H. A. STAPLES.

CHAIN MACHINE.

APPLICATION FILED FEB. 20, 1908.

917,903. Patented Apr. 13, 1909.

4 SHEETS—SHEET 1.

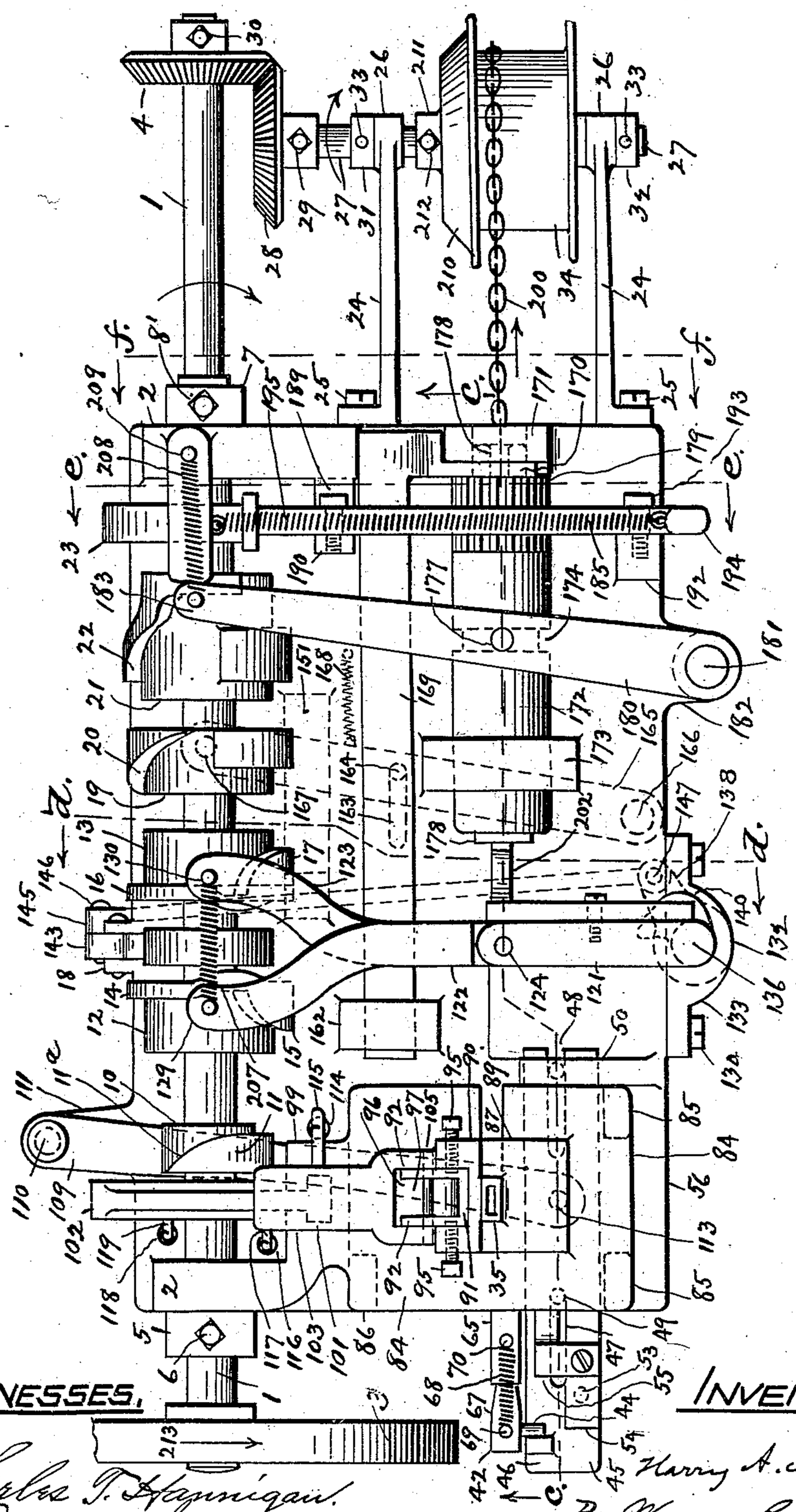


FIG 1.

WITNESSES.

Charles T. Hannigan.

Alfred A. Johnson

INVENTOR.

Harry A. Staples

By Warren R. Pierce

Attorney.

H. A. STAPLES.

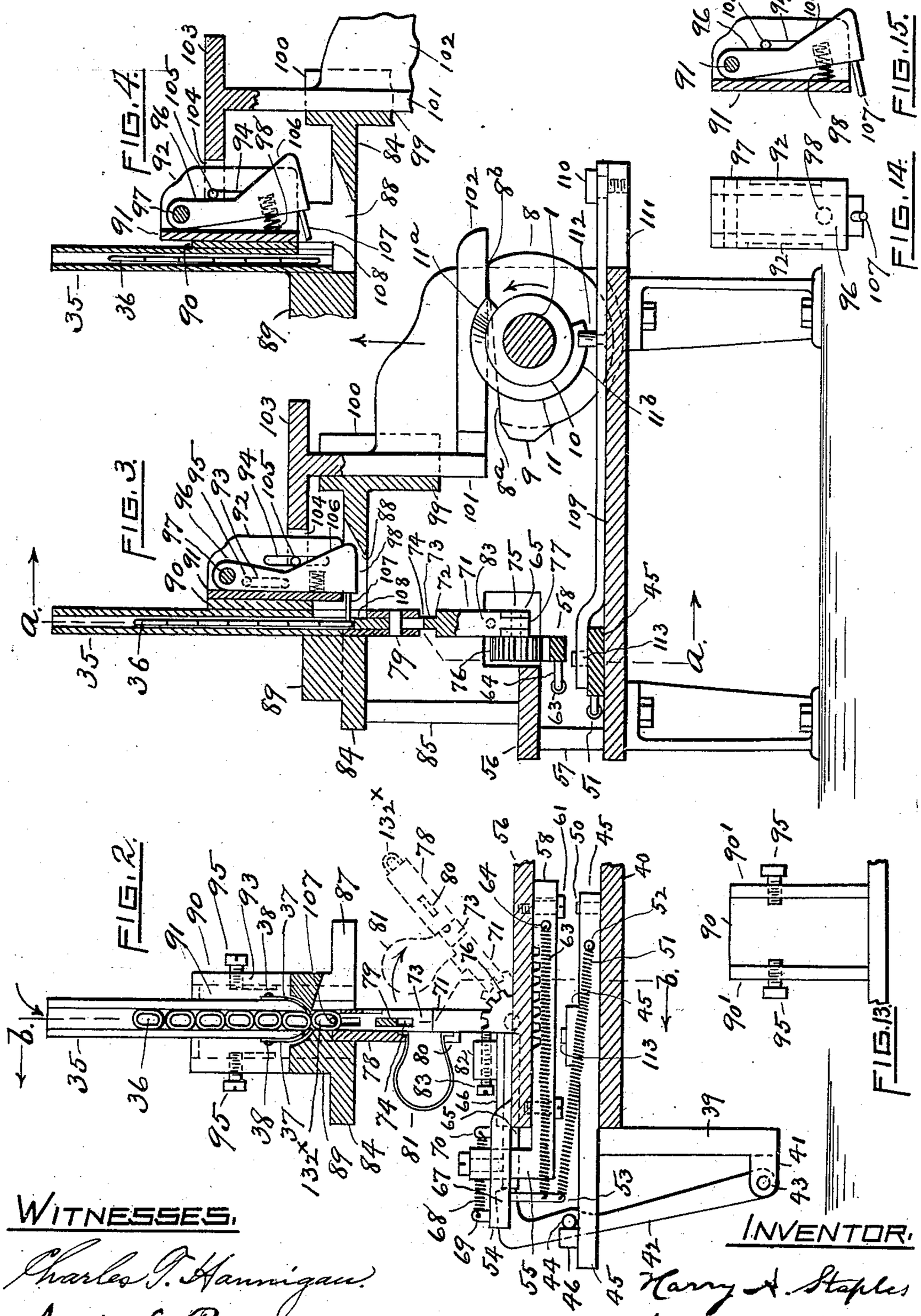
CHAIN MACHINE.

APPLICATION FILED FEB. 20, 1908.

917,903.

Patented Apr. 13, 1909.

4 SHEETS—SHEET 2.



WITNESSES.

Charles P. Hannigan.

Annie E. Perce.

INVENTOR.

Harry A. Staples

By Warren R. Perce

Attorney.

