Feb. 7, 1933. O. J. BERGER 1,896,692

AUTOMATIC FORGING MACHINE

Filed Sept. 30, 1929 14 Sheets-Sheet 1

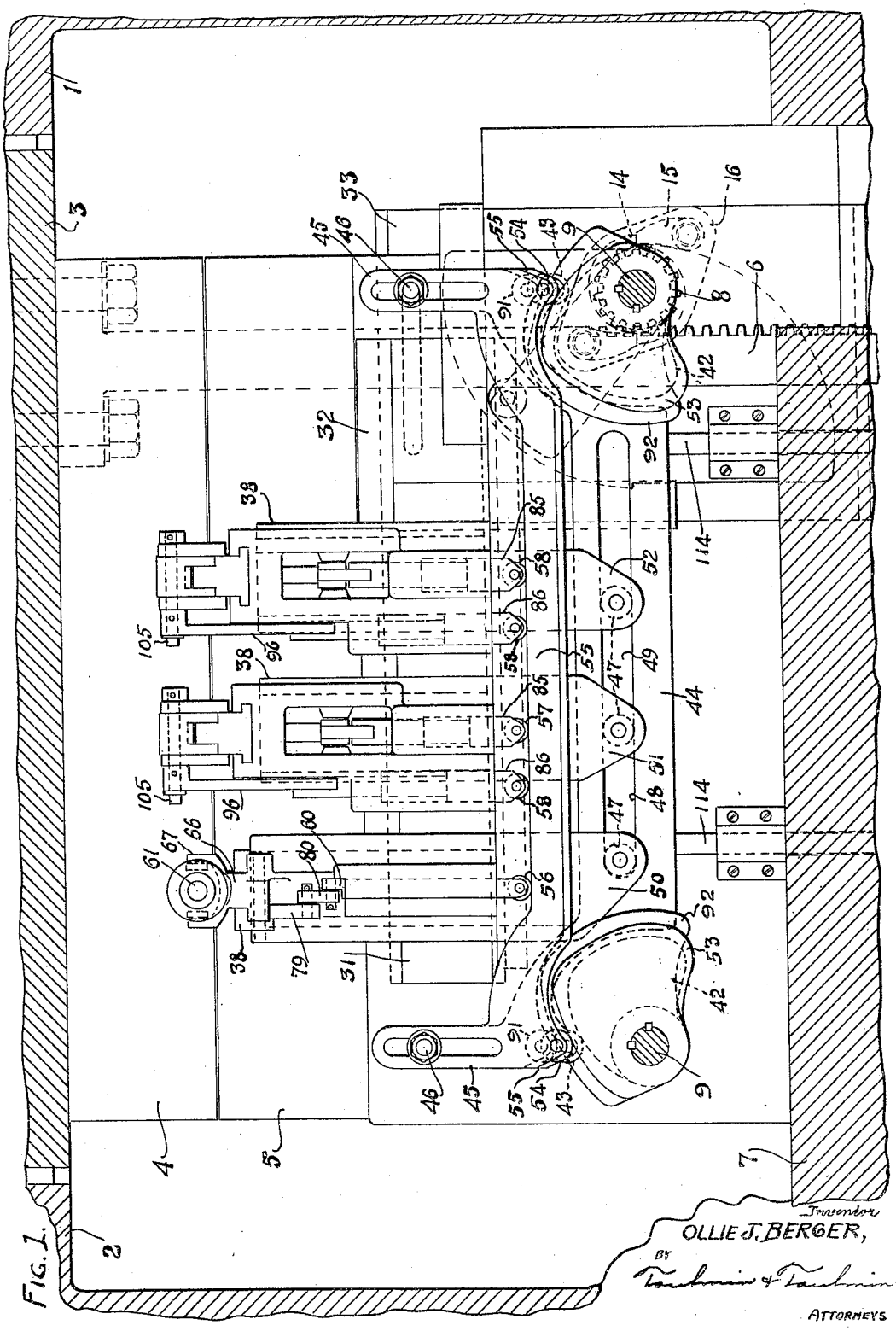


FIG. 1.

