each screw describes is immaterial, but the pitch of such threads is sufficient to feed the blanks inward toward the devices for delivering them to the link-forming mechanism intermittently and consecutively, said screws being turned step by step a complete revolution by means presently to be described.

39 is the well, which leads from the die directly to the devices for pushing said blanks to the screws, and into which well the blanks drop as fast as they are cut.

40 is a block which is bolted to the bed of the machine, and 41 is a slide adapted to reciprocate in suitable ways in said block, as shown at Figs. 4 and 5. Secured to this block in any suitable manner above this slide, but not interfering with the movements of the latter, is a plate 42, which extends from a point in the rear of the well to the point where the link-blanks are delivered to the devices which carry the blank to the link-forming mechanism, and this plate forms the floor of the well, the lower edge of the latter depending above this plate a distance equal to the thickness of one of the blanks.

43 is a cover-plate secured to the plate 42 in such manner that an elongated space is left between these plates sufficient to accommodate the flat blanks and permit the latter to have a free movement therethrough.

44 is a finger secured to the rear of the slide 41 and lying flat upon the plate 42. This finger is about the thickness of one of the blanks, and when the slide 41 is projected said finger will push out the lowermost blank, which rests on the plate 42, and will deliver said blank to the threads on the screws 38. The proper and correctly-timed movements of this

slide 41 are effected from the peripheral cam 45 on the shaft 37 through the medium of the bell-crank 46, which is pivoted to the bed of the machine and has depending from its outer leg a roll (not shown) within the groove of the cam, and the link 47, whose extremities are pivoted, respectively, to the inner leg of said crank and to the slide 41.

The plates 42 43 at the point throughout their length where they are separated by the passage-way for the blanks are of a width less than the length of said blanks, and the screws extend in close proximity to said passage-way, on opposite sides thereof, so that as the blanks are delivered to the screws said blanks will be carried intermittently by the revolution of said screws throughout this passage-way to the devices which deliver the blanks to the link-forming mechanism.

On the shafts of the screws are intermeshing spur-gears 48 49 of equal size, and rigid on the shaft of one screw, outside of its gear, is a pinion 50.

51 is a large spur-gear rigid on a shaft 52, which latter is journaled in any suitable bearings on the bed, and this gear meshes with the pinion 50, the relative sizes of said gear and pinion being such that a quarter-revolution of the gear will effect a complete revolution of the pinion. This gear 51 has a hub 53, around which are formed ratchet-teeth 54, which are four in number.

55 is a disk having rigid therewith a pinion 56, said disk and pinion being loose on the shaft 52.

57 is a pawl pivoted to the inner side of the disk 55 and normally in engagement with the toothed hub 53, so that it will be readily understood that when the pinion 56 is revolved in one direction the screws 38 will be turned a complete revolution, and when said pinion is revolved in the reverse direction said screws will remain stationary.

Guided within suitable ways on the bed is a rack-bar 58, which meshes with the pinion 56.

59 is a lever pivoted at or about its center to the bed and having a roll (not shown) which depends from its outer end into the groove of the peripheral cam 60 on the shaft 37, while the inner end of said lever is pivoted to a slide-block 61, which is capable of reciprocation within suitable ways in said rack-bar. The throw of this cam is such that the rack-bar will be projected to an extent sufficient to cause a complete revolution of the pinion 56, whereby the screws 38 are each revolved a complete turn.

It will be noted that the well 39 is carried by the reciprocatory slide 7 in its movements, and the cam which operates the slide 41 is so timed that the finger 44, after it has pushed the blank forward to the screws, will dwell during each movement of the slide 7, whereupon the finger will be retracted to allow the lowermost blank from the well to drop upon the plate 42. It will therefore be clear that the blanks from the well will drop at different locations on this plate after the push-finger has been retracted, but as the latter always reciprocates throughout the same extent these blanks will simply be carried a farther or shorter distance before they are delivered to the screw conveyers.

When the threads on the screws have been completely filled with blanks by the action of the various parts and mechanisms hereinbefore described, it will be clear that by the continued operation of these parts and mechanisms a blank will be delivered from the screws at their inner ends at every complete revolution of said screws, while the threads of the latter will be kept constantly filled with blanks by the delivery at the rear ends of the screws of a blank at each complete revolution of said screws. As above stated, these screws serve as conveyers to deliver the blanks to the instrumentalities whereby said blanks are consecutively carried to the mechanism for forming the links, and I will now describe said instrumentalities and mechanism.