H. A. STAPLES.

CHAIN MACHINE.

APPLICATION FILED FEB. 20, 1908.

917,903.

Patented Apr. 13, 1909.

4 SHEETS—SHEET 3.

FIG. 7.

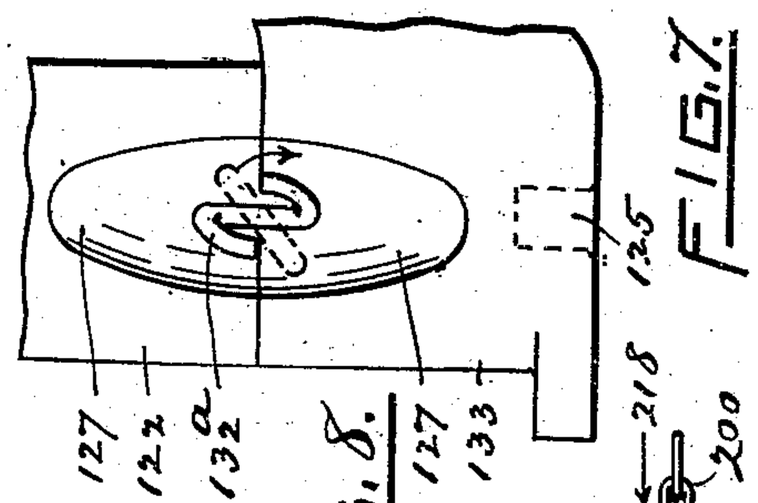


FIG. 8.

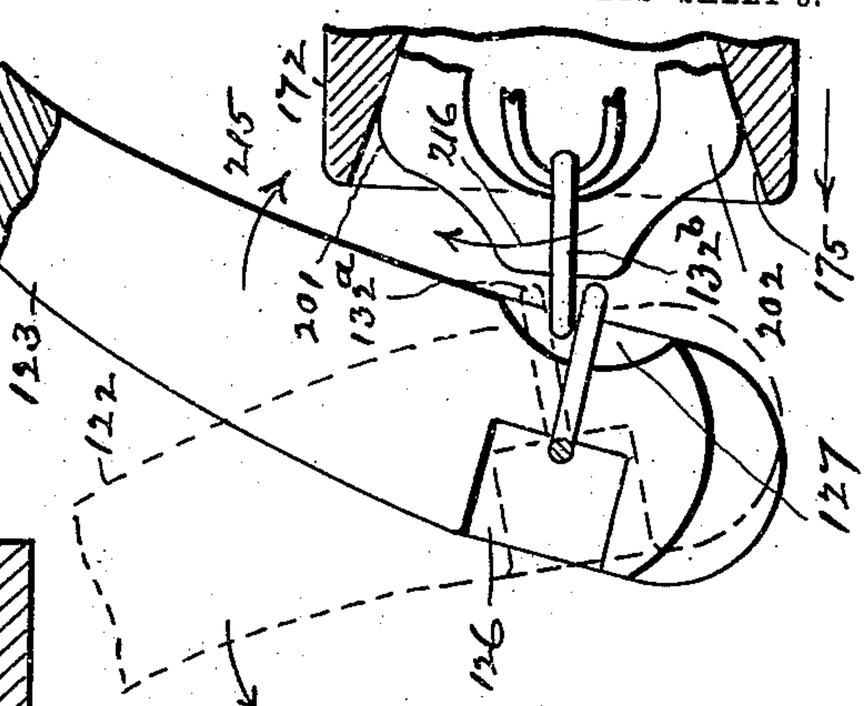


FIG. 5.

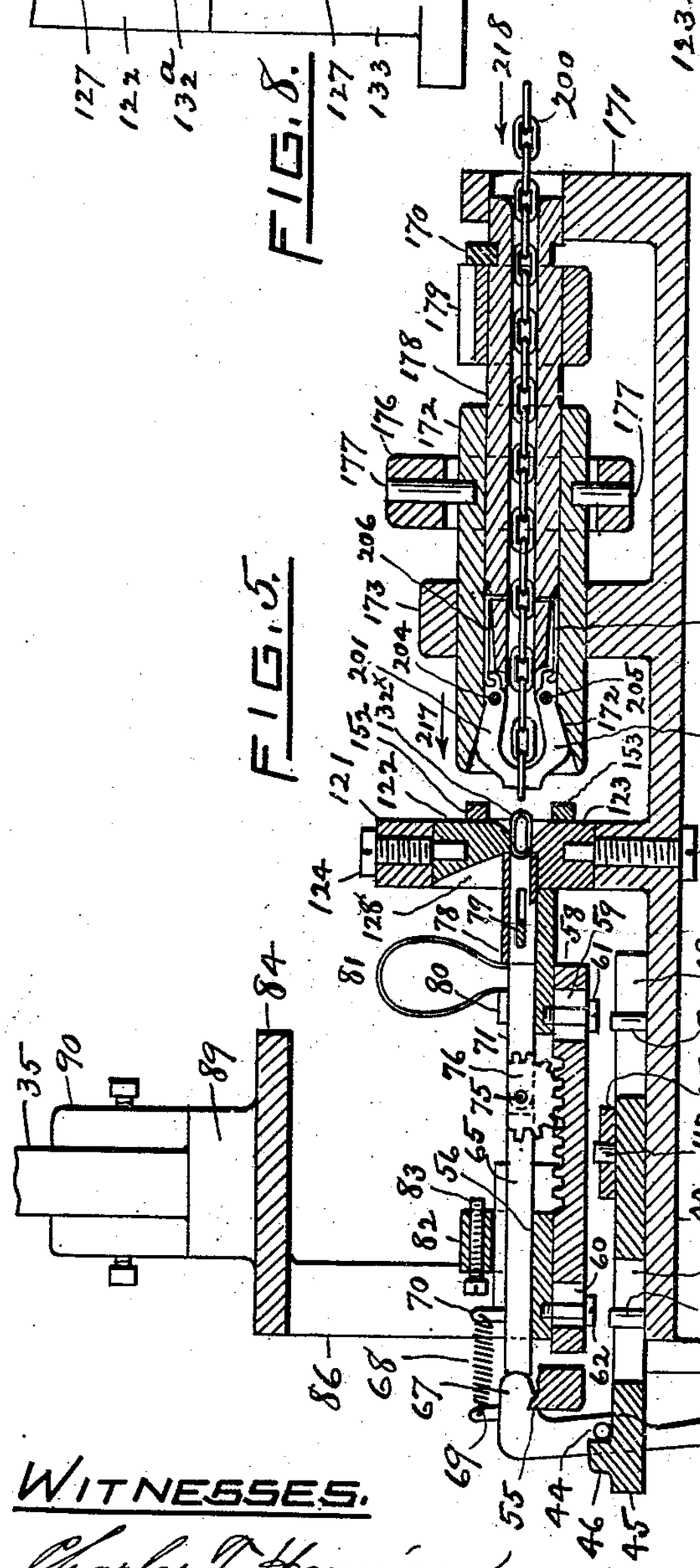


FIG. 6.

WITNESSES.

Charles T. Hannigan.

Alfred L. Johnson

INVENTOR.

Harry A. Staples

By Warren R. Pence

Attorney.

H. A. STAPLES.

CHAIN MACHINE.

APPLICATION FILED FEB. 20, 1908.

917,903. Patented Apr. 13, 1909.