Inventor
OLLIE J. BERGER,
By Taulmin & Taulmin
Attorneys

Feb. 7, 1933. O. J. BERGER 1,896,692

AUTOMATIC FORGING MACHINE

Filed Sept. 30, 1929 14 Sheets-Sheet 2

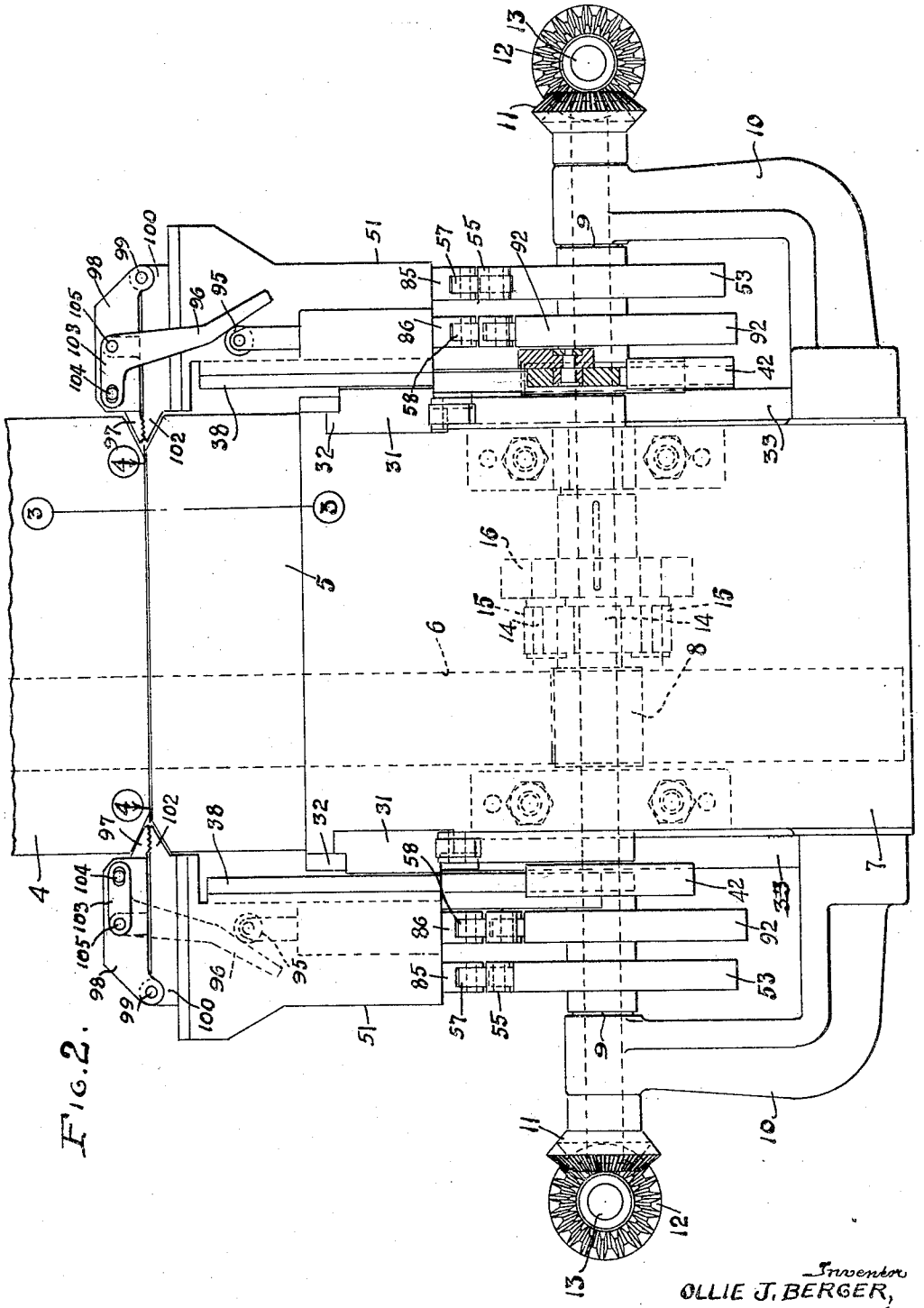


FIG. 2.