62 is an upright bolted to the bed of the machine, and within this upright is a vertical bar 63, capable of sliding freely therein. 64 is a lug extending rearward from the top of said bar, and 65 is a set-screw driven through said lug in such manner as to depend immediately above the top of the upright 62, the purpose of this lug being to limit the downward movement of the bar.

66 is a box which depends from the bottom of the bed, and within this box is a bar 67, capable of sliding freely therein, the lower extremity of said bar having projecting therefrom a pin 68, which latter extends loosely through the bottom of the box and has secured to its outer extremity lock and jam nuts 69 70 for the purpose of limiting the upward movement of said bar. Around this pin, inside of the box, is a coil-spring 71, which bears, respectively, against the bar and the bottom of the box, whereby said bar is normally projected upward.

72 is a bell-crank pivoted to a bracket rising from the bed of the machine and whose upper horizontally-disposed leg is loosely connected to the bar 63 in the ordinary manner, while the lower leg of this bell-crank is connected with the slide 73 by means of a link 74, whose extremities are pivoted, respectively, to said leg and slide. This slide is capable of reciprocating within suitable ways on the bed and has extending laterally from its rear portion a friction-roll (not shown) which projects into the groove of the face-cam 75 on the shaft 76. From the foregoing it will be readily understood that the cam 75 operates to lower and elevate the bar 63 for the purpose presently to be explained.

The bars 63 67 are in vertical alinement, so that when said bars are in contact the depression of the bar 63 will carry with it the bar 67 against the resiliency of the spring 71. The normal and relative positions of these bars 63 67 are such that the top of the lower

bar 67 will be on a level with the upper surface of the plate 42, which latter, it will be remembered, formed the passage-way upon which the blanks rested while they were carried by the screws to the instrumentalities which I am at present describing, while the upper bar 63 will be slightly elevated so as to leave a clearance between its lowermost edge and the top of the lower bar about equal to the thickness of one of the blanks. The bottom of this bar 63 has cut therethrough from side to side a gate 77, (see Fig. 4,) which gate is sufficient only to contain a blank when it has been delivered between said bars in proper position by the action of the screws aforesaid. As soon as a link-blank has been carried between said bars the upper bar will be depressed by the action of the cam 75 until said bar is astride of the blank and comes in contact with the bar 67. A continued depression of the bars 63 67 now takes place until said blank is brought to a point in horizontal alinement with the passage-way 78, through which said blank must be delivered to the link-forming mechanism. This passage-way 78 is merely a covered guideway for the blanks and is disposed along the bed of the machine, as shown at Figs. 8 and 9, and when a blank is brought down into position by means of these bars referred to it will be right in line with the passage-way, so that it can be readily pushed throughout the same. Should the cam 75 become a little worn, the proper adjustment of the screw 65 renders it impossible to depress the bars low enough to carry the blank below the passage-way 78.

79 is a slide adapted to reciprocate in suitable ways on the bed, and carried by this slide is a finger 80, which extends horizontally within the passage-way 78. This finger is in its normal position retracted, as shown at Fig. 8, so as to be in the immediate rear of a blank which has been delivered opposite the passage-way 78 by the action of the bars, and when said finger is projected it will drive said blank throughout the passage-way and beyond the same into proper position with respect to the mechanism for forming the links, the width of the finger being of course such that it will readily pass through the gate 77 in the upper bar while performing the function just referred to.

Referring particularly to Figs. 1, 2, 3, 5, 8, and 9, 81 is a bell-crank pivoted to a bracket 82, which extends from one side of the bed, the upper or vertical leg of said bell-crank being connected to the slide 79 by means of a lever 83, whose extremities are pivoted, respectively, to said slide and leg. The lower leg of this bell-crank 81 is formed into a segment-gear 84, which meshes with a segment-lever 85, pivoted to the bracket 82. This lever 85, at a point between its pivotal point and the segment formation, carries a roll 86, (see Fig. 5,) which extends within the groove of the face-cam 87 on the shaft 76, so that it will be clear that the revolution of the cam 87 will effect the proper reciprocatary movements of the finger 80.

As the blanks are one by one projected by the action of the finger 80, they will be subsequently acted upon by mechanisms for giving a quarter-turn to the blank, whereby the latter is raised into a vertical position for bending said blank into U shape and for shaping said blank thus bent into a completed link, and the description immediately following will have especial reference to these mechanisms.