4 SHEETS—SHEET 4.

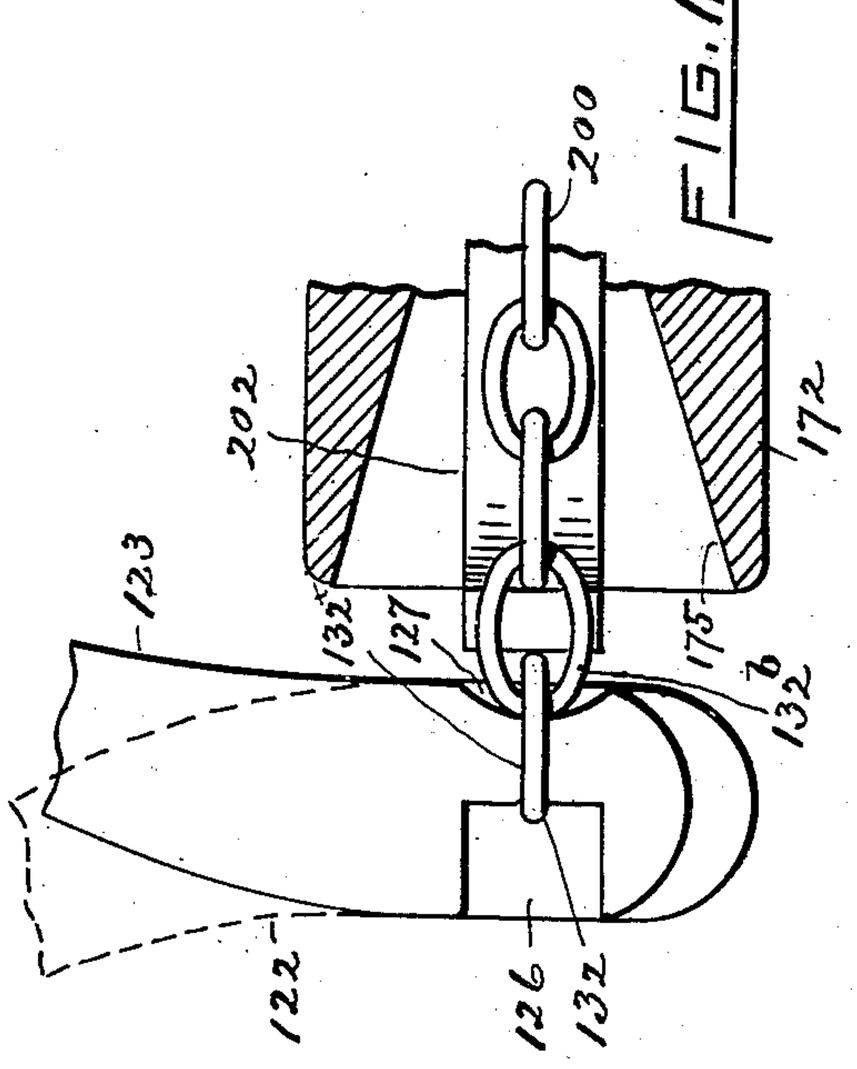


FIG. 11.

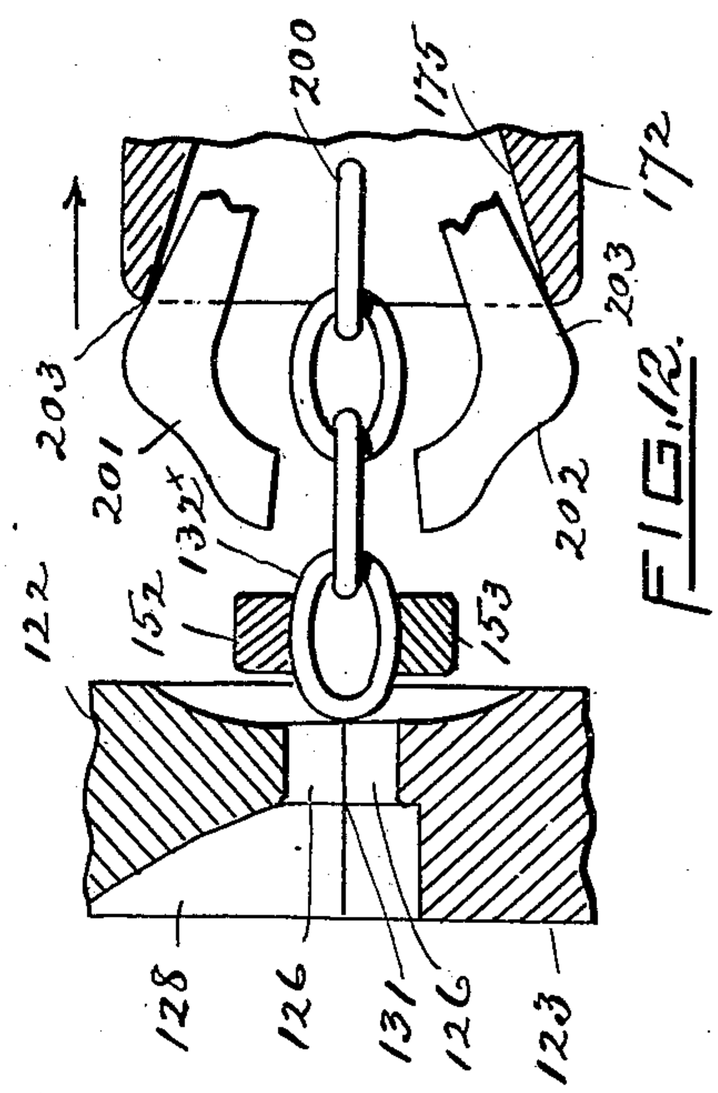


FIG. 12.

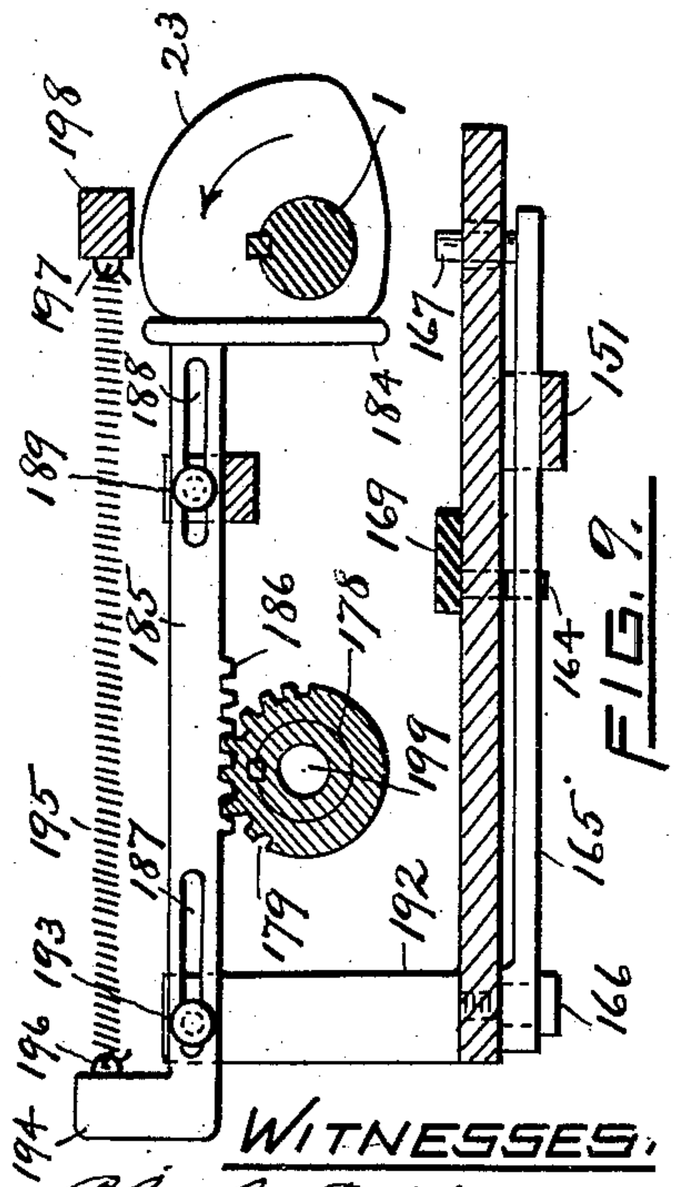


FIG. 9.

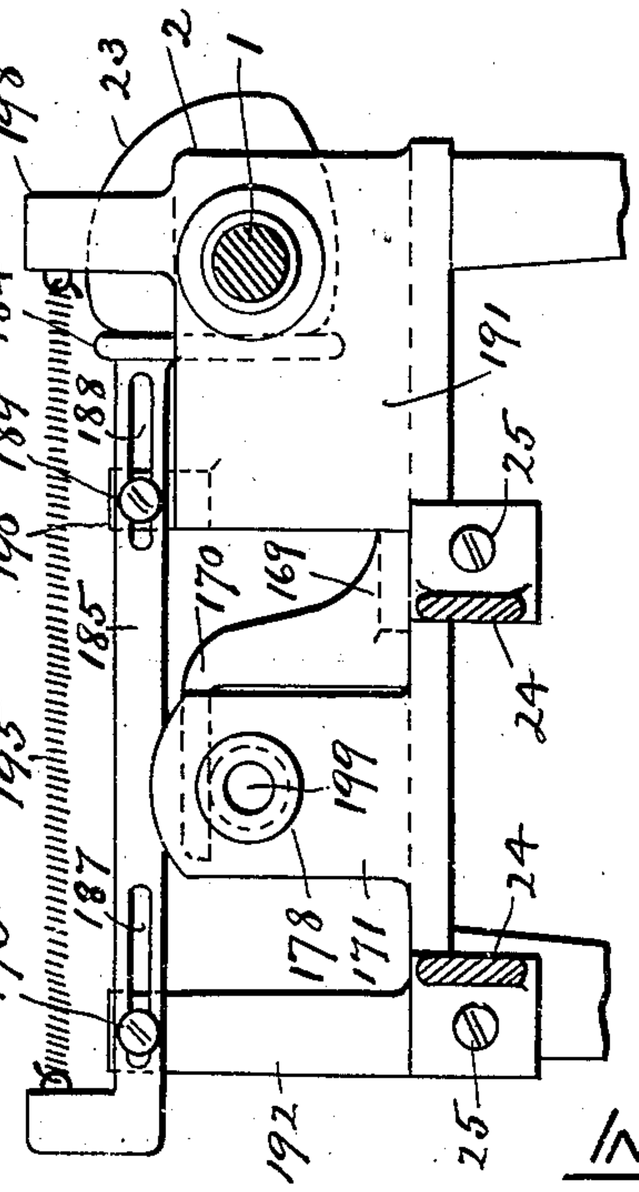


FIG. 10.