Inventor
OLLIE J. BERGER,
By Taubman & Taubman
Attorneys

Feb. 7, 1933. O. J. BERGER 1,896,692

AUTOMATIC FORGING MACHINE

Filed Sept. 30, 1929 14 Sheets-Sheet 3

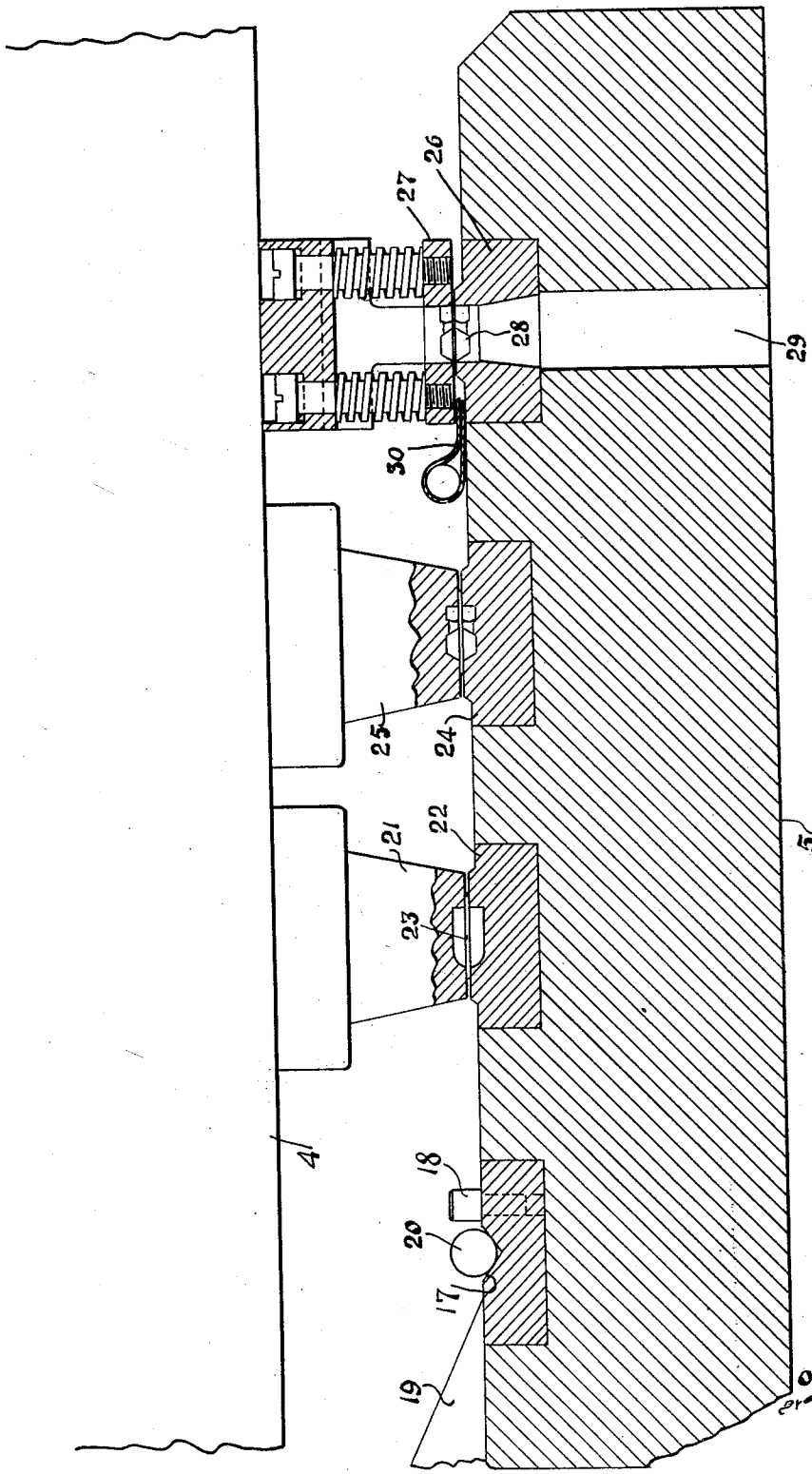


FIG. 3.

