No. 679,278. Patented July 23, 1901.

# A. CROCKER.

## METAL WORKING MACHINE.

(No Model.) (Application filed Aug. 6, 1900.)

8 Sheets—Sheet 1.

Fig. 1.

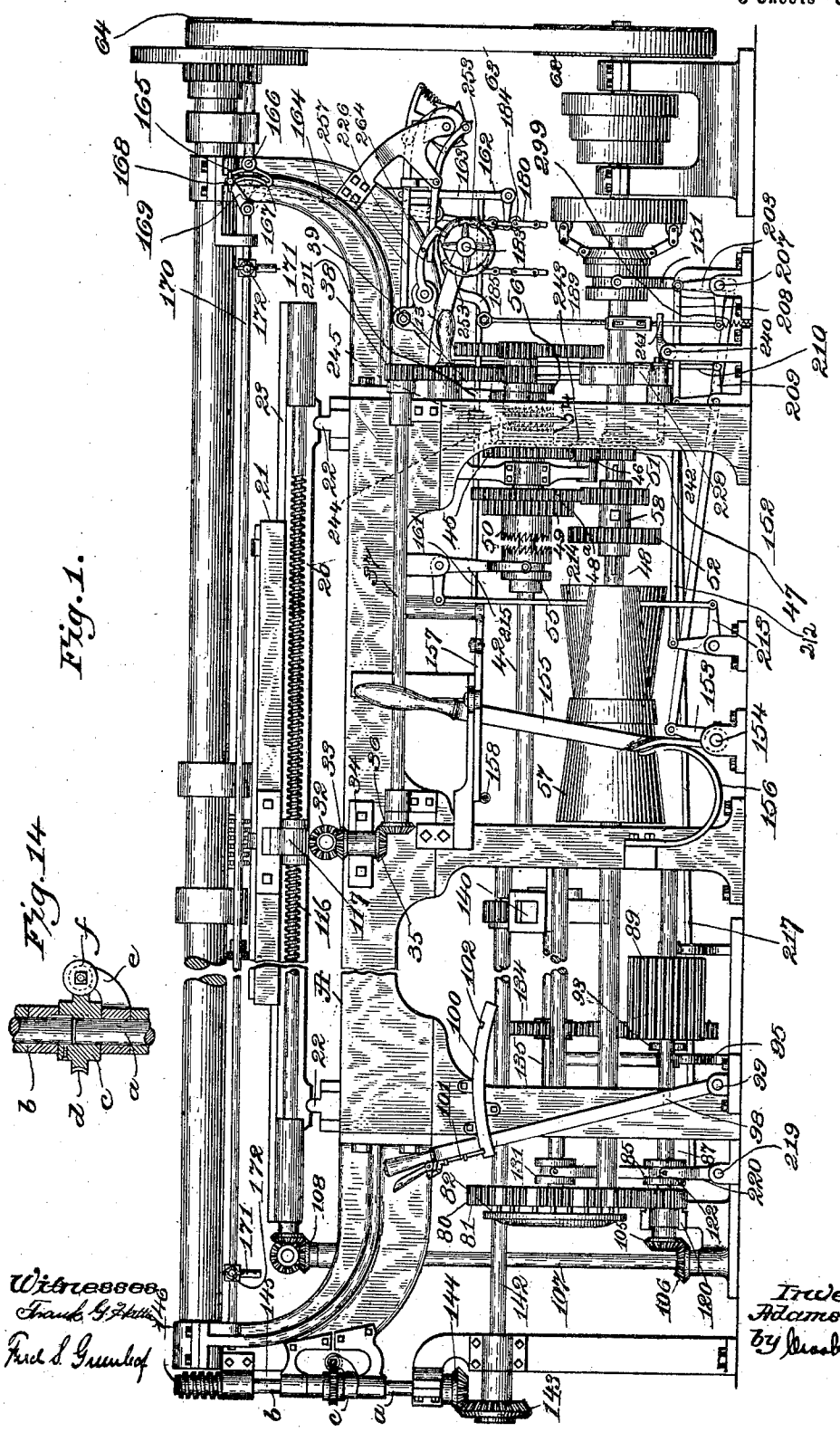


Fig. 14.



Witnesses:
Frank G. Hyatt
Fred L. Gruenloff

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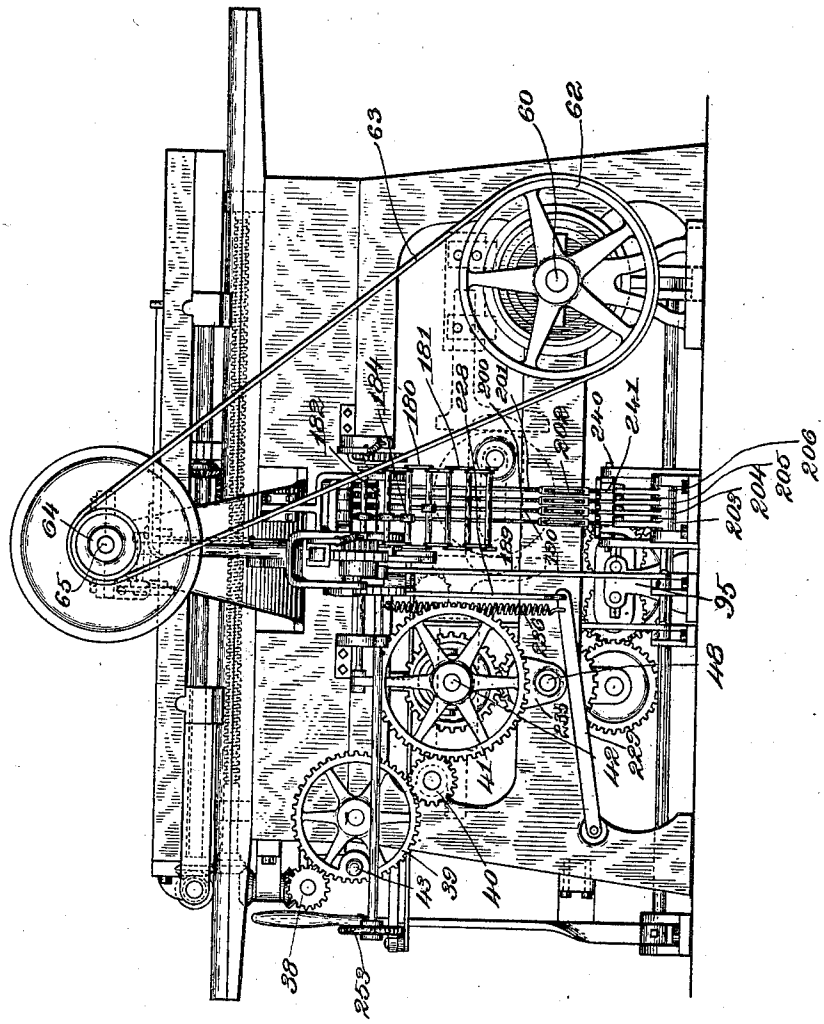
A. CROCKER.

METAL WORKING MACHINE.

(No Model.) (Application filed Aug. 6, 1900.)

8 Sheets—Sheet 2.

Fig. 2.




Witnesses:
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8 Sheets—Sheet 3.

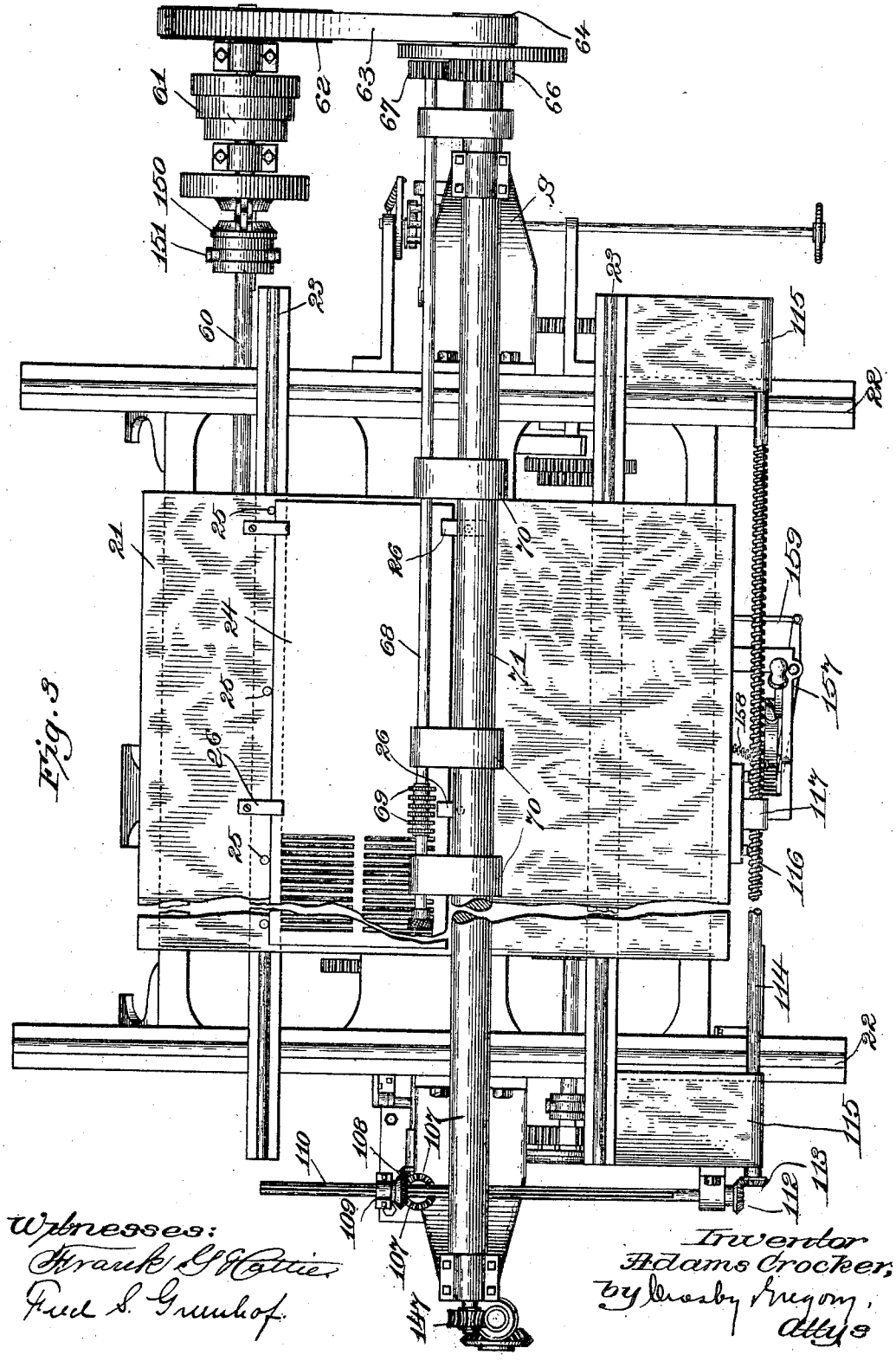



Fig. 3.