WITNESSES:

Charles T. Hannigan.

Alfred A. Thomas

INVENTOR.

Harry A. Staples

By Warren R. Pence

Attorney.

UNITED STATES PATENT OFFICE.

HARRY A. STAPLES, OF PAWTUCKET, RHODE ISLAND.

CHAIN-MACHINE.

No. 917,903. Specification of Letters Patent. Patented April 13, 1909.

Application filed February 20, 1908. Serial No. 416,864.

To all whom it may concern:

Be it known that I, HARRY A. STAPLES, a citizen of the United States, residing at Pawtucket, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Chain-Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

Like reference numerals indicate like parts.

Figure 1 is a top plan view of my improved chain machine. Fig. 2 is a view partly in elevation and partly in section on line *a a* of Fig. 3. Fig. 3 is a view partly in elevation and partly in section on line *b b* of Fig. 2. Fig. 4 is a similar view of the parts shown in the upper portion of Fig. 3, but with the pin withdrawn from engagement with the lowermost link in the feed chute. Fig. 5 is a view partly in elevation and partly in section on line *c c* of Fig. 1. Fig. 6 is a view partly in elevation and partly in section on line *d d* of Fig. 1. Fig. 7 is a detail view illustrating the method of connecting two consecutive links of a chain. Fig. 8 is a view in elevation illustrating the means for spreading apart the ends of a link for the insertion of the next preceding link. Fig. 9 is a view partly in elevation and partly in section on line *e e* of Fig. 1. Fig. 10 is a view partly in elevation and partly in section on line *f f* of Fig. 1. Figs. 11 and 12 are detail views of the spreaders and chain-gripping devices. Figs. 7, 8, 11 and 12 are on a much enlarged scale. Figs. 13, 14, and 15 are detail views.

My invention relates to machines for making jewelers' chains, and consists of the novel construction and combination of the several parts hereinafter described as specifically set forth in the claims.

In the drawings 1 represents the main shaft of the machine rotatably mounted in bearings 2 at the two opposite ends of the frame. The shaft 1 is driven by the pulley 3, which is keyed to it at one end thereof, and it is also provided at its opposite end with a beveled gear 4. A collar 5 is fastened on the shaft 1 by a set screw 6 and holds the said shaft against longitudinal movement in one direction, and a collar 7 is fastened on said shaft by a set screw 8′ and holds said shaft against longitudinal displacement in the opposite direction.

The various actuating cams, mounted on the main shaft 1 of the machine, are described as follows: There are several cams upon the shaft 1, keyed or otherwise secured to it so as to turn therewith. The first cam may be called the vertical feed cam and is designated in the drawings as 8. It is shown in Fig. 3 and is an arc-shaped cam, approximately 232° in extent on its curved periphery, and the remaining part of its edge is straight, as shown at 8^a. It is provided with a lift or high part 9. Adjacent to the vertical feed cam 8 is the lateral feed cam 10, consisting of a circular disk, upon whose edge is a concentric flange 11 of larger diameter and which has two beveled sides 11^a and 11^b. There are two link-spreading cams on the shaft 1, indicated as 12 and 13, respectively, each having a cylindrical body. The cam 12 has a concentric flange 14 of larger diameter, whose inner face is beveled and formed with the swell 15. In like manner the cam 13 has a concentric flange 16 of larger diameter, whose inner face is beveled and formed with a swell 17. Between the link-spreading cams 12 and 13 a link-holding cam 18 is fastened on the shaft 1, as indicated in full lines in Fig. 1 and by dotted lines in Fig. 6. It has the arc-shaped periphery of a small diameter and the arc-shaped concentric periphery of a larger diameter as plainly illustrated in Fig. 6 with curved slopes from the larger to the smaller portions. On the main shaft 1 is next in order a cam 19 for giving reciprocating longitudinal movement to the slide, which advances the link-gripping jaws to the work. This cam 19 has a cylindrical body and a collar or flange 20 fastened thereon, whose inner face has the spirally directed cam-surface hereinafter more fully described. The next cam marked 21 is fastened to the main shaft 1 and serves to operate the sleeve for opening and closing the gripping jaws. This cam 21 has a cylindrical body and a collar or flange 22, whose inner face has the peculiar cam-surfaces hereinafter described. The cam 23 on the main shaft 1 has the sector-shape shown in Figs. 9 and 10, and gives a limited, periodical, intermittent rotation to the gripping jaws and their connected parts.

Two brackets 24, 24, are secured by screws 25, 25, to the end of the frame which is opposite to the pulley 3 and are provided with bearings 26, 26, at their outer ends. A shaft 27 is mounted in said bearings. A bevel gear 28 is fastened by a set screw 29 upon one end of the shaft 27 and meshes with

the bevel gear 4 (of the same diameter and number of teeth) the last named gear being secured upon the main shaft 1 by the set screw 30. Collars 31, 32, are secured by set screws 33, 33, to the shaft 27 in position contiguous to the bearings 26, 26, and hold the shaft 27 from longitudinal displacement. A drum 34 is loosely mounted upon the shaft 27.

The mechanism for feeding the chain links to the machine is described as follows: The general purpose of this machine is to connect together swaged links to form a chain. These links are separately fed by hand, or otherwise, to a chute or spout 35, which is illustrated in Figs. 1, 2, 3 and 4. The links so fed are designated as 36 in Fig. 2 and rest, one upon another, by gravity, the lowermost link, designated as $132^{\times}$ in the drawings, being supported loosely by means of the spring fork comprising two light springs 37, of suitable curvature for said purpose, which are located at the bottom of the chute or spout 35 and are held by screws or pins 38. A hanger 39 extends down from the frame 40 of the machine and has ear pieces 41. A lever arm 42 is mounted in the ear pieces 41 by a pivot 43. A pin 44 extends from the side of the lever arm 42. A slide bar 45 is mounted loosely on the bed or frame of the machine. A block 46 upon the upper outer end of the slide bar 45 is normally in contact with the pin 44 of the lever 42. The slide bar 45 has the two longitudinal slots 47, 48, through which, respectively, screws or pins 49 and 50 pass loosely into the bed of the machine, thus confining the slide bar 45 to a straight linear movement. A spiral spring 51, fastened at one end to an eye 52 on the edge of the slide bar 45, is fastened at its opposite end to the bottom of a hanger 53, which extends down from a fixed support or bracket 54. Another hanger 55 extends down from the bracket 54. The bracket 54 is supported upon a table 56, which is mounted on legs 57, the latter resting on the bed of the machine. A rack bar 58 is slidable on the under surface of the table 56 and is provided with two longitudinal slots 59, 60, through which, respectively, screws 61, 62, pass loosely and enter the table 56. A spiral spring 63 is fastened at one end to the eye 64 on the side of the rack bar 58 and at the opposite end to the hanger 53. A horizontal carrier bar or slide 65 is loosely mounted upon the upper surface of the table 56, between parallel ways 66, and its outer end is in contact with the rounded edge of the bent end or head 67 of the lever arm 42. A spiral spring 68 is fastened at one end to an eye 69 on the head 67 of the lever arm 42 and at the opposite end to a post 70, which extends up from the horizontal carrier bar 65.