Referring particularly to Figs. 3, 6, 7, 8, and 9, 88 is a shaft journaled within suitable bearings on the bed and carrying at or about its middle portion an elongated pinion 89 and at its outer extremity a grooved collar 90. This shaft is capable of both rotation and a lengthwise movement in its bearings, and at the inner extremity of said shaft is a notch 91, which, in normal position, is in alinement with the passage-way 78, but is separated therefrom by a space sufficient to permit a blank to be inserted in one end within said notch, while the other end will be clear of said passage-way.

92 is a rack-bar in engagement with the pinion 89 and guided in suitable ways on the bed of the machine, the rear of said bar being provided with a roll (not shown) which extends within the groove of the face-cam 93 on the shaft 37. The revolution of this cam 93 will effect the reciprocation of the bar 92, whereby the shaft 88 will be turned from the position shown at Fig. 8 a quarter-turn to the position shown at Fig. 9. When a blank is projected from the passage-way 78 by means of the finger 80, the farther edge of said blank will be contained within the notch 91, the blank, of course, being horizontally disposed, and the turning of the shaft 88 brings the blank into a vertical position, so that it is ready for the U-bending operation. Immediately prior to this U-bend operation it becomes necessary to disengage the blank from the notch 91, and this is accomplished by withdrawing the shaft 88 by means of a lever 94, pivoted to the bed, the inner end of which lever is forked and is provided with pins 95, which extend within the groove of the collar 90, while the outer extremity of this lever has a roll (not shown) which depends into the groove of the peripheral cam 96. The rotation of this cam 96 will cause the lever 94 to oscillate, whereby the shaft 88 is retracted to release a blank or projected to be in position to receive a blank, as the case may be.

The mechanism for forming the U bend to the blanks comprises a mandrel and a pair of reciprocatory pivoted jaws, which bend the blank first into U shape around the mandrel at its largest portion, and then, after said mandrel has been lowered so as to bring its smallest portion into position, said jaws are operated so as to close upon the U-shaped blank and thereby shape the completed link.

For an understanding of this link-bending mechanism reference may be had to Figs. 3, 4, 6, 7, 8, and 9 of the drawings.

The mandrel consists of a spindle 97, which in cross-section is about the general shape of the proposed U bend to the blank, and from the top of this spindle, coincident with the edge thereof, extends a pin 98, whose diameter is substantially equal to that of the loop of a completed link. For convenience I will not hereinafter refer to this spindle and pin specifically, but I will use the term "mandrel," and will refer to the pin as the "diminished portion" and to the spindle as the "largest portion." This mandrel extends upward through an opening in the bed of the machine, is capable of a free reciprocation therein, and for the performance of its functions assumes a position immediately in front of a blank which has been delivered through the passage-way 78 into the notch 91. This mandrel at its lower end is secured to a slide 99, which latter is capable of free reciprocation within suitable ways in a bracket 100, bolted to the bottom of the bed of the machine.

Referring particularly to Figs. 1, 3, 4, and 7, 101 102 are crank-arms which are secured at the opposite extremities of the rocker-shaft 103, the latter being journaled within a suitable box 104, bolted beneath the bed of the machine and appearing only in dotted lines at Fig. 4. The crank 102 is connected with the slide 99 by means of the link 105, whose extremities are pivoted, respectively, to said crank and slide, and while this construction is merely illustrated in a broken front elevation at Fig. 7 and is not therefore quite so apparent as further illustration might make it, still such construction relates merely to mechanical details rather than to any essential part of my invention, and further or more complete illustration is not deemed necessary.

The crank-arm 101 extends upwardly and carries a roll 106 at its extremity, which roll extends within the groove of the peripheral cam 107 on the shaft 37, by the revolution of which cam a rocking movement is imparted to the shaft 103, whereby the slide 99, which carries the mandrel, is caused to reciprocate vertically.

As before stated, I use a pair of pivoted jaws in connection with the mandrel for bending and shaping the blanks, and as a preface to the description of such jaws I would say that they are pivoted, after the manner of a pair of scissors, to a slide, which latter is capable of a reciprocatory movement toward and away from said mandrel. There is also provided means for opening and closing these jaws, so that when the latter advance against a blank to bend the same they will be distended, whereby the jaws may pass beyond the mandrel, so as to inclose the same during the bending of the blank into U shape, and after this U-bending is complete and the mandrel has been lowered to present its smallest portion to the partially-formed link the jaws are closed, so as to bring the ends of the link together and completely shape the link around this smallest diameter of the mandrel.

108 are jaws which are pivoted at 109 upon the slide 110, which latter is adapted to reciprocate within suitable ways 111 on the bed of the machine, the forward extremities of said jaws being properly recessed, so as to conform to the shape of the completed link.