Witnesses:
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8 Sheets—Sheet 4.

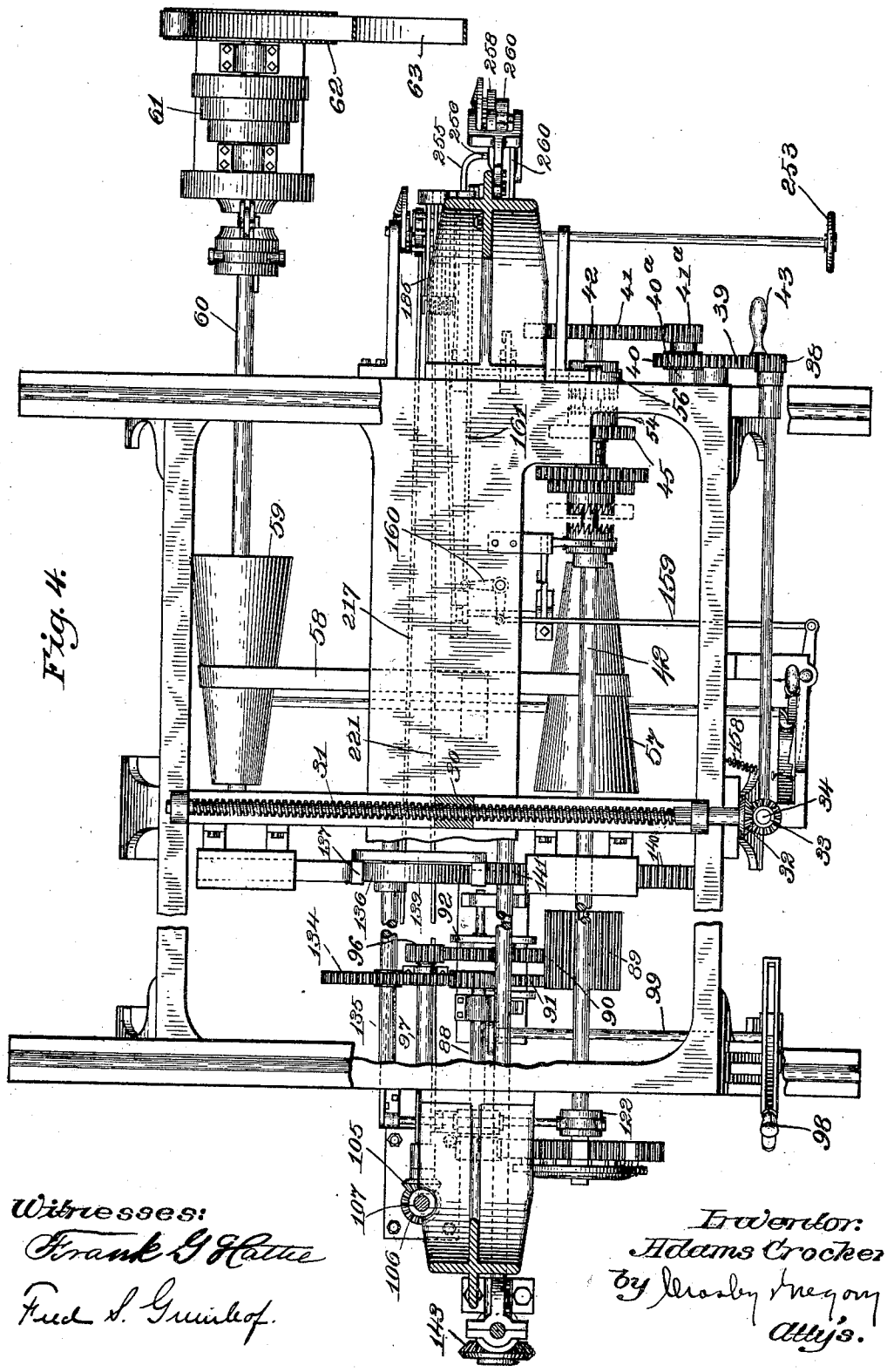



Fig. 4.

Witnesses:
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8 Sheets—Sheet 5.

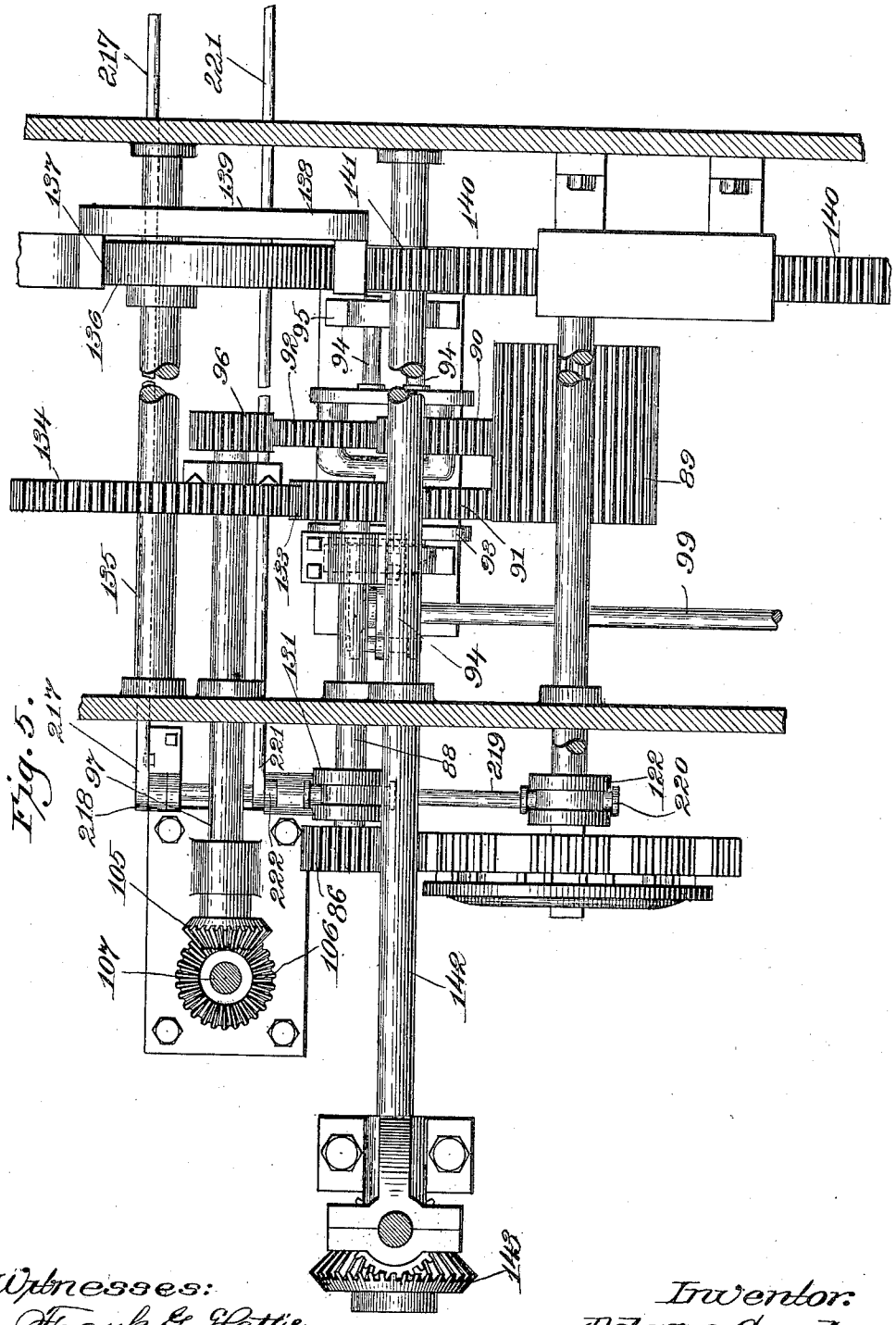



Fig. 5.

Witnesses:
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(No Model.)

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8 Sheets—Sheet 6.

Fig. 7.