An oscillating carrier 71 has two shoulders 72 and an intermediate longitudinal projection or tongue 73, the latter being made with a transverse slot 74. The oscillating carrier 71 is connected with the horizontal carrier bar 65 by a pivot 75, on one end of which pivot a gear 76 is mounted and fastened to the oscillating carrier 71; whose teeth mesh with the teeth of the rack bar 58. The inner end of the oscillating carrier 71 has a tongue 77, which enters a slot in the adjacent end of the horizontal carrier 65 and is there pivoted, as shown at 75 in Fig. 3.

The oscillating carrier 71 has an extensible head or link receptacle 78, which is provided with a central longitudinal slot to receive the tongue 73 of the oscillating carrier 71. This extensible head 78 has a transverse slot, through which a pin 79 passes loosely across the slot 74 of the tongue 73. The pin 79 in cross section is oblong and rectangular. On the oscillating carrier 71 is a block 80, in a nick of which one end of a bow spring 81 is engaged. The opposite end of the spring 81 bears against the inner end of the extensible head 78, thus normally holding the head 78 in its extended position, with the pin 79 occupying the outer end of the slot 74, as seen in Fig. 2.

A block 82 is supported by the table 56 and a screw 83 passing through said block serves as an adjustable stop to limit the upward movement of the oscillating carrier 71 and to cause it normally to stand in a true vertical position.

A table 84 is supported by legs 85, 86. The legs 85 rest upon the table 56 and the leg 86, rests upon the bed of the machine. The table 84 is slotted, as shown at 87 in Fig. 2, to allow oscillatory movement of the carrier 71 and extensible head 78, as illustrated in said Fig. 2. The table 84 is also slotted at 88, as shown in Fig. 3.

A supporting block 89 is provided with a slot, fitting the chute or spout 35, and is integral with or rests upon the table 84. The block 89 is cut away, as indicated in Fig. 2, to afford spaces for the action of the springs 37. On the opposite side of the chute or spout 35 is a channeled upright piece 90, separately shown in Fig. 13, constituting by its parallel flanges 90′, 90′, a vertical guide way. A slide 91 shown in Fig. 15, has two parallel sides 92 (see Fig. 14), each of which is provided with a vertical slot 93. Each of said parallel sides 92 has also a vertical slot 94. A screw 95 passes through each flange of the upright piece 90 loosely into one of the slots 93 of the flanges 92 of the slide 91. A spring-pressed arm 96 is mounted by a pivot 97 between the two flanges 92 of the slide 91. A spring 98 is mounted in a socket in the arm 96, as seen in Figs. 3 and 4, and has its outer end bearing against the slide 91.

The table 84 has a vertical guide-way 99, provided with parallel flanges 100. A vertically movable bar 101 is mounted between the flanges 100 of the guide-way 99, and is provided with a horizontally extending foot 102,

whose outer end is represented in Fig. 3 as resting upon the corner 8^b of the link-feed cam 8. At the upper end of the bar 101 is a horizontal table or bracket 103 slotted or bifurcated at 104 to receive loosely the flanges 92 of the slide 91. A cross pin 105 extends through the table or bracket 103, across the slot 104 and passes through the slots 94 of the flanges 92 of the slide 91, as seen in Figs. 1, 3 and 4, and bears against the outer edge of the arm 96, by means of the spring 98, which presses said arm 96 out into said contact with the cross pin 105. The lower part of the arm 96 has a sloping edge, as seen at 106. On the opposite edge of the arm 96 at the bottom thereof is a pin 107, which passes loosely through a slot at 108 the bottom of the chute 35 into said chute.

A lever 109 is mounted by a screw pivot 110 upon a bracket 111, which extends from the bed of the machine, as illustrated in Fig. 3. The lever 109 has a pin or cam-surface 112, against which the cam-surfaces 11^a and 11^b of the cam 10, 11, travel. The inner end of the lever 109 is curved upward and connected by the pivot 113 to the slide bar 45. The spring 51 gives return movement to the slide bar 45.

A pin 115 from the bracket 103 supports a spring 114 and the other end of said spring is attached to the vertical guide-way 99. A spring 116, attached to a pin 117, which extends from the horizontal table or bracket 103, is secured at its bottom to the bed or frame of the machine. A spring 118, attached to a pin 119, which extends from the horizontal foot 102, is secured at its bottom to the bed or frame of the machine.

The mechanism for opening or spreading the links is described as follows: A standard or upright piece 121 is fastened to the bed of the machine, and has a rectangular transverse slot, best seen in Fig. 5, and partially occupied by the spreaders 122 and 123. The upper spreader 122 is pivoted to the standard 121 by the screw 124, and the lower spreader 123 is pivoted to the standard 121 by the screw 125. The standard 121 is cut away on its edge to receive the tail ends of said spreaders, as illustrated in Fig. 6. Each spreader has a rectangular opening 126, as best seen in Fig. 7, and a concavity 127, on the opposite edge. The thinning of the upper spreader 122, as seen in Fig. 5, offers a space 128 for the curvilinear travel of the head 78 of the oscillating carrier arm 71. The spreaders 122 and 123 have cam pins 129, 130, at their respective outer ends, of which one (129) is shown in Fig. 6. The cam pin 129 rests at its bottom on the peripheral surface of the cylindrical body of the cam 12, and said cam pin 129 bears laterally against that side of the flange 14, which is provided with cam-surfaces 15, as shown in Fig. 1. In like manner, the cam pin 130 of the spreader 123 rests at its bottom on the peripheral surface of the cylindrical body of the cam 13 and said cam pin 130 bears laterally against that side of the flange 16, which is provided with cam-surfaces 17, as shown in said figure. The spreaders 122 and 123 have in the axial line of their rotation the two vertical slots, illustrated in Fig. 6, which two slots, when the said spreaders are in the position shown in said figure register longitudinally to form one continuous slot 131. By comparing Figs. 2 and 5 it is seen that the link $132^\times$ indicated in two places in Fig. 2 (once in solid lines and once in dotted lines) has come into position between the spreaders 122 and 123 in a vertical position, as represented in Fig. 5, which position is in said slot 131 of Fig. 6. The mechanism for temporarily holding the link $132^\times$ after it has been connected to the chain is described as follows. In a slot or recess formed in the outer vertical edge of the standard or upright piece 121 is mounted a cylindrical barrel or piece 132. A bracket 133 is fastened by screws 134 to the edge of the bed of the machine. The barrel 132 has a concentrically reduced extension or stem 135, shown in Fig. 6, which passing through a bearing in the bracket 133 constitutes a pivotal connection therewith. A screw 136, extending through the lip of the standard 121, enters the top end of the barrel 132 and forms the upper pivot thereof. A collar 137 has a radial arm 138, and said collar is fastened by a screw 139 to the extension or stem 135 of the barrel 132, so that said collar and barrel turn together. Midway the barrel 132, is a cam 140, fastened thereon and turning therewith. A lever arm 141 is mounted by a pivot 142 to a bracket 143, which extends from the bed of the machine. The upper part of the lever arm 141 is provided with a head 144, whose end is in contact with the peripheral edge of the cam 18, which cam is shown in solid lines in Fig. 1 and in dotted lines in Fig. 6. A link bar 145 is connected at one end to the lower end of the lever arm 141 by the pivot 146, and at its opposite end to the outer end of the radial arm 138 of the collar 137 by a pivot 147. A spiral spring 148 is fastened at one end to an eye 149 on the link bar 145 and at the opposite end to the ear or pin 150 of the bracket 151, hereinafter described. Two holding jaws 152 and 153 are mounted on the standard 121 by pivots 154 and 155, respectively. The outer ends of the jaws 152 and 153 rest upon the cam 140. A spiral spring 156 extends from one of said jaws to the other, and is fastened at its ends to the pins 157 and 158. Stop pins 159, 160, from the standard 121 limit the inward movement of the free ends of the jaws 152, 153.