112 are rolls which depend from the rear extremities of the jaws within straight grooves 113 in blocks 114, which latter are secured to slides 115, dovetailed to the front of the bed, so as to be capable of a lateral reciprocation, that is to say, a reciprocation in a plane at right angles to the length of the jaws. From the rear faces of these slides rolls 116 extend within the grooves of the peripheral cams 117 118 on the shaft 37, so that it will be readily understood that when these cams revolve the slides 115 will be spread apart or contracted, as the case may be, thereby closing or opening the jaws.

119 is a lever pivoted at 120 to the bed of the machine and carrying on one side face at a point about midway of its length a roll 121, which latter extends within the groove of the face-cam 122 on the shaft 37, whereby when said cam is revolved a to-and-fro swinging movement will be imparted to said lever. An elongated opening 123 is formed at the upper end of the lever 119, and within this opening is a block 124, which is capable of sliding freely therein, the position of said block within this opening being determined by means of an adjusting-screw 125, passed from the upper edge of the lever lengthwise of said opening through the block. This screw is stationary as to any lengthwise movement, so that when it is operated the block will be carried up and down within the opening. 126 is a pitman, one extremity of which is pivoted to the slide 110, while the other extremity is pivoted around a stud 127, which projects from the block 124. From this description it will be evident that when the lever 119 is swung to and fro by the action of the cam 122 the slide 110 will thereby be reciprocated to throw the jaws forward or to retract them, as the case may be. Of course the pitman 126 may be pivoted directly to the upper extremity of the lever 119; but I prefer the construction shown, since it is very desirable to provide for a somewhat variable throw of the jaws to compensate for wear, or on account of the variations in the thickness of the metal strip from which the blanks are cut, or to meet various other obvious and ordinary contingencies.

The movements necessary to effect the carriage of the jaws and the opening and closing of the latter do not interfere with each other, since the jaws are connected with the slides 114 through the medium of the rolls 112

of the straight grooves 113, which latter extend in a direction at right angles to the plane in which these slides move.

Motion is communicated to the shaft 37 from the shaft 76 by means of intermeshing bevel-gears 128 129, secured, respectively, on said shafts, and the shaft 76 receives its movement from the press-shaft 130 through the medium of the shaft 131, journaled in suitable bearings bolted to the frame of the press, said shaft 131 being provided at each end with bevel-gears 132 133, which mesh with bevel-gears 134 135, respectively, on the shafts 130 and 76.

For reasons which will hereinafter appear it is quite necessary that the mechanism immediately carried or operated by the press-gate and which relates to the blanking-out operations should be capable of operating independently of the various mechanisms for feeding and delivering the blanks and for forming the latter into completed chain, and I have therefore provided a friction-clutch 136, which is splined upon the press-shaft 130 and is provided with a circumferential groove 137, said clutch being capable of a free sliding movement throughout its splined connection.

138 is a lever pivoted at 139 to the frame of the press and extending downward to be within convenient reach of the hand of the operator, the upper extremity of this lever carrying a roll 140, which extends within the groove 137 of the friction-clutch. The gear 134 is loose on the press-shaft, so that it will be readily understood that the operation of this lever 138 will effect the rotation or stopping of the shaft 76 at the will of the operator.

It will thus be apparent that all of the parts which are carried and operated by the press-gate can perform their functions when disassociated from the rest of the machine, and this feature possesses considerable merit and obviates a great annoyance which would otherwise obtain if the blanking mechanism and the link-forming mechanism always operated together.

To be more explicit, I would again call attention to the fact that when the press-gate descends blanks are cut out from the metal strip simultaneously with the punching out of eyes for alternate blanks in line with said cut-out blanks, and therefore when a new strip of metal is inserted within the machine and the blank and link forming mechanisms are operated together it follows that the link-forming devices will have taken twelve (12) blanks from the well before the blanking mechanism has commenced to deposit the blanks in said well.

By reference to Fig. 20 it will be seen that there are cut out from the strip six lapping blanks, all extending lengthwise of the metal strip, and it will be manifest that while a series of three blanks abreast are being cut from the strip a series of three sets of eyes are being simultaneously cut abreast across the strip in alinement with said blanks, and also that these blanks and eyes are separated by a series of eyes also in alinement with said blanks. That is to say, there would be a shortage of twelve (12) blanks in the well, which would have to be made good by depositing blanks in the well by hand.