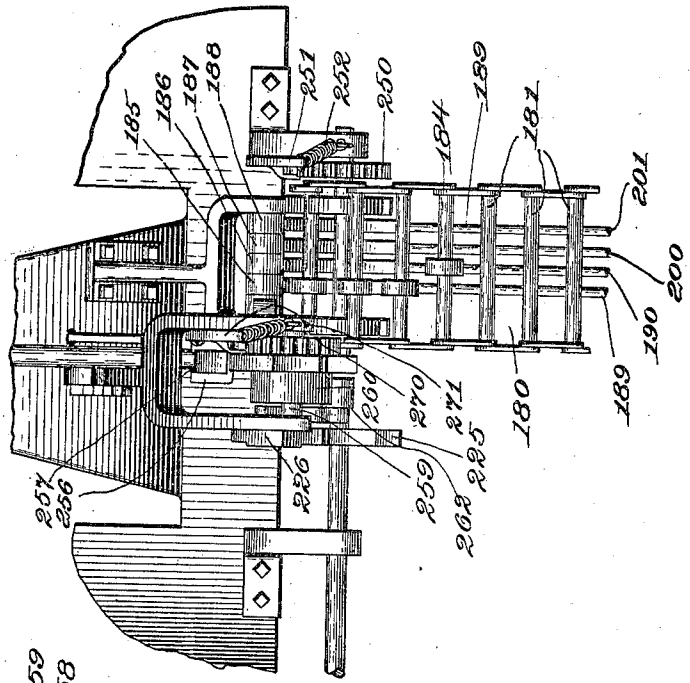
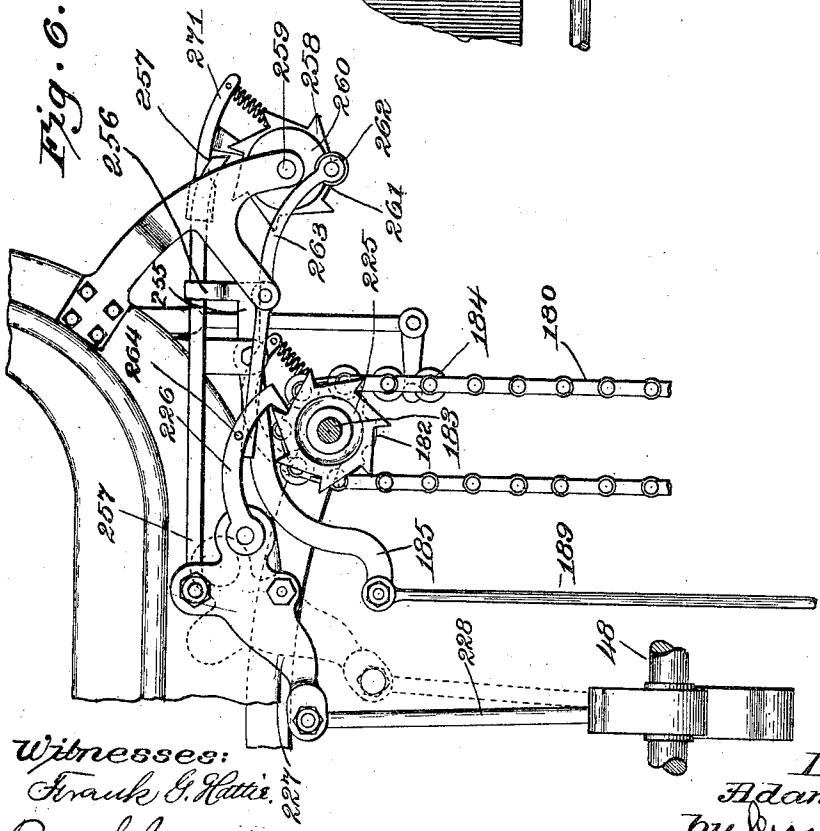



Fig. 6.




Witnesses:
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Fig. 11.

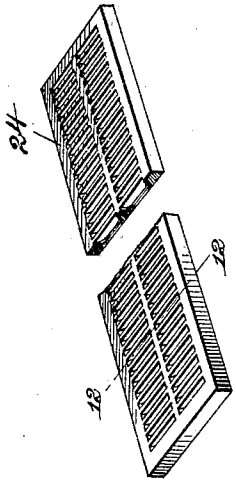



Fig. 12.

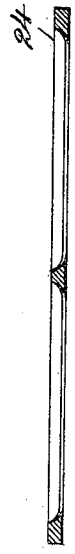



Fig. 13.

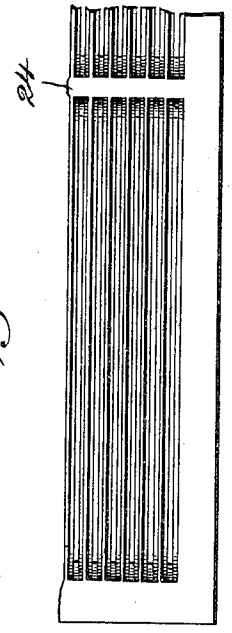
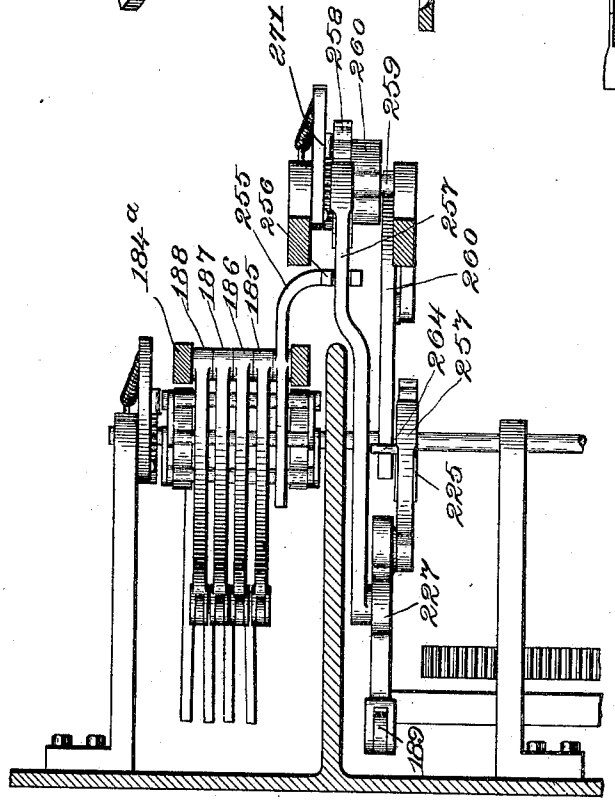



Fig. 8.




Witnesses:
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No. 679,278. Patented July 23, 1901.

A. CROCKER.

METAL WORKING MACHINE.

(No Model.) (Application filed Aug. 6, 1900.)

8 Sheets—Sheet 8.

Fig. 10.

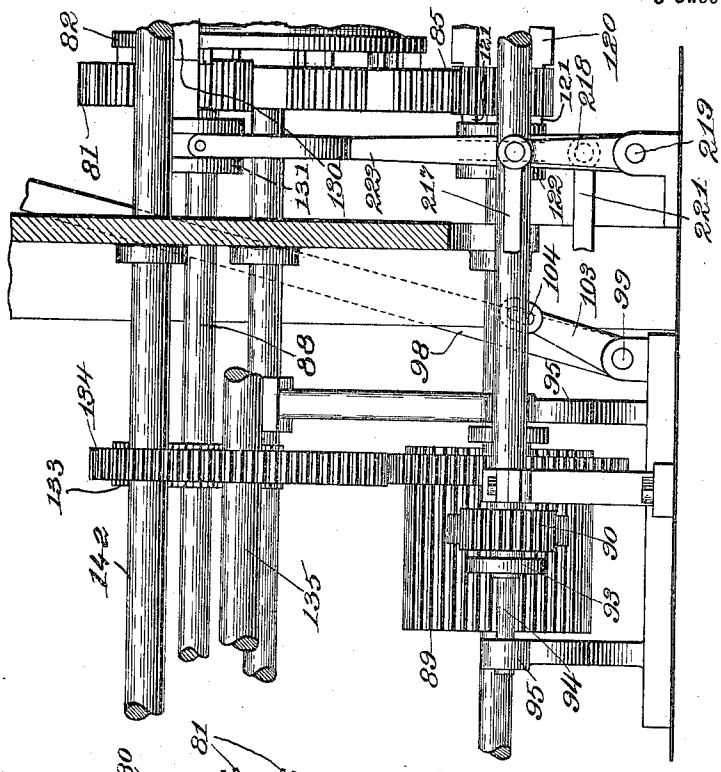
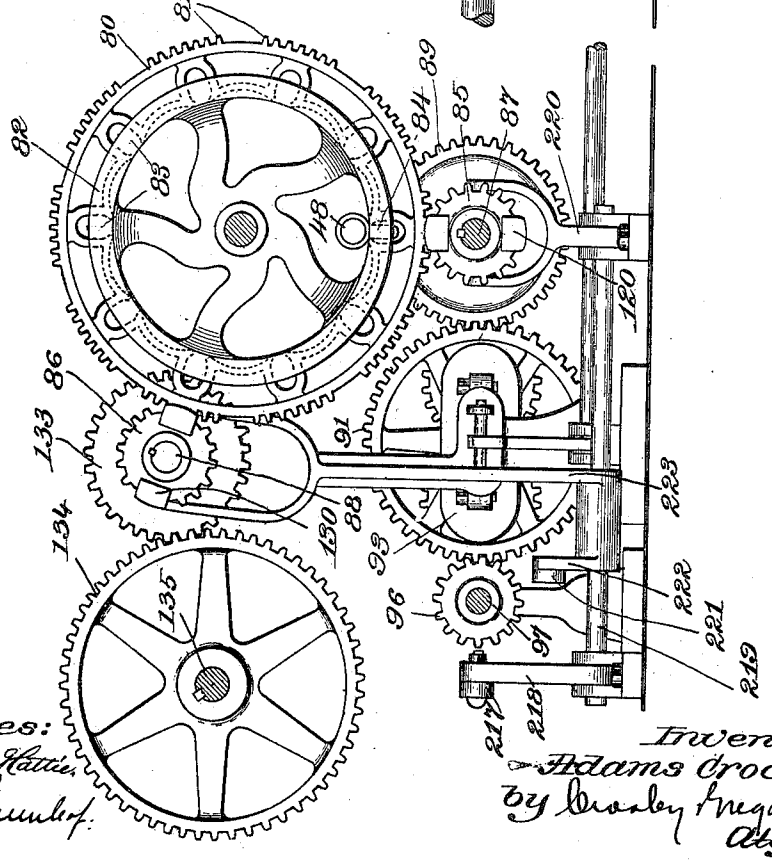



Fig. 9.