The mechanism for operating the link-gripping and link-turning devices are as follows: A slide bar 169 is movable on the

bed of the machine through a guide 162. The machine bed has a longitudinal slot 163, about midway its length, which is shown in dotted lines in Figs. 1 and 9. A pin 164, passing through said slot in the bed of the machine and indicated by dotted lines in Figs. 1 and 9, limits the longitudinal travel of the slide bar 169. A lever arm 165 is movable on the under surface of the bed of the machine and is mounted thereon by the pivot 166, as indicated in dotted lines in Fig. 1. The lever arm 165 is supported upon a bracket 151 on the underside of the bed of the machine, shown in dotted lines in Fig. 1, in elevation in Fig. 9 and in cross section in Fig. 6. A cam pin 167 projects upwardly from one end of the lever arm 165 and is in operative contact with the cam-surfaces on the side of the flange 20 of the cam 19 of main shaft 1. A spiral spring 168, shown in dotted lines in Fig. 1, is fastened at one end to an eye on the lever arm 165 and at the opposite end to an eye extending from the bed of the machine, as shown in said figure. The slide bar 169 has a bent extension 170. A bearing 171 is secured to the bed of the machine. A sleeve 172 is rotatably mounted in a bearing 173, which extends up from the bed of the machine. The sleeve 172 is provided with a circumferential groove 174. The end of the sleeve 172, which is contiguous to the standard 122, has its bore conically enlarged so as to form a circular cam-surface, indicated at 175. A collar 176 surrounds the sleeve 172, and has two opposite radially-directed pins 177, which project loosely into the circumferential groove 174 of said sleeve. A tube 178 is mounted in the bore of the sleeve 172 and in the bearing 171, as best shown in Fig. 5, and is provided with an annular groove, as there seen, into which the bent end 170 of the slide 161 enters loosely. A wide gear 179 is fastened on the tube 178. A lever arm 180 is mounted by a pivot 181 upon a bracket 182, which extends from the bed of the machine. The lever arm 180 has a cam pin 183, whose bottom rests on the cylindrical body of the cam 21 and has its side in operative contact with the cam-surfaces on the side of the flange 22. The collar 176 is fastened to the under side of the lever arm 180 and is carried thereby. The cam 23 operates against a vertical piece or strip 184. A rack bar 185 having teeth 186, as shown in Fig. 9, to mesh with the teeth of the gear 179, is secured at one end to the vertical piece or strip 184 and is provided with two longitudinal slots 187, 188, adapted to limit the longitudinal travel of said rack bar. A pin 189, passes through a post 190, extending from the end piece 191 of the machine, and engages loosely with the rack bar 185 in the slot 188 thereof. A post 192 extends up from the bed of the machine, and a pin 193 passes loosely through the slot 187 into said post. The rack bar 185 has a bent-up end 194 and a spiral spring 195 is attached at one end to an eye 196 of the bent end 194 and at its opposite end to an eye 197 of a post 198, which extends up from the bearing 2. The tube 178 has a central longitudinal bore 199, through which the chain 200, as made, passes to the drum 34. In the enlarged end of the tube 178 are mounted two gripping jaws 201, 202, each having a sloping cam edge 203, adapted to coöperate with the cam-surface 175 of the bore of the sleeve 172. The gripping jaws 201, 202, are mounted on pivots 204 and 205, respectively. Each gripping jaw 201 and 202 has its inner end hooked or notched, and a flat spring 206 is engaged at one end with said inner end of the jaw, as illustrated in Fig. 5, and its opposite end is inserted in the tube 178, which is longitudinally grooved to allow space for the action of the said springs. The function of said springs 206 is to spread apart normally the outer ends of said gripping jaws, as illustrated in Fig. 12. A spiral spring 207 is secured at one end to the pin 129 of the spreader 122 and at the opposite end to the pin 130 of the spreader 123. A spiral spring 208 is secured at one end to the pin 183 of the lever arm 180 and at its opposite end to a pin 209 on the post 198. On the shaft 27 a friction disk 210 is fastened and mounted in rubbing contact with the drum 34. The disk 210 has a concentrically reduced neck 211, which is provided with an annular groove. A set screw 212 passing through the neck 211 secures the disk 210 in its adjusted position by the pressure of said set screw against the shaft 27. In this manner, the disk 210 is forced to whatever frictional engagement thereof with the drum 34 may be desired and is held in such adjusted position.

The operation of my improved chain machine is described as follows: The swaged links, which are to be united in series to form a chain, are fed by hand to the chute 35 and fall by gravity therein. The lowermost of these links, designated as $132^{\times}$ in the drawings, rests upon the two inwardly curved springs 37. At this time the link-feeding devices are in the position shown in Fig. 3. The horizontally extending foot 102 is resting on the straight surface 8^{a} of the cam 8, and the vertical bar 101 and the table or bracket 103 are in their lowermost position. The cross pin 105, carried by the table or bracket 103, is down nearly to the bottom of the slots 94 of the flanges 92 of the slide 91, and bearing against the spring-pressed arm 96 forces said arm to a vertical position, thus thrusting the pin 107 through the lowermost link $132^{\times}$ in the chute 35, all as illustrated in Fig. 3. Power, communicated from a proper source, is applied to the pulley 3 and rotates it in the direction indicated by the arrow

213, thus rotating in the same direction all the cams and the gear which are on the main shaft 1. The cam 8, moving as indicated by the arrow thereon in Fig. 3, lifts by its corner or portion 8^b the horizontally extending foot 102, and with it the vertical bar 101 and the table or bracket 103, thus raising said parts to the position shown in Fig. 4. It is here seen that the cross pin 105 has moved up along the slots of the flanges 92 of the slide 91, thus enabling the spring 98 to press the arm 96 into the angular position represented in Fig. 4. This movement of the arm 96 carries the pin 98 from the position shown in Fig. 3 to the position shown in Fig. 4. The pin 107, which in Fig. 3 is shown as extending through the lowermost link $132^\times$ of the series in the chute 35, in moving downward as described, pulls down said lowermost link and disengages said link from the springs 37 and delivers said link into the upper end of the head 78 of the oscillating link carrier 71, then standing in a vertical position, as illustrated in Fig. 2. The entire function of the cam 8 is to feed the links from the chute 35 to the head 78 of the carrier 71, including the said oscillatory movement of the spring-pressed arm 96, and to hold the parts shown in Fig. 4 in their elevated position there represented, during all the time the foot 102 is in contact with the arc-shaped periphery of the cam 8. The extra lift or high part 9 of the cam 8 is designed to give a slight final rise to the foot 102 and its connected parts for the purpose of lifting the table or bracket 103 and its connected parts so that the pin 107 rises into position to engage the then lowermost link $132^\times$ in the chute 35 which is next to be united with the chain. The rising movement of the foot 102 and connected parts is caused by the rotation of the cam 8, while its corner 8^b is moving frictionally along the straight under side of the foot 102. This upward movement stretches the springs 114, 116 and 118, and when the lift 9 of the cam 8 clears in its rotation thé under side of the foot 102, said springs, being then free to act, contract and automatically return the parts shown in Fig. 4 to their former position shown in Fig. 3.

The cam 10 commences work as soon as the parts shown in Fig. 4 have come into the position there represented. At this time the said lowermost detached link $132^\times$ has been delivered to the head 78 of the carrier 71, then in the position illustrated in solid lines in Fig. 1, and the link in the chute, which has become in its turn the lowermost in the chute 35, falls by gravity into contact with the springs 37. The cam 10 in rotating presses its cam-surfaces on the side of the flange 11, which cam-surfaces bear against the pin or cam-surface 112 on the lever arm 109 and so gives to the lever arm 109 a slight horizontal oscillation on its pivot 110. The opposite end of the lever arm 109, being pivoted at 113 to the slide or bar 45, causes said bar 45 to slide on the bed of the machine. The block 46 on the slide bar 45 presses the pin 44 on the lever arm 42 and also the bent end or head 67 of the lever arm 42 against the outer end of the horizontal carrier bar 65, which is mounted on the table 56 and guided by the ways 66. The carrier bar 65 is pivotally connected at 75, with the oscillating carrier 71. The oscillating carrier 71 is provided with the gear 76, whose teeth mesh with the teeth of the rack bar 58. The result is that the pushing movement of the lever arm 42, moves the horizontal carrier bar 65, which causes the gear 76 partially to rotate by the engagement of said gear with the rack bar 58. This partial rotation of the gear 76 moves the carrier 71 (and its head 78) from the position shown in solid lines in Fig. 2 to the position shown in dotted lines in said figure and on to the horizontal position shown in Fig. 5. In traveling in this curve the head 78 of the carrier 71 enters into the space 128 (Fig. 5) and the final push of the head or bent end 67 of the lever 42 against the horizontal carrier 65, causes the outer end of the head 78 to enter the rectangular slot or opening 126 (Figs. 7, 11, 12) and delivers the link $132^\times$ into the slots 131 of the spreaders, the bow spring 81 yielding for that purpose. To accomplish this final movement of the carriers 65 and 71, as no further rotation of the gear 76 is possible, it is necessary that the rack bar 58 should have an additional limited movement lengthwise equal to said extra movement of said carriers, and this is made possible by the slots 59 and 60. The return movement of the lever 109 is caused by the spring 51. This return movement of the lever 109 causes the slide bar 45 to move inwardly. The block 46 on the slide bar 45, as said slide bar moves inwardly, presses against the pin 44 of the lever 42 and causes the lever 42 to move from the position shown in Fig. 2 to the position shown in Fig. 5, the hanger 55 serving as a stop to limit the reverse movement of the rack bar 58. The return movement of the carriers 65 and 71 is caused by the spring 68. The screw 83 in the block 82 is adjusted as a stop to limit the return movement of the carrier 71 and to cause it to take a true vertical position.