In the instance of my present machine the operator disconnects the clutch 136 from the gear 134 whenever it becomes necessary to put in a new strip of metal, and he does not make connection between this clutch and gear until the punches carried by the press-gate have cut out the eyes for twelve (12) blanks, whereupon he connects said clutch and gear, so that the next descent of the press-gate will cause the dies to cut out blanks the eyes whereof have been previously cut out by the punches, while the latter will at the same time cut out the eyes for blanks that are alternately arranged along the metal strip with respect to the blanks cut.

In the manufacture of chain the general operation of my machine is as follows: The blanks will be delivered to the link-forming mechanism as fast as they are deposited within the well by the blanking mechanism. Presupposing a blank to have been delivered through the passage-way 78 into the notch 91 and the shaft 88 to have been operated to bring said blank into a vertical position, with the mandrel elevated so as to bring its largest portion immediately opposite said blank, the jaws 108, in distended condition, now advance against the blank, striking the same on opposite sides of the mandrel and bending said blank around the mandrel into U shape. The mandrel now descends until its smallest portion is opposed to the partially-formed link, whereupon the jaws are operated so as to close firmly against the partly-formed link and thereby shape it around the mandrel, the extreme ends of the completed link containing the eyes projecting beyond the jaws. The mandrel is now withdrawn entirely from the link, and the jaws, closed and grasping the completed link, are then retracted until the eyes in said link are brought immediately opposite to the passage-way 78, so that a horizontally-disposed link-blank thrust from said passage-way will pass through said eyes and be delivered into the notch 91, whereupon the shaft 88 operates to turn this blank into vertical position, the jaws are distended, thus releasing the completed link, and said jaws are operated against this succeeding blank with the same results as above described.

From the foregoing description it will be evident that the successful operation of my link-forming mechanism does not at all depend upon any particular way of cutting out the blanks, and therefore the latter may be cut out one at a time transversely across a narrow strip of metal whose width is about equal to the length of the blanks, and as fast as these blanks are cut out they may be deposited in the well; or I need not use any blank-

ing mechanism whatever in connection with my link-forming mechanism, since blanks cut out on an independent machine may be strung on wires and led into the well in the ordinary manner common to sheet-metal-chain machines; but it is a decided advantage to have a machine which is itself capable of automatically making chain out of a continuous strip of sheet metal, and therefore although I do not wish to be limited in this respect still I prefer to use the machine as shown and described.

The method which I have originated to cut out the blanks by the action of reciprocatory punches and dies is a vast improvement, since I am thereby enabled to cut the blanks in rows lengthwise of the strip, thus reducing the scrap to a minimum and getting the full benefit of the tensile strength of the metal.

Blanking-out presses are as a rule quite large and heavy, and the metal used for making sheet-metal chains always comes in the form of rolls weighing several hundred pounds, which must be mounted on some sort of roll or spool adjacent to the machine, so that it will be seen that any attempt to shift the metal itself beneath the punches would necessitate the shifting back and forth of the big roll of metal, unless the latter is extremely narrow and thin. The best results are accomplished by shifting the punches and dies, since it takes less power to do this, and the metal itself is never disturbed, except when fed straight through the machine by the feed-rolls.

Although I have shown means for cutting up the scrap as it passes from the machine, still it is preferable to wind the scrap on a drum, in order that it may be available as a marketable article commonly used to protect trees, poles, &c. This is another point of advantage in favor of my construction, since if the metal were shifted to and fro the scrap could not be wound on a drum unless some provisions were made for shifting this drum also in harmony with the shifting movements of the metal.

The various appliances that come into immediate contact with the blanks and links are actuated by properly-timed cams with various intermediate levers and other parts which I have hereinbefore described, but these various mechanical contrivances which I have utilized for effecting the proper movements and functions of the blank and link manipulating appliances are quite ordinary and could be supplanted by other well-known mechanisms without the exercise of anything beyond the skill of the ordinary workman, and I therefore do not wish to be limited to the use of any particular association of cams, levers, gears, and the like.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a machine for manufacturing sheet-metal chain, the combination with means for advancing the metal strip step by step, of the vertically-reciprocatory punches, the dies over which said strip is fed, and means for shifting said punches and dies laterally across the strip, substantially as set forth.

2. In a machine for manufacturing sheet-metal chain, the combination of means for advancing the metal strip step by step, the vertically-reciprocatory press-gate, the subpress-gate carried by the press-gate and capable of being shifted laterally within suitable ways therein, the standard having a housing within which the subpress-gate is guided as to its vertical movements, the dies carried by said standard, and means for laterally shifting said standard at right angles to said strip, substantially as set forth.