Witnesses:
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# UNITED STATES PATENT OFFICE.

ADAMS CROCKER, OF FITCHBURG, MASSACHUSETTS.

## METAL-WORKING MACHINE.

SPECIFICATION forming part of Letters Patent No. 679,278, dated July 23, 1901.

Application filed August 6, 1900. Serial No. 25,994. (No model.)

*To all whom it may concern:*

Be it known that I, ADAMS CROCKER, a citizen of the United States, residing at Fitchburg, county of Worcester, State of Massachusetts, have invented an Improvement in Metal-Working Machines, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to metal-working machines; and it involves certain fundamental features illustrated in simple embodiments thereof in the accompanying drawings, wherein—

Figure 1 is a front elevation of a metal-working machine involving my present improvements. Fig. 2 is an end elevation as seen from the right in Fig. 1. Fig. 3 is a plan view of the same, part of the machine being broken out and the two sections brought together for economy in space. Fig. 4 is a view similar to Fig. 3 with the work wholly removed. Fig. 5 is a sectional plan view, upon an enlarged scale, of part of the driving mechanism or more particularly that part thereof employed for lowering and raising the pulley or pulleys and for effecting the side feed of the work. Fig. 6 is a front elevation, upon an enlarged scale, of the pattern mechanism. Fig. 7 is a right-hand side elevation of said pattern mechanism. Fig. 8 is a plan view of the same. Fig. 9 is a left-hand side elevation of a portion of the driving mechanism. Fig. 10 is a front view of the same, both upon an enlarged scale. Fig. 11 is a perspective view of the work. Fig. 12 is a cross-section taken in the line 12 12, Fig. 11, and upon an enlarged scale. Fig. 13 is a still further enlarged view of one corner of the work, and Fig. 14 is a detail showing a means for regulating the stroke of the tool-carrier.

The machine illustrated in the accompanying drawings is capable of turning out different kinds of work, but will hereinafter be described as arranged for making screen-plates for use in paper and pulp manufacture. These plates are milled out on the back side—that is, the under side as fixed in the vat—crosswise or lengthwise of the plate, according to the judgment of the user. The plates are slotted by milling-cutters, and the slots vary in the number per inch and are arranged in rows, and in order to obtain strength in the plate and at the same time secure the maximum screening-surface the rows are separated by bars, consisting of that part of the metal which is uncut. A margin is also left uncut completely around the plates for the purpose likewise of strength and as well to furnish means by which they can be fastened by screws or otherwise to or in the vat. The milling-cutters do not initially cut through the whole thickness of the plate, but leave a small amount of stock, which is thereafter sawed through and to very narrow gage, according to the requirements of screening, the idea being that for free screening the pulp can go through a limited thickness of the metal, and the milling is done to allow perfect clearance for the pulp after it has passed through the fine slot.

In the machine illustrated I provide one or more cutters to act upon the plate for grooving the same, and then afterward can use the same machine, but with different cutters, for forming the slots specified.

In the making of uniform paper free from spots, &c., it is essential that the screen-plate wears evenly in respect to the fine slots and also that the bottom and walls of the milled slot and the walls of the fine slot shall be free from roughness which may be caused by the chatter of the cutter-tool, for by the presence of such roughness is caused what are called "strings"—that is, pulp attaches to the rough portions, accumulates for a time, and eventually drops off in a more or less dry and hard or insoluble state—and it is important for continuous perfect screening that the fine slot shall have a knife or very fine edge and that such shall be retained as long as possible.

Heretofore and up to the present time it has not been possible to materially eliminate the weak points stated, and in order to properly make a plate it has been necessary to resort to a great deal of hand-labor after the plate has been milled and sawed, the bottom and sides of the milled slot and the walls of the fine screen-slot being scraped and filed by hand to remove the roughness, as well as to bring the fine slot to proper gage; but even by this added labor it has been almost impossible to wholly overcome the defects pointed

out, and, besides, unless very carefully handled the existing apparatus not only fail to eradicate the faults, but add new ones.

Having paid due regard to the vital points to be accomplished in the proper making of a screen-plate and with a view of producing plates at a minimum cost, to the end that manufacturers shall be able to purchase new plates more frequently, and hence greatly improve the quality of their paper and pulp, I have devised a machine which accomplishes automatically the making of practically perfect screen-plates possessing all the essential features above pointed out.

The machine illustrated involves in its construction a work-holder and a tool-carrier and suitable means for operating the same, so that the tool or tools can be caused to engage the work to mill a groove or cut a slot therein, as the case may be, and it includes certain sets of mechanisms which are operated individually or step by step by driving means, including a pattern mechanism, and I desire at this point to state that I use the term "pattern mechanism" in its broad sense to include any and all pattern apparatus adapted to secure certain operations in predetermined order. The work holder or platen illustrated includes in its construction a plurality of superimposed slides, as 20 and 21, the lower slide being supported upon the parallel rails or guides 22, mounted upon a framework A of any suitable construction. The slide 20 constitutes the longitudinal slide, while the upper slide 21 is the cross or transverse slide, it being supported by parallel rails or guides, as 23, upon said lower slide. The upper slide 21 is adapted to directly sustain the work, the latter being shown as a plate 24, in which it is desired to mill grooves and afterward to cut slots centrally through the bottoms of the grooves. One edge of the plate to be milled may be placed against guide pins or bolts, as 25, upon the upper slide, after which said plate may be secured by clamps, as 26, carried by said slide and separated at suitable intervals. In the present case I provide a gang or plurality of cutters, six being illustrated. These cutters form a row of six grooves or channels in the plate as the same is being fed forward. Then a space is left and six more grooves formed, after which the work is fed sidewise and simultaneously backward, so that the plate can be positioned to permit the cutters to form a series of grooves or channels in line with those first made, and this operation is subsequently repeated until the desired number of grooves has been milled. By feeding the lower slide forward the work can be advanced, and by feeding the lower slide forward and the upper slide sidewise or transversely simultaneously the work can be moved diagonally to bring the same into position to receive a new series of rows of grooves or channels. The under slide 20 has upon its under side a fixed nut, as 30, (see Fig. 4,) through which the screw 31 extends, said screw being supported by suitable bearings upon the framework and having at its front end a bevel-gear 32, meshing with a bevel-gear 33 upon a shaft 34 on the framework. The shaft 34 has at its lower end a bevel-gear 35, meshing with a bevel-gear 36 upon a shaft 37 upon the framework. The shaft 37 carries a pinion 38, (see Figs. 2 and 4,) meshing with a gear 39 upon the frame, which in turn meshes with the pinion 40, carried on a stub-shaft $40^a$, and rigid with said pinion 40 is another pinion, $41^a$, meshing with the gear 41 upon the shaft 42. The screw 31, in connection with the nut 30 upon the under slide 20, serves as a suitable and convenient means for reciprocating said under slide, and to provide for moving said slide back and forth whenever occasion for the same arises the gear 39 is furnished with a hand-crank 43. The shaft 42 is adapted to be intermittingly connected by means of suitable coupling device and gearing with a main shaft in such manner that said shaft 42 can serve through the intermediate connections for moving the under slide first forward and then backward, and the last-mentioned motion may be simultaneous with the cross-feed of the upper slide 21, so that the work can be brought into position to have a row of grooves or slots milled therein. The shaft 42 carries a loose gear 45, meshing with a pinion 46, which in turn meshes with a gear 47 fixed upon the shaft 48. Said shaft 42 carries a gear $48^a$, rigid with the gear 49, and both of them forming a part of the clutch-sleeve 50, and all being loose upon said shaft 42. The gear $48^a$ is adapted to mesh with the gear 51 and the gear 49 to mesh with the gear 52, said gears 51 and 52 being rigid with the sleeve 53, which is slidable upon and is splined to the shaft 48, so as to rotate therewith. The gears $48^a$ and 51 are shown in mesh in Fig. 1. By sliding the sleeve 53 along the shaft 48 the gear 52 can be moved into mesh with the gear 49, so as to drive the clutch-sleeve at a higher rate of speed. The gear 45 is rigid with the clutch-sleeve 54, both being loose upon the shaft 42. The clutch-sleeve 50 coöperates with a clutch-sleeve, as 55, while the clutch-sleeve 56 cooperates with the clutch-sleeve 54, and the outermost clutch-sleeves 55 and 56 are splined to the shaft 42. When the clutch-sleeves 56 and 54 are in engagement, the slide 20, through the intermediate parts, will be driven forward, and the opposite result will take place when the sleeves 50 and 55 are in engagement. The shaft 48 (see Figs. 1 and 4) is shown as provided with a cone-pulley 57, over which the belt 58 passes, the latter being also passed around the cone-pulley 59 upon the main shaft 60. Said main shaft is continuously driven, except, of course, when it is stopped and started automatically at the commencement and conclusion of a plate milling or sawing operation. Said shaft 60 is shown as having a stepped cone-pulley 61, adapted to be connected by a belt (not shown) with a

motor of some suitable kind, and it is provided at its outer end with a pulley 62, connected by the belt 63 with the pulley 64 upon the shaft 65, Fig. 2. The shaft 65 is provided with a gear 66, meshing with a similar gear 67 upon the shaft 68, having a gang of tools or cutters, as 69. In the present instance the tools or cutters are continuously rotated. The shaft 68 is supported by rock arms or bearings, as 70, upon the rock-shaft 71, sustained by suitable bearings upon the framework. Said rock-shaft 71 is operated in such manner as to first carry the tools or cutters into contact with the work and then to hold them positively in contact with said work and against chattering and to thereafter lift them from the work, and while they are maintained thus elevated the work is fed forward, so as leave a space or uncut portion between a row or line of grooves or slots, and the operations specified are controlled by automatic mechanism, in this instance consisting of pattern mechanism, one convenient form of which is illustrated and hereinafter described.