The operation of the cams 12 and 13 will now be explained. These cams actuate the spreaders 122 and 123. The link $132^\times$ is brought into the position shown in Fig. 5 by the action of the carrier 71 and its head 78. It then projects through the slot 131 of the spreaders 122 and 123 and is in proximity to the gripping jaws 201 and 202, which will soon perform their function upon it. But this link, when in the position and condition illustrated in Fig. 5, has its ends in abutment with each other, and the whole

link, from end to end, extends in one vertical plane as represented in Fig. 11, it is necessary, before it can be united to the chain 200 and become a part thereof, that its two ends should be separated from each other, that is, spread apart, into the shape shown in Figs. 7 and 8 and designated therein as 132[a]. When the ends of the link 132 are thus spread, the last formed link 132[b], which has been united to the chain 200, can be inserted in the link 132[a] in the manner illustrated in Fig. 7. This spreading action is accomplished as shown in Fig. 6. The upper open end of the link is in the vertical slot of the upper spreader 122, and the lower open end of the same link is in the vertical slot of the lower spreader 123. These two spreaders are slightly oscillated in directions opposite to each other, as indicated by the arrows 214 and 216 in Fig. 7. The spreaders 122 and 123 turn on the pivots or screws 124 and 125, respectively, as their respective cam pins 129 and 130 are pressed by the respective cam-surfaces 15 and 17. The spring 207 serves to maintain the operative contact of the cam pins 129 and 130 with the cam-surfaces 15 and 17, respectively. The result of this cam action is that the link is first opened or spread apart at its ends as in 132[a] and then after the link 132[b] is inserted in said opened link 132[a] as hereinafter explained, the said cams 12 and 13, close said link again and bring the link ends together in abutment as before. The link 132[a] having been thus united to the chain is drawn out of the slots of the spreaders 122, 123, as hereinafter explained, but the holding jaws 152, 153, then close upon said link as illustrated in Fig. 12 in order that the chain may not be drawn too far. This function is performed by the cam 18 of the main shaft 1 as follows. At such time during the link-connecting operation as the said last link has been wholly withdrawn from the spreaders 122 and 123, and the gripping jaws 201 and 202 are disengaged from the chain 200 (which condition is illustrated in Fig. 12), it is necessary that the chain should be held securely. It is then so held by means of the holding-jaws 152 and 153. In their holding position they are shown in cross section in Fig. 12, and in elevation in Fig. 6. These jaws are actuated by the cam 18, which moves the lever arm 141, pivotally mounted at 142. The link bar 145 is moved by the lever arm 141 and imparts an oscillation to the radial arm 138 of the collar 137 which collar being fastened to the stem 135 of the barrel 132 gives an equal oscillation to said barrel. By this oscillation the cam 140 of the barrel 132 moves in and out of the space between the tail ends of the levers 152 and 153, said ends being held to contact with the cam 140 by the spring 156. The return of said parts to their former position is effected by the spring 148.

The operation of giving linear movement to the link-connecting mechanism is thus described. The rotation of the cam 19 with its cam-surface 20 oscillates the lever arm 165 by the contact of its pin with said cam-surface 20. This lever arm 165 is supported by the bracket 151 and turns on a pivot 166. A pin 164 from the lever arm 165 passes through the slot 163 in the bed of the machine, and enters the slide or bar 169. Thus a longitudinal reciprocating motion is given to the slide bar 169 by the cam 19, said bar being confined to a linear direction by said pin 164 and slot 163 and by the guide 162. This reciprocating movement of the slide bar 169 is communicated by the bent end or extension 170 thereof to the outer end of the gear 179, which being splined to the tube 178, as illustrated in Fig. 9, gives an equal reciprocation, to the same extent, to the tube 178 and its connected parts. The tube 178 on its opposite end carries the two pivotally mounted gripping jaws 201 and 202. These jaws are normally kept open or apart at their outer ends by means of the springs 206, whenever they are extended out beyond the sleeve 172, as in Fig. 12, but whenever these jaws are withdrawn within the sleeve 172, as in Figs. 1, 5, 7 and 11, the cam-surface 175 of the end of the sleeve 172 closes the outer ends of these jaws together and in that position said jaws grip the last united link 132[b], as seen in Figs. 5, 7 and 11. The return movement of the slide bar 169 and the parts actuated thereby is given by the spring 168. The periodical intermittent rotation of the tube 178, amounting to a quarter-turn, is caused by the cam 23 of the main shaft 1, which pushes the vertical plate 184 of the rack bar 185, whose teeth 186 engage the teeth of the gear 179 upon the tube 178. The return movement of the said rack bar and gear are caused by the spring 195. The gear 179 is made quite wide, as seen in Fig. 1 so that the said gear and the tube 178 may have the longitudinal reciprocation already described without affecting the rotation of said parts. The longitudinal reciprocation of the sleeve 172 for the closing and opening of the outer ends of the gripping jaws 201 and 202 is caused by the cam 21 of the main shaft 1. The pin 183 of the lever arm 180 follows the cam-surfaces 22, and the pin 177 of the lever arm 180, entering loosely the circumferential groove 174 of the sleeve 172, which is movable through the collar 176 of said lever arm, causes said movement of the sleeve 172 for the purpose specified. The quarter-turn of the said gripping jaws 201 and 202 in one direction is indicated by the arrow 216 in Fig. 7 and the return movement is in the opposite direction. The entering position of the last connected link of the chain with relation to

the link 132ª is indicated by the diagonal dotted lines in Fig. 7. After the new link has been connected and closed to form a part of the chain, the link and chain are in the relative positions illustrated in Fig. 11, and when the quarter-turn has been affected the parts are in the position shown in Fig. 5, the gripping jaws 201 and 202 being then in engagement with the new link now connected and made part of the chain. The rotation of the main shaft 1, gears 4 and 28 and the shaft 27 causes the friction disk 210 to have a rubbing contact with the drum 34, which, when the chain is not held by the gripping jaws 201 and 202 or by the holding jaws 152 and 153, gives a slight rotation to the drum 34. Said frictional device 210, also allows the forward movement of the gripping jaws 201 and 22, indicated by the arrow 217 in Fig. 5, to take place, which is necessary to move the chain bodily in that direction (indicated by the arrow 218) to allow the insertion of the last connected link of said chain to be inserted in the new link 123ª. As seen in Fig. 5, the chain, as completed, is received in the bore 199 of the tube 178 and passes to the drum 34 and thence to a pan or reel (not shown).

I claim as a novel and useful invention and desire to secure by Letters Patent:—

1. In a chain machine, the combination of a main shaft; means to rotate the same; mechanism for uniting the links to form a chain; a bevel gear fastened on said shaft; a second shaft mounted in bearings and extending at a right angle to the main shaft; a beveled gear fastened on the second shaft engageable with the first named gear; a drum loosely mounted on the second shaft; a friction disk fastened on the second shaft and rotatable therewith continuously in one direction and adapted by a rubbing contact with said drum to impart thereto a rotatory movement in said direction; and means adapted to give said link-uniting mechanism a periodical rearward movement for the purpose of imparting a reverse travel to the chain, and thereby to give a periodical rotatory movement to said drum in the other direction, thus overcoming the said normal forward rotation of the drum.

2. In a chain machine, the combination of a chute adapted to hold a series of links therein by gravity; a spring in the chute to hold against the action of gravity the lowermost link of said series in the chute; a bracket slidable in vertical ways; an oscillatory arm mounted pivotally in a support which is carried by said bracket; and a pin extending from the oscillatory arm and adapted to engage said lowermost link and to detach the same from said spring and chute.