3. The combination with the punches and dies of means for feeding the metal strip between the same, of means for shifting said punches and dies transversely to the strip, whereby the blanks are cut out in a row across the strip, substantially as set forth.

4. The combination of the vertically-reciprocatory press-gate, the subpress rigid with said press-gate as to vertical movements but capable of sliding transversely within suitable ways in the same, the slide capable of reciprocating within suitable ways on the bed of the machine, the standard carried by said slide and provided with a housing within which the subpress is guided as to vertical movements, the punches depending from said subpress, the dies carried by the standard beneath the punches, means for feeding the metal strip step by step in the direction of its length between said punches and dies, and means for shifting said slide step by step transversely to said strip and intermediate of consecutive feeding movements of the latter, substantially as set forth.

5. In a machine for manufacturing sheet-metal chain, the combination of mechanism for feeding the metal strip step by step in the direction of its length, the punches and dies whereby the blanks are cut out from said strip, devices for shifting said punches and dies transversely across said strip, and means carried and operated by said devices for preventing the feeding of the metal strip except at the termination of the shifting movement of the punches and dies in each direction, substantially as set forth.

6. In a machine for manufacturing sheet-metal chain, the combination of means for feeding the metal strip and for cutting out the blanks therefrom, of mechanism for bending said blanks and forming them into completed chain, a pair of screw conveyers leading to said mechanism, and a push-finger for delivering the blanks one by one into said conveyers, substantially as set forth.

7. In a machine for manufacturing sheet-metal chain, the combination of the two screw conveyers whose threads are separated by a distance about equal to the width of the ends of the blanks while the distance between

the conveyers is such that the blanks may be accommodated therein lengthwise with their ends substantially abutting against the bodies of the conveyers, means for supplying the blanks one by one to the outer extremities of said conveyers, means for revolving the latter whereby said blanks are carried inward, and means located at the inner terminals of said conveyers whereby the blanks are received from the latter and are bent up and formed into completed chain, substantially as set forth.

8. In a machine for manufacturing sheet-metal chain, the combination of the standard capable of a lateral reciprocation, the punches and dies carried by said standard, the well in said standard beneath the dies, the passage-way beneath the well and separated from the bottom of the latter by a space about equal to the thickness of a blank, the pair of screw conveyers, the push-finger capable of a uniform reciprocation throughout said passage-way beneath said well whereby the blanks are one by one delivered to said conveyers, and mechanism located at the inner ends of said conveyers whereby the link-blanks are received from the conveyers and moved to mechanism for forming the blanks into completed chain, substantially as set forth.

9. The combination of the feed-rolls whereby the metal strip is advanced, the ratchet secured upon the shaft of one of the feed-rolls, the vertically-reciprocatory press-gate, the resilient pawl carried by said gate and engaging with said ratchet to operate the feed-rolls, the slide whereby the punches and dies are shifted transversely across the strip, and the trip carried by said slide and engaging with the pawl to keep the latter away from the ratchet at all times except when said slide has reached the respective limits of its sliding movements, substantially as set forth.

10. In a machine for manufacturing sheet-metal chain, the combination with the blanking-out mechanism, the well for receiving the blanks carried by said mechanism, the instrumentalities for forming the blanks into completed chain, the screw conveyers for feeding the blanks to said instrumentalities, the push-finger adapted to reciprocate immediately beneath said well whereby the blanks are delivered to said conveyers, and means for disconnecting the blank-feeding and link-forming mechanisms from the blanking-out mechanism while said finger is at the limit of its forward movement immediately beneath said well, substantially as set forth.

11. In a machine for manufacturing sheet-metal chain, the combination of the screw conveyers, instrumentalities for cutting out the link-blanks and for delivering them to the screw conveyers, devices for threading said blanks through the eyes of previously-completed links, and a pair of vertical slides between the meeting ends of which said link-blanks are successively received from the screw conveyer and then carried by said slides to the blank-threading devices, substantially as set forth.

12. In a machine for manufacturing sheet-metal chain, the combination of the blanking-out mechanism, the screw conveyers, the finger for pushing the blanks into the conveyers, the link-forming devices, instrumentalities for threading the blanks through the eyes of previously-formed links, and a pair of vertically-operating slides between which the blanks are delivered by the conveyers and by which slides said blanks are carried to said threading instrumentalities, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES F. SMITH.

Witnesses:
F. W. SMITH, Jr.,
M. T. LONGDEN.