A mutilated gear, as 80, is adapted to be intermittingly connected through certain trains of gearing or analogous mechanism with the mechanism that operates the tool-carrier and that which effects the cross-feed of the upper slide 21, the actuating devices for securing the operations of the parts being thrown into and out of operation through the agency of the pattern device and intermediate coöperating parts. The mutilated gear to which reference has been made is denoted by 80, and it has sets of teeth, as 81, upon its periphery and is furnished upon the inner side of its periphery with an annular projection, as 82, having pockets or concavities upon its inside, as 83, to receive the tooth 84 upon one end of the shaft 48, said tooth being adapted to enter the successive pockets or concavities, thereby to rotate the mutilitated gear 80, the movement of the latter, however, being a very slow one and in the present case intermittent. The primary or driving mutilated gear is adapted to coöperate with similar mutilated secondary or driven gears, as 85 and 86, fixedly carried, respectively, upon shafts, as 87 and 88, said shaft 87 being provided with a wide gear, as 89. The gear 89 connects with and drives the gear 96, mounted on shaft 97, normally or when the upper slide is given its advancing side feed through gears 90 and 92, said gears being suitably mounted on a sliding frame, as 93, and said frame having projecting from each end the studs 94, which are slidingly supported in suitable bearings or uprights 95, as shown in Figs. 5 and 10. This position of the gearing is illustrated in Fig. 5. In order to provide for giving the said upper slide a reverse movement, I have provided a reversing mechanism consisting of the single gear 91, which is suitably mounted on the sliding frame 93 and is of such a size that when the said frame 93 is moved to the right from its position in Fig. 5 the said gear 91 will connect and mesh with both gears 89 and 96. By thus substituting the connecting single gear 91 for the two connecting-gears 90 and 92 it is obvious that a reverse motion will be given to shaft 97. When the shaft 97 is being driven through the gears 89, 90, 92, and 96, the upper slide will be given what might be called its "advancing side feed;" but when the slide 93 is shifted to bring the gear 91 into mesh with the gear 96 the upper slide will be driven through the gears 89, 91, and 96 to secure the opposite or retractive side feed of the carriage. This latter arrangement of gearing is best seen in Fig. 9. While the milling operation is in progress, the gears 89, 90, 92, and 96 will be in mesh; but when it is desired to return the upper slide to its initial position the gears 89, 91, and 96 will be brought into a train, which operation may be effected by hand preferably from a lever, as 98, fulcrumed, as at 99, upon a suitable support and extending through a slot in a segment 100, bolted to the front of the framework. The lever is equipped with a detent or dog 101, the working end of which is adapted to enter notches, as 102, near the opposite ends of the segment. With the lever in the position indicated in Fig. 1, the gears 89, 90, 92, and 96 will be in mesh, as indicated in Fig. 5. By swinging the said lever to the right the other train of gears can be put into action in the manner hereinbefore described. The shaft 99, to which the lever 98 is connected, has at a suitable point a crank-arm 103, Fig. 10, connected by a pin-and-slot joint, as 104, with the sliding shafts 94, by reason of which connections the frames 93 can be moved back and forth to accomplish the results just set forth.

The shaft 97, Fig. 5, has a bevel-gear 105, meshing with the bevel-gear 106 upon the vertical shaft 107, having at its upper end a like bevel-gear 108, meshing with the bevel-gear 109, splined to the horizontal shaft 110, having at its opposite end bevel-gear 112, meshing with the bevel-gear 113 upon the shaft 114, supported by offsets, as 115, upon the upper slide, said shaft 114 being provided with a screw, as 116, extending through a fixed nut, as 117, on said upper slide, the connections described serving when thrown into action to feed the upper or transverse slide sidewise.

The pinion 85, it will be remembered, is of the mutilated kind, it having diametrically opposite spaces adapted to receive intermittingly filling teeth or blocks, as 120, (see Fig. 9,) carried at the ends of projections, as 121, upon the sleeve 122, slidable upon the shaft 87, but rotatable therewith. In their normal position the filling teeth or blocks 120 are at one side of the vertical plane of the teeth in the gear 85, and both the gears 85 and 80 are in such position that the spaces adapted to receive said teeth are at the point of tangency between the said gears, all as shown in Fig. 9. When in this position, gear

80 can be rotated without imparting rotation to gear 85. When, however, the teeth 120 are caused to fill the space, which is accomplished by moving the slide 122 to the right in Fig. 5, said master-gear when the mutilated parts on its periphery receive the teeth 120 serves to rotate the pinion 85, and this operation will continue so long as the teeth 120 are in the space in said pinion 85.

It will be understood, of course, that the movement of the teeth 120 into and out of the spaces in the pinion 85 is controlled automatically and in the present case by a pattern device which is driven from the main shaft of the machine.

With the parts at rest the cutting-tools 69 will be above the upper surface of the work or plate 24; but at the proper time after the starting of the machine the tools will be lowered into contact with and into the work to the proper depth and will be held in such position, and simultaneously the work will be moved forward by the operation of the under slide 20 for the requisite distance, and when the grooves are of the proper length the cutting-tools will be elevated clear of the work, and thereafter the work will be fed forward by the operation of the under slide in such manner as to leave an uncut portion between the first series of grooves or channels and the second series. When the second, third, or other series of grooves is formed, both slides will be operated in unison so as to bring the work into position to have another series of channels cut therein in line with the first series, as represented in Fig. 3, it being remembered that the cutting-tools in the present case are continuously rotated.

The pinion 86 has, like the pinion 85, slidable teeth 130, adapted to coöperate therewith, but normally ineffective, they being connected with the sleeve 131, slidable upon the shaft 88, but rotatable therewith. When the teeth 130 are moved into position to be operated by the gear 80, the pinion 86, and consequently the shaft 88, will be rotated. The cutting-tools are successively lowered, held in working position positively against chattering, and are elevated by mechanism controlled by the master-gear 86.

The shaft 88 has a pinion 133 upon its inner end meshing with the gear 134 upon the shaft 135, said shaft being provided with an eccentric 136, adapted to engage the faces 137 and 138 of an offset portion 139 upon the rack 140, thereby to reciprocate the latter. The pinion 141 meshes with the rack 140 and is fixed to the shaft 142, having bevel-gear 143 (see Figs. 1 and 5) at its outer end meshing with the bevel-gear 144 upon the vertical shaft 145, said shaft having a worm 146 at its upper end in mesh with the worm-gear 147 upon the rock-shaft 71, constituting part of the tool-carrier. (See Fig. 3.)

When it is desired to lower the tool to working position, the teeth 130 are moved, by mechanism hereinafter described, into position to be operated by the gear 80, and as said gear is partially rotated through the tooth 84 this rotation is communicated through gear 86 and shaft 88 to pinion 133 and in turn to gear 134 and shaft 135. The rotation of this shaft through cam 136 moves the rack 140 in one direction and through the gearing above described lowers the tool-carrier. The master-gear 80 is intermittently rotated by tooth 84 until the rack 140, through the connection above described, is thrown to the limit of its motion in one direction, this operating to lower the tool-carrier, so as to bring the tool to the proper working position. At this instant the pattern device operates to bring the teeth 130 into their ineffective position, so that the further rotation of gear 80 does not affect gear 86, and as a result the tool is maintained in its working position, it being locked in such position and firmly held against chattering by reason of the worm-and-gear connection 146 147 until the said teeth 130 are again brought into effective position and the master-gear 80 is again partially rotated by the tooth 84. When this occurs, the cam 136 will move the rack 140 in the opposite direction, which obviously will operate to raise the tool and tool-carrier.

By using a worm 146 for raising or lowering the tool-carrier I have provided a construction which locks the said tool-carrier in either its working or elevated position, and hence operates to firmly and positively hold the tool against the work, thereby preventing any chattering of the tool.

The shaft 145 is divided into two sections, as *a* and *b*, and the sleeve *c*, rigidly carrying the worm-gear *d*, is loosely mounted on the section *a* of said shaft, while it is fast to the section *b*. The section *a* has fast thereon the fixed bracket *e*, provided with a worm-shaft *f*, the worm of which meshes with the worm-gear. The end of said worm-shaft is squared, so that it may be engaged by a wrench. By turning the worm-shaft the worm-gear *d* is rotated, and because of its rigid connection with the section *b* of the shaft it rotates the said section relative to section *a* and through the worm 146 raises or lowers the tool without moving any of the other operative parts of the machine, thus furnishing a means for regulating the stroke of the tool-carrier, and hence the depth of cut to be made by the gang of cutters, without interfering in any way with the rest of the machine.

In connection with the machine I provide stop-motion mechanism, the purpose of which is to automatically stop the machine at the ends of the advancing and returning movements, respectively, of the work-carrier, the power remaining off until started by hand.