3. In a chain machine, the combination of a chute adapted to hold therein a series of links by gravity; a spring in the chute to hold against the action of gravity the lowermost link of said series in the chute; a fixed support on said chute and provided with two parallel sides or ways; a bracket vertically movable along said fixed support between the parallel sides thereof; two oppositely arranged pins in said parallel sides of said fixed support; an upright piece carried by said bracket and having two parallel sides, each of which has a vertical slot, into which slots said pins, respectively, extend loosely; an oscillatory arm pivotally mounted at its upper end between the last named parallel sides and above said two pins; a detaching pin adapted normally to engage with the said lowermost link to withdraw said link from the hold of said spring and to remove said link from the chute; a rotatable cam; means for rotating said cam; a vertically movable bar slidable in guide-ways and provided with a horizontal foot which rests on the operative surface of said cam; a horizontal table secured to said vertical bar and provided with a slot as shown; a cross pin mounted in said table and extending loosely across the slot last aforesaid as also loosely through the two slots of the last named parallel sides and capable of a sliding contact with the edge of the oscillatory arm; and a spring adapted to maintain said contact between the oscillatory arm and the cross pin last aforesaid.

4. In a chain machine, the combination of a chute adapted to hold a series of links by gravity; a spring in the chute to hold against the action of gravity the lowermost link of the series in the chute; a fixed support on the chute and provided with two parallel sides, each having a vertical slot; a bracket vertically movable along said fixed support between the parallel sides thereof; two oppositely arranged pins in said parallel sides of said fixed support; an upright piece carried by said bracket and having two parallel sides, each of which has two vertical slots, into two of said slots, which are oppositely located, said pins respectively extend loosely, a spring-pressed oscillatory arm having an outwardly sloping edge and pivotally mounted at its upper end between said parallel sides of said upright piece and above said two pins; a connection between the bracket and the upright piece adapted to oscillate said arm; a detaching pin adapted normally to engage with the lowermost link in the chute and to withdraw said link from the hold of said spring in the chute and to remove said link from the chute; a rotatable cam; means for rotating said cam; a vertically movable bar slidable in guideways and provided with a horizontal foot which rests on the operative surface of the cam; a horizontal table secured to said vertical bar and provided with a slot as shown; a cross pin mounted in said table and extending loosely through the two slots of the last named parallel sides and

capable of a sliding contact along the outer tapering edge of the oscillatory arm to move said arm to a vertical position against the action of the spring in said arm.

5. In a chain machine, the combination of a chute adapted to hold a series of links therein; a rotatable main shaft; means operated from the main shaft to remove from the chute said links one by one; a link carrier pivotally mounted at one end and adapted to move into alinement with said chute and to receive therefrom a link; a mechanism for uniting links to form a chain; and means for oscillating said link carrier from its said position into a position contiguous to said link-uniting mechanism to deliver said link thereto.

6. In a chain machine, the combination of a link carrier, an extensible head mounted thereon and suitable to hold a link; and a spring mounted on the link carrier and adapted to hold said head in an extended position substantially as and for the purpose specified.

7. In a chain machine, the combination of a link carrier having two opposite shoulders and an intermediate longitudinal tongue which has a longitudinal slot; an extensible head having a link-holding orifice at its outer end and which is provided with a longitudinal slot arranged to receive loosely said tongue; a pin extending through said head from side to side and passing through said tongue slot; and a spring normally holding said head in its extended position.

8. In a chain machine, the combination of a longitudinally movable carrier bar, mounted slidably on a support; means for giving to said carrier bar a longitudinal reciprocating movement; an oscillatory link carrier mounted at the end of the said carrier bar upon a pivot; a gear mounted on the oscillatory link carrier concentrically with said pivot; and a spring-actuated rack gear upon a support and meshing with said gear.

9. In a chain machine, the combination of a longitudinally movable carrier bar slidable upon a support; means for giving to said carrier bar a longitudinal reciprocation; an oscillatory link carrier mounted at the end of the said carrier bar upon a pivot; a gear mounted on the oscillatory link carrier concentrically with said pivot; a spring actuated rack gear upon a support and meshing with said gear; a vertical chute adapted to contain links and to deliver them *seriatim* to the oscillatory link carrier in a head thereof; and a set screw in a fixed support and constituting an adjustable stop to limit the upward travel of the oscillatory link carrier and to maintain it in vertical alinement with the vertical chute.

10. In a chain machine, the combination of a lever arm pivotally mounted at one end upon the bed of the machine; a slide bar mounted upon the bed of the machine and pivotally connected with the other end of said lever arm; a block upon said slide bar; a pivotally mounted lever arm movable in an inward direction by said block; a spring to give return movement to the second named lever arm; a carrier bar longitudinally movable by the second named lever arm; an oscillatory link carrier pivotally mounted on the end of said carrier bar; a rack gear movable by the carrier bar; and a gear fastened on the oscillatory link carrier and rotatably engageable with the rack bar.

11. In a chain machine, the combination of a longitudinally movable carrier bar slidable on a support; an oscillatory link carrier pivotally mounted on said carrier bar; a gear upon the oscillatory link carrier; means for imparting to said carrier bar a longitudinal reciprocating movement; a rack gear slidable upon a support, held thereto by screws, which pass through longitudinal slots therein into said support and having teeth in mesh with said gear; and a spring for giving return movement to said rack gear.

12. In a chain machine, the combination of a fixed support; two spreaders pivotally mounted on said support in one axial line; means for imparting to said spreaders oscillatory movement in opposite directions; and means for introducing a chain link in registering slots of said two spreaders for the purpose of opening said link and bending its abutting ends from or to each other.

13. In a chain machine, the combination of a fixed support; an upper spreader pivotally mounted on said support and having a vertical slot near its inner end; a lower spreader pivotally mounted on said support in the same axial line and having a vertical slot near its inner end, which two slots are in alinement when said two spreaders are in their inoperative position; means for entering a link into said two slots when they are in alinement; and means for imparting to said spreaders oscillatory movements directed oppositely to each other.

14. In a chain machine, the combination of a rotatable main shaft; a fixed support; an upper spreader pivotally mounted on said support and having a vertical slot near its inner end; a cam pin on the outer end of the upper spreader; a lower spreader pivotally mounted on said support in the same axial line and having a vertical slot near its inner end; a cam pin on the outer end of the lower spreader; a cam on the main shaft adapted to give oscillatory movement to the upper spreader, and a second cam on the main shaft adapted to give oscillatory movement to the lower spreader but in directions opposite to those of the upper spreader.

15. In a chain machine, the combination of a tube mounted slidably in supports; means for giving to said tube a periodic

longitudinal movement back and forth; a second tube longitudinally movable in the first named tube and adapted to allow a passage of the manufactured chain therethrough; means for giving said second tube a quarter-turn in alternately opposite directions; gripping jaws pivotally mounted at one end of the second named tube and provided with springs adapted to keep them normally spread; and closing means for said gripping jaws, comprising bevel cam edges thereon coöperating with a bevel cam annular surface in the bore of the first named tube and in contact therewith.

16. In a chain machine, the combination of a rotatable shaft; three cams fastened on said shaft; a tube slidably mounted on supports; a pair of gripping jaws carried by said tube; a spring on the tube adapted to hold said jaws normally in open position; a slide bar mounted on the bed of the machine and having a limited linear movement thereon; a lever arm pivoted at one end to the bed of the machine and pivotally connected to said slide bar; a cam pin on the opposite end of said lever arm in operative contact with the first cam; a spring to give return movement to said lever arm; a sleeve loosely mounted on said tube and having on its interior surfaces cams adapted to impart a closing movement to said jaws; a second lever arm pivotally mounted at one end to the bed of the machine; a cam pin in the opposite end of the second lever arm in operative contact with the second cam; a pin mounted on the second lever arm and extending loosely into a circumferential groove on said sleeve; a spring to give return movement to said second lever arm; a gear upon said tube; a bent extension from said slide bar in contact with the outer end of said gear; a rack bar engageable with said gear and slidably mounted on supports; a cam pin at one end of the rack bar in operative contact with the third cam; a spring to give return movement to said rack bar; a fixed support; a fourth cam on said shaft; two pivotally mounted lever arms operable by said fourth cam and adapted alternately to spread and close the ends of each chain link in series for the purpose of consecutively uniting said links to the chain one after another; two other pivotally mounted lever arms adapted to coöperate to hold a link and then to separate therefrom; a spring between the tail ends of said last named lever arms and fastened to each, respectively; a fifth cam fastened on said shaft, and means operated by the last named cam and adapted periodically to spread apart the said tail ends, the said fourth and fifth cams being so placed upon the shaft and timed that the last named lever arms engage the link while the first named lever arms are disengaged from the link and vice versa.

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

HARRY A. STAPLES.

Witnesses:

ALFRED S. JOHNSON,

ARTHUR P. JOHNSON.