The main shaft 60, Figs. 3 and 4, is in two parts, adapted to be connected by a clutch, as 150, (see Fig. 3,) the left-hand portion of the shaft being driven so long as the two sections of the clutch are coupled, while the right-hand section of said shaft is continu-

ously driven from the stepped cone-pulley 61. The clutch 150 is of the friction type, its movable member being operated by a shipper, as 151, consisting of a suitably-fulcrumed lever connected therewith in some well-known manner. A rod, as 152, is connected with the lever 151 and is pivoted to the crank-arm 153 upon the shaft 154, carrying at its outer end a hand-lever 155. A U-shaped flat spring, as 156, is illustrated as connected with the hand-lever 155 and also with the framework, the purpose of the spring being to rapidly shift the lever 155 to uncouple the two parts of the clutch at a desired time and stop the machine, said lever 155 being shown in its inoperative position in Fig. 1. The lever 155 is normally held in its effective position by a pivoted latch, as 157, held in its working position, as shown in Fig. 3, by a coiled spring, as 158, connected, respectively, to said latch and to the frame. A rod, as 159, is pivoted to the right-hand end of said latch, (see Fig. 4,) the other end of said rod being united to one arm of the angle-lever 160, pivoted upon the under side of the framing, the other arm of said lever being jointed to the rod 161. The rod 161 is connected with one arm of the angle-lever 162, supported by the bearing 163, the rod 164 being connected with the other arm of said angle-lever and being united at its other end to the crank 165 upon the shaft 166, provided upon its outside with the slotted segment 167, adapted to be entered by the bolt 168, carried by the link 169, pivoted to what is shown as the right-hand end of the bar 170, slidably supported by brackets upon the framing. The said bar 170 is equipped with abutments, as 171, in its opposite ends adapted to be adjustably clamped thereto by set-screws, as 172. These abutments or stops 171 are adapted to be alternately engaged by the upper slide 21 when the same is at the limit of its respective strokes, so that the slide-bar can be moved to the left or right, as the case might be, for the purpose of tripping the latch 157 through the intermediate connections to effect the release of the lever 155. As the slide 21 reaches the limit of its movement to the right in Fig. 1 it abuts against the right-hand stop 171, turns the segment on its pivot 166, thereby raising the crank-arm 165 and through the connections described tripping the latch 157 to allow the lever 155 to throw the clutch out of operation and stop the machine. The spring 158 is strong enough so that when the lever 155 is thrown into the position to start the machine again it will throw the latch 157 into operative position and through the connections 159, 160, 162, and 164 bring the crank-arm back to its central position—that is, with the segment 167 substantially vertical and the crank-arm horizontal, as illustrated in Fig. 1.

From the manner in which the latch 157 is connected to the crank-arm 165 it is necessary that said crank-arm always be raised in order to trip the latch 157, and to provide for always raising said crank-arm, whether the rod 170 is moved to the right or left, I have connected the link 169 to the crank-arm 165 by a pin-and-slot connection, as shown. When, therefore, the upper slide is moving toward the left, so that when it reaches the limit of its movement in this direction it will through the left-hand abutment 171 move the rod 170 toward the left, I loosen the bolt 168, swing the link 169 down to the dotted-line position in Fig. 1, and by tightening the bolt secure it in the lower end of the segmental slot. When in this position, it will be seen that a movement of the rod 170 to the left will raise the crank-arm 165, and consequently trip the latch 157. When the slide 21 begins its movement to the right again, the link 169 is again secured to the segment 167 at the upper end of the slot, as shown in the drawings.

It will be remembered that the movements of the work carrier and cutting mechanism are controlled by a pattern device, and the same may be of any suitable character. I have illustrated a simple form of such apparatus and will now describe the same. The pattern-chain is denoted by 180, and it consists of two series of parallel links connected by cross-bars, as 181, constituting convenient pivots for uniting the links and also as supports for rolls that elevate at proper times the levers that throw the actuating devices for the several parts into operation. The cross-bars 181 are adapted to fit into peripheral cavities or seats in the heads of a spool 182, fixed to the shaft 183. The cross-bars carry rolls, as 184, arranged in such manner thereon as to elevate the levers 185, 186, 187, and 188 in the desired order, said levers being suitably fulcrumed upon a bearing upon the framework, as at $184^a$. (See Fig. 8.) The pattern-chain may be supported by a suitable device, as a second spool, such as that shown at 182, although it is not shown herein, as I have only deemed it necessary to represent a portion of the pattern-chain. In the present case the pattern-chain is fed step by step, and the rolls 184 are so arranged thereon that when one of them raises the lever 185 the under slide will be fed forward and when another raises the lever 186 said under slide will be moved backward and when the lever 187 is raised by the appropriate roll the upper slide will be moved crosswise and when the lever 188 is similarly raised the tool-carrier will be lowered or elevated, all through the intermediate mechanism set forth. Rods, as 189, 190, 200, and 201, are pivoted to and depend from the said several levers, each of the rods being in two parts connected by turnbuckles, as 202, so as to shorten or lengthen the same in case this should be necessary. The lower ends of the rods are pivoted to the horizontal arms of angle-levers 203, 204, 205, and 206, loose upon a shaft, as 207. The vertical arm of the angle-lever 203 is pivoted to the rod 208, which rod is likewise connected to the vertical arm of the angle-

lever 209, the horizontal arm of which is pivoted to the rod 210, pivoted at its upper end to one of the arms of the angular clutch-shifter 211, connected with the movable clutch-sleeve 56. When the lever 185 is lifted by the pattern-chain, the clutch-sleeve 56 will be thrown into engagement with its companion 54 through the intermediate parts, so as to rotate the shaft 42 and move the under slide 23 forward, and when the roll of the pattern-chain passes out of contact with the said lever the latter will drop, so as to move the sleeve 56 away from the sleeve 54, and thereby stop this motion of the slide. The rod 212 is pivoted to the vertical arm of the second angle-lever 204 and is similarly united to the vertical arm of the angle-lever 213, to the horizontal arm of which the rod 214 is pivoted. Said rod 214 is pivoted at its upper end to the horizontal arm of the clutch-shipper 215, so that by reason of the intervening connections between the lever 186 and the clutch-shipper 215 the clutch member 55 can be moved into and out of engagement with its companion 50 to either start or stop the shaft 42, and it will be understood that when the clutch parts 55 and 50 are in engagement said shaft will be driven in a direction exactly opposite to that followed when it is operated through the clutch parts 56 and 54. When, therefore, the lever 186 is raised by the appropriate roll on the pattern-chain, the clutch members 55 and 50 will be thrown into engagement, causing the under slide 23 to move backward. The rod 217 is pivoted, respectively, to the third angle-lever 205 and to the crank-arm 218 upon the shaft 219, to which the shipper-lever 220 is connected, said shipper-lever being adapted to move the sleeve 122 back and forth, to which latter it will be remembered the teeth 120 are connected, to thereby render the teeth effective, so that the pinion 85 can be driven from the gear 80 to feed the upper slide crosswise. Since the third angle-lever 205 is connected by rod 200 with the lever 187, it will be understood that when said lever is lifted by the proper roll on the pattern-chain the upper slide will be fed crosswise by reason of the connections just described. The lever 188 is connected by rod 201 with the fourth angle-lever 206, and this angle-lever 206 is connected with arm 222 of the shipper-lever 223 by rod 221. The shipper-lever 223 is connected at its upper end to the sleeve 131, to which it will be remembered the teeth 130 are connected. By reason of these connections the lever 188, the movement of which is controlled by the arrangement of rolls on the chain, controls the mechanism which operates to render the gear 86 effective or ineffective, and hence controls the movement of the tool-carrier.

From the above description it will be observed that the different sets of mechanisms which operate respectively to feed the under slide 23 forward, to feed the said under slide backward, to feed the upper slide crosswise, and to raise and depress the tool-carrier are all under the control of the pattern device, and by arranging the rolls on the chain in any selected order these several operations may be performed at any predetermined time and in any predetermined order. The pattern mechanism is given a step-by-step feed, and for this purpose I have shown a pawl-and-ratchet mechanism. The shaft 183, Fig. 6, is provided at its outer end with a ratchet 225, adapted to be engaged by gravity-pawl 226, pivoted to one arm of the rocker 227, the rod 228 being similarly connected to the other arm of said rocker. The rod 228 (see Figs. 2 and 6) is pivoted to the rock-arm 229. The rocker 227 is shown as occupying its extreme positions by full and dotted lines, respectively, in Fig. 6, and it is lowered in the present case by a cam, as 235, secured to the shaft 48 and adapted to engage the upper side of the lever or rocker 229, and is elevated by the coiled spring 236, connected to the free end of said rocker 229 and to the framework. (See Fig. 2.) In Figs. 2 and 6 the rocker is illustrated as up, and when the cam 235 rotates it will impinge against the rocker 229 in such manner as to throw the same down, thereby through the rod 228 moving the rocker 227 to its dotted-line position, so that the pawl 226 will be drawn backward to rotate the ratchet 225 the distance of one tooth. As the rocking lever 229 is returned by the spring 236 the rocker 227 will be returned to its full-line position, so as to thrust the pawl 226 forward, so that it can drop over another tooth of the ratchet 225.

I provide safety mechanism, one convenient form of which will now be described, to automatically stop the machine in case the rods 189, 190, 200, and 201 of the pattern mechanism should be broken. A shaft is shown at 240, it carrying a series of arms, as 241, disposed in the path of the turnbuckle 202. The arm 242 extends oppositely from said shaft and is pivoted to the upright rod 243, likewise connected to the angle-lever 244. In case any one of the levers 185, 186, 187, or 188 breaks the turnbuckle connected therewith will fall and strike the coöperating arm 241, thereby forcing the same down and thrusting the rod 243 upward, so that the vertical arm of the angle-lever 244 is forced to the right in Fig. 1 and against the projection 245 upon the rod 161, which it will be remembered is connected with the latch 157, thereby tripping said latch and releasing the lever 155, so that the same can be swung to the right to uncouple the members of the clutch 150 and stop the machine. The shaft 183, constituting a part of the pattern mechanism, is provided at one end with a disk 250, having peripheral pockets adapted to be entered by the tooth of the pawl 251, said tooth being held in a pocket by the coiled spring 252, connected to the pawl. This construction prevents backward movement of the pattern-chain and any undue forward movement thereof. The shaft 183 has at its outer end

a hand-wheel 253, by which it may be turned to move the pattern-chain forward or backward should the same be necessary.

When one series of slots have been cut the entire length of the work, it becomes necessary to bring the slide 21 of the work-holder back to its initial position and at the same time to feed the under slide 23 backward sufficient to bring the work into position to cut the second series of slots. The return motion of the upper slide 21 is accomplished by throwing the reversing-lever 98 into such position that the gear 91 will connect gears 89 and 96 when any motion given to gear 89 will through the gearing herein described give to the upper slide its return movement. It will be remembered, however, that the forward movement of slide 21 was intermittent, it being fed forward at each movement in this instance the space occupied by six slots, that being the number cut at a single operation, this intermittent movement being controlled by the pattern device. If the same mechanism were used to give the said slide 21 its return movement, by simply throwing the reversing-gear 91 into operative position it is evident that such return motion would be intermittent, and consequently slow, and the pattern-chains would have to have a large number of consecutive links, each carrying a roll adapted to operate the lever 187. This would result in making the chain very long and clumsy. In order to give to the slide 21 a continuous movement during its return stroke and to obviate the necessity of so long a pattern-chain, I have provided what I term a "repeating" means, which is active in this instance on the return movement of the upper slide 21 of the work-holder. It will be understood, however, that such repeating mechanism may be used in any of the operations controlled by the pattern mechanism when it is desired to repeat the same operation several times successively.

The repeating means illustrated will now be described. Referring to Figs. 6 and 8, a lever is shown at 255, it being supported by the same shaft that carries the levers 185, 186, 187, and 188, and this lever 255 is adapted to be engaged and lifted by rolls on the pattern-chain. Said lever 255 is bifurcated at one end thereof, as at 256, to receive a feed-pawl 257, pivoted to the rocker 227. The working end of the feed-pawl is adapted to engage the teeth of a ratchet 258, fixed to the shaft 259 when it is desired to render the repeating means effective. Normally the repeating-lever 255 upholds the feed-pawl 257, as indicated by full lines in Fig. 6, where its working end is out of engagement with the teeth of the ratchet 258. When, however, what is shown in Fig. 8 as the left-hand end of the lever 255 is raised by a roll on the chain, the right-hand end will be lowered, permitting the pawl 257 to fall into engagement with the ratchet 258, thereby to rotate said ratchet. When said right-hand end of the repeating-lever 255 is elevated, the pawl 257 of course will be lifted clear of the ratchet 258, so as to stop the rotation of the same. The shaft 259 carries a cam 260, having a peripheral opening 261 to receive the roll 262 at the end of the lever 263, the end of the lever farthest from that of the roll 262 being adapted to engage under the end of the pin 264 and uphold the pawl 226. When the ratchet 258 is rotated in the manner previously set forth, the roll 262 will be forced out of the peripheral seat 261 in the cam 260, and said cam will force the right-hand arm of the lever 263 down and the left-hand arm thereof up, thereby lifting the pawl 226, and consequently stopping the step-by-step rotation of the pawl 225 and the motion of the pattern mechanism.

When it is desired to repeat any one operation a number of times—as, for instance, the operation of giving the upper slide 21 its retractive movement, as before explained—a roll is so positioned on the chain that it will be brought under the left-hand end of the repeating-lever 255 to raise the same and depress the opposite end thereof. This allows the pawl 257 to fall into engagement with the ratchet 258, thereby rotating the same and through the cam 260 and lever 263 lifting the pawl 226 out of operative engagement with the ratchet 225, thereby stopping its step-by-step movement. This stopping of the ratchet 225 is so timed that a roll is left under lever 187, thereby holding the same elevated, and consequently holding the teeth 120 in effective position, as before explained, to thereby give the said upper slide a continuous retractive movement. If desired, this repeating means may at the same time and in the same way operate to give the under slide a continuous movement, so that when one series of slots have been cut the proper mechanism will give to the under slide its backward movement and simultaneously to the upper slide its transverse retractive movement, so as to bring the work-holder into proper position to begin milling the second series of slots. When the seat or recess 261 is opposite the roll 262, said roll can enter the same, and the pawl 226 is thereby free to fall, so as to again feed the ratchet, and the ratchet will be fed one step, and another series of repeating cam devices may, if necessary, be brought into position to simultaneously lift any of the three levers 255, 186, and 187, and these operations will be continued until the work-holder has resumed its initial position. Upon the shaft 259 a disk, as 270, is mounted, it having peripheral recesses to be entered by the tooth of a spring-actuated pawl 271, so as to prevent any undue motion of the ratchet 258 either forward or backward.

The invention is not limited to the construction previously set forth, for the same may be materially modified within the scope of the accompanying claims.

Preferably I employ suitable springs 299 to assist in controlling the levers 185, 186, 187,

and 188, such springs being connected to each of the levers 203, 204, 205, and 206 and to any fixed part of the frame. These springs serve to positively depress each of the levers as soon as a roll has passed out from under such lever. It is not necessary that such springs be used, as the weight of the lever is ordinarily sufficient to bring the lever into its inoperative position; but I prefer to use the springs to assist the action of gravity.

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

1. In a metal-working machine, a tool, a tool-carrier, mechanism to bring the tool from its inoperative to its working position, and a pattern-chain to control said mechanism.

2. In a metal-working machine, a tool, a tool-carrier, mechanism to put the tool into its working position and to positively hold the same in such position, and a pattern-chain controlling said mechanism.

3. In a metal-working machine, a tool, a tool-carrier, mechanism to put the tool into and away from its working position, and a pattern-chain to control said mechanism.

4. In a metal-working machine, a tool, a rocking tool-carrier mechanism to operate the tool-carrier to carry the tool from its inactive position to its working position, and a pattern-chain to control said mechanism.

5. In a metal-working machine, a shaft provided with bearings, a second shaft sustained by the bearings, mechanism for rocking the first-mentioned shaft, including a pattern device, a tool upon the second shaft, and means for rotating the latter.

6. In a metal-working machine, a tool, a tool-carrier, mechanism to operate the tool-carrier alternately in opposite directions to first move the same into contact with the work and then out of contact with the work, and to hold it in contact with the work positively for a predetermined time, said mechanism including a worm on the tool-carrier and a gear coöperating therewith, and means to intermittingly rotate said gear.

7. In a metal-working machine, a tool, a tool-carrier, worm-gearing connected with the tool-carrier, a shaft supporting one of the members of the worm-gearing, and means to rotate said shaft alternately in opposite directions, said shaft remaining at rest between its two movements.

8. In a metal-working machine, a tool-carrier having a tool and a work-holder, each of said parts being shiftable relatively to the other, and pattern-controlled means to operate said parts independently.

9. In a metal-working machine, a work-holder, a rocking tool-carrier, a rotating tool carried thereby, and means to cause the tool to engage the work, and to positively hold it in engagement with the work and against chattering for a predetermined time, and pattern-controlled means to operate the work-holder and tool-carrier either simultaneously or independently.

10. In a metal-working machine, a shaft having bearings, a second shaft supported by the bearings, provided with a plurality of cutters, means for continuously rotating said second shaft, and means for locking the first-mentioned shaft alternately in opposite directions, and said first-mentioned shaft arranged to be held at rest during such two motions.

11. In a metal-working machine, a tool, a tool-carrier, a work-holder, and means, including a pattern-chain, for operating the work-holder.

12. In a metal-working machine, a tool, a tool-carrier, a work-holder through which the work is attached, and pattern-controlled means for operating the work-holder and the tool-carrier either independently or in unison.

13. In a metal-working machine, a tool, a tool-carrier, a work-holder consisting of a plurality of superimposed slides, and mechanism, including a pattern device, for independently operating the slides.

14. In a metal-working machine, a tool, a tool-carrier, a work-holder consisting of a plurality of superimposed slides, and mechanism for operating the slides separately or simultaneously, said mechanism including a pattern device.

15. In a metal-working machine, a tool, a tool-carrier, a work-holder, means to cause the tool to engage the work, said means including coöperating mutilated gears, a tooth or block normally ineffective and adapted to coöperate with one of said gears, and means to put said tooth or block into its effective position.

16. In a metal-working machine, a tool, a tool-carrier, a work-holder, means to cause the tool to engage the work, said means including coöperating mutilated gears, a tooth or block normally ineffective and adapted to coöperate with one of said gears, and means to put said tooth or block into its effective position, said means embodying a pattern device.

17. In a metal-working machine, a tool, a tool-carrier, a work-holder, means to cause the tool to engage the work, said means including two coöperating mutilated gears, a tooth or block normally ineffective and adapted to coöperate with one of said gears, a sliding sleeve supported by the shaft that carries the gear with which said tooth coöperates, and means for moving said sleeve back and forth.

18. In a metal-working machine, a tool, a tool-carrier, a work-holder, means to cause the tool to engage the work, said means including two coöperating mutilated gears, one of said gears having diametrically opposite spaces, a plurality of teeth or blocks adapted to enter said spaces, and automatic mechanism to move said teeth or blocks back and forth simultaneously.

19. In a metal-working machine, a tool, a tool-carrier, a work-holder; two mutilated gears; a tooth normally ineffective; means to put the tooth into its effective position; means to drive the primary mutilated gear; a shaft connected with and operated from the secondary gear, said shaft having an eccentric; a bar operated by said eccentric; and connections between said bar and the tool to operate the latter.

20. In a metal-working machine, a tool, a tool-carrier, a work-holder; two mutilated gears; a tooth normally ineffective; means to put the tooth into its effective position; means to drive the primary mutilated gear; a shaft connected with and operated from the secondary gear, said shaft having an eccentric; a bar operated by said eccentric, said bar having teeth; a pinion meshing with said teeth; and connections between said pinion and the tool for moving the latter into and out of its working position.

21. In a metal-working machine, a tool, a tool-carrier; a work-holder; means to cause the latter to engage the work, said means including two coöperating mutilated gears, one of said gears having a plurality of pockets; a tooth or block to coöperate with the other gear and normally ineffective; means to put the tooth or block into its effective position; and rotary teeth to enter said pockets thereby to turn the gear having the same.

22. In a metal-working machine, a tool, a tool-carrier; a work-holder; means to cause the tool to engage the work and simultaneously to feed the work-holder, said means including driving and driven mutilated gears; teeth to coöperate with both driven mutilated gears; and means to automatically put the teeth into their effective position.

23. In a metal-working machine, a tool, a tool-carrier; a work-holder, a plurality of mutilated gears, a tooth to coöperate with one of said gears and normally ineffective; means to put the tooth into its effective position; and connections between the second one of said mutilated gears and the work-holder.

24. In a metal-working machine, a tool; a tool-carrier; a work-holder; a plurality of coöperating mutilated gears; a tooth adapted to coöperate with one of said gears and normally ineffective; means to put the tooth in its effective position, said means including a pattern device; and connections between the second mutilated gear and the work-holder to operate the latter.

25. In a metal-working machine, a tool, a tool-carrier; a work-holder consisting of a plurality of superimposed slides, a plurality of coöperating mutilated gears; a tooth adapted to coöperate with one of said gears and normally ineffective; means to put the tooth into its effective position; and connections between the second mutilated gear and one of the slides for operating the latter in opposite directions.

26. In a metal-working machine, a tool, a tool-carrier; a work-holder consisting of a plurality of superimposed slides, a plurality of coöperating mutilated gears; a tooth adapted to coöperate with one of said gears and normally ineffective; means to put the tooth into its effective position; and connections between the second mutilated gear and one of the slides for operating the latter in opposite directions, said connections including a plurality of manually-shiftable gears.

27. In a metal-working machine, a tool, a tool-carrier, a work-holder; means to put the work-holder in its effective position, said means including a pattern device and the latter embodying a chain having rolls and a lever to be engaged by said rolls.

28. In a metal-working machine, a tool, a tool-carrier; a work-holder, means to operate the work-holder and the tool-carrier, said means including a pattern device and the latter embodying a chain having rolls and levers to be engaged by said rolls.

29. In a metal-working machine, a tool, a tool-carrier, a work-holder, means to put the work-holder in its effective position, said means including a pattern device, and stop mechanism adapted to be operated on breakage of the jacquard device to stop the machine.

30. In a metal-working machine, a rotating tool, a tool-carrier, a work-holder, and means including a pattern-chain for controlling the position of both the tool and the work-holder.

31. In a metal-working machine, a tool, a tool-carrier, and a work-holder, said work-holder comprising two superimposed slides, and a pattern device for operating independently the tool and work-holder.

32. In a metal-working machine, a tool, a tool-carrier, and a work-holder, said work-holder comprising two superimposed slides, and mechanism for operating independently the tool-carrier and each portion of the work-holder, said mechanism including a pattern device.

33. In a metal-working machine, a tool, a tool-carrier and means to operate the tool-carrier, said means including a worm-gear on the tool-carrier and a worm adapted to drive said worm-gear, a sectional shaft for the worm and means for turning one section relative to the other whereby the position of the tool-carrier may be adjusted to regulate the depth of the cut.

34. In a metal-working machine, a tool-carrier, and means for operating the same, said means including a sectional shaft carrying a worm, and a worm-gear on the tool-carrier to coöperate therewith, a worm-gear splined to one of said shaft-sections, and a worm carried by the other, whereby the one section can be turned relative to the other.

35. In a metal-working machine, a tool-carrier, a reciprocating work-holder, a stop-

motion to throw the machine out of operation, said stop-motion including a slidable rod having abutments adapted to be operated by the work-holder, a tripping device, and connections between the rod and tripping device whereby the tripping device is operated by a movement of the rod in either direction.

36. In a metal-working machine, a stop-motion, said stop-motion including a slidable rod, a latch for the operating-lever, a slotted segment pivotally mounted on the machine and connected to the latch, a link detachably connecting the rod with the segment, and a work-holder to operate the rod, and thereby trip the latch.

37. In a metal-working machine, a reciprocating work-holder, and means to stop the machine at the end of each reciprocation of said work-holder, said means including a latch for the operating-lever, a crank-arm, connections between the crank-arm and latch to trip the latch when the crank-arm is raised, and means operable by the work-holder when it reaches either limit of its movement to raise the crank-arm.

38. In a metal-working machine, a reciprocating work-holder, a slidable rod having abutments adapted to be engaged by the work-holder when it reaches either limit of its movement, a latch for the operating-lever, a pivoted arm connected with said latch and adapted to operate said latch when the arm is raised, and connections between the rod and arm, whereby the arm is raised to trip the latch when the rod is moved in either direction by the work-holder.

39. In a metal-working machine, a reciprocating work-holder, a slidable rod having abutments, adapted to be engaged by said work-holder as it reaches the limit of its movement in either direction, and means operated by said rod to effect the stopping of the machine, said means including a pivoted member having a segmental slot therein, a link pivoted to the rod and detachably engaging said slot, whereby the link may be connected with either end of the slot to effect the stopping of the machine, by a movement of the rod in either direction.

40. In a metal-working machine, a rotating tool, a work-holder, means to reciprocate the work-holder with respect to the tool, a pattern device controlling the reciprocations of the said work-holder, said pattern device including a repeating mechanism.

41. In a metal-working machine, a tool-carrier, a work-holder, means to intermittently move the work-holder with respect to the tool-carrier, said means including a pattern device, and a repeating mechanism connected with the pattern device whereby the intermittent motion of the work-holder may be made substantially continuous.

42. In a metal-working machine, a tool-carrier, a reciprocating work-holder, gearing for reciprocating the same, clutch mechanism for rendering said gearing operative or inoperative, and pattern mechanism for controlling said clutch mechanism.

43. In a metal-working machine, a reciprocating work-holder, a feed-screw for reciprocating the same, reversing-gearing for operating said feed-screw, and pattern mechanism controlling said reversing-gearing.

44. In a metal-working machine, a tool-carrier, a reciprocating work-holder, means for reciprocating said work-holder, said means including a shaft, two gears loosely mounted thereon, means to rotate said gears in opposite directions, and pattern-controlled clutch mechanism for clutching either of said gears to the shaft.

45. In a metal-working machine, a reciprocating work-holder, a rock-shaft having arms projecting therefrom, a shaft mounted for rotation in said arms, said shaft adapted to carry a tool, and pattern-controlled mechanism to oscillate said rock-shaft.

46. In a metal-working machine, a reciprocating work-holder, a rock-shaft having integral arms projecting therefrom, a shaft rotatively mounted in said arms and parallel to the rock-shaft, said rotatively-mounted shaft adapted to carry a tool, and pattern-controlled mechanism to oscillate said rock-shaft.

47. In a metal-working machine, a work-holder, a rock-shaft having arms projecting therefrom, a shaft rotatively mounted in said arms, and adapted to carry a tool, means to oscillate said rock-shaft including a sectional shaft, a means to turn one section of said shaft relative to the other whereby the relative positions of the rock-shaft may be varied.

48. In a metal-working machine, a work-holder, a rock-shaft having integral arms projecting therefrom, a tool-carrying shaft rotatively mounted in said arms, pattern-controlled means to operate said rock-shaft, said means including a sectional shaft, and means to turn one section of said shaft relative to the other, whereby the position of the tool-carrying shaft may be adjusted.

49. In a metal-working machine, a work-holder, a tool-carrier comprising a rock-shaft, a tool supported thereby, gearing to oscillate said rock-shaft to carry the tool from its inactive to its working position, said gearing including a rack and pinion, and pattern-controlled means for rendering said gearing inactive when the rack reaches either limit of its movement.

50. In a metal-working machine, a work-holder, a tool-carrier comprising a rock-shaft, a tool supported thereby, gearing to oscillate said rock-shaft to carry the tool from its inactive to its working position, said gearing including a rack and pinion, and pattern-controlled means operating to arrest the operation of said gears for a predetermined time when the rack reaches either limit of its movement.

51. In a metal-working machine, a shiftable work-holder, a tool-carrier, a tool carried thereby, work-holder-shifting devices, tool-carrier-operating devices, and a pattern-chain controlling both of said devices.

52. In a metal-working machine, a work-holder adapted to support the work and move the same in a plurality of directions, a tool-carrier, a tool carried thereby, tool-carrier-shifting devices, work-holder-operating devices and a pattern-chain controlling the operation of both of said devices.

53. In a metal-working machine, a tool, a tool-carrier, a work-holder consisting of a plurality of superimposed slides, and pattern-controlled mechanism for operating the work-holder and tool-carrier independently.

54. In a metal-working machine, a tool, a tool-carrier, a work-holder consisting of a plurality of superimposed slides, and pattern-controlled mechanism for independently operating the slides and for operating the tool-carrier.

55. In a metal-working machine, a tool, a tool-carrier, a work-holder consisting of a plurality of superimposed slides, and pattern-controlled means for moving each slide at right angles to the direction of movement of the other slide.

56. In a metal-working machine, a tool, a tool-carrier, a work-holder consisting of a plurality of superimposed slides, slide-moving devices operating to move each slide at right angles to the direction of movement of the other slide, tool-carrier-moving devices and pattern mechanism for controlling both of said devices.

57. In a metal-working machine, a tool-carrier, and tool-carrier-operating devices, a shiftable work-holder, and work-holder-operating devices, and a single pattern mechanism to control each of said devices.

58. In a metal-working machine, a tool-carrier, and tool-carrier-operating devices, a reciprocating work-holder, and work-holder-operating devices, and a pattern-chain controlling the operation of both of said devices.

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

ADAMS CROCKER.

Witnesses:
JOHN C. EDWARDS,
LOUIS C. SMITH.