Inventor
OLLIE J. BERGER,
by Taulmin & Taulmin
Attorneys.

Feb. 7, 1933. O. J. BERGER 1,896,692

AUTOMATIC FORGING MACHINE

Filed Sept. 30, 1929 14 Sheets-Sheet 4

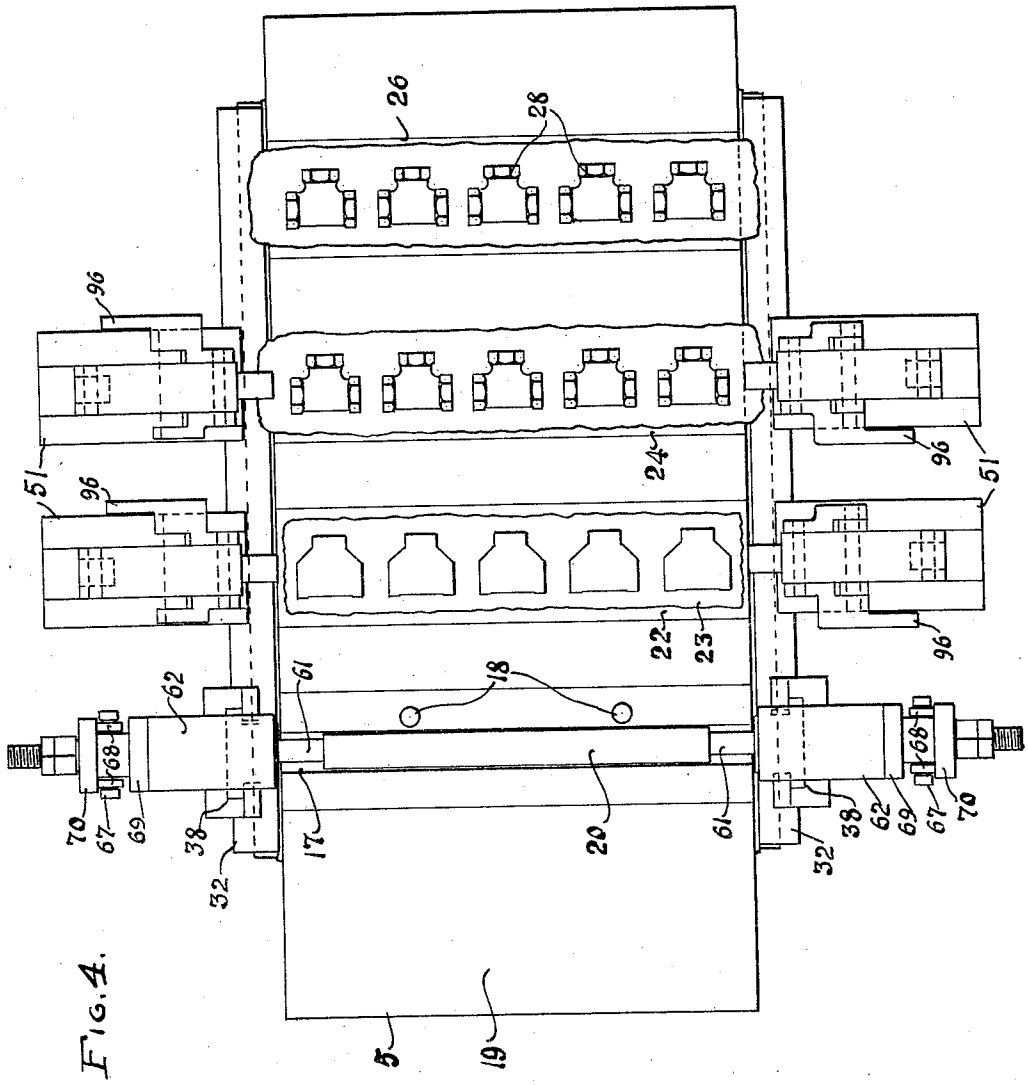


FIG. 4.

Inventor
OLLIE J. BERGER,
BY Taubman & Taubman
Attorneys

Feb. 7, 1933. O. J. BERGER 1,896,692

AUTOMATIC FORGING MACHINE

Filed Sept. 30, 1929 14 Sheets-Sheet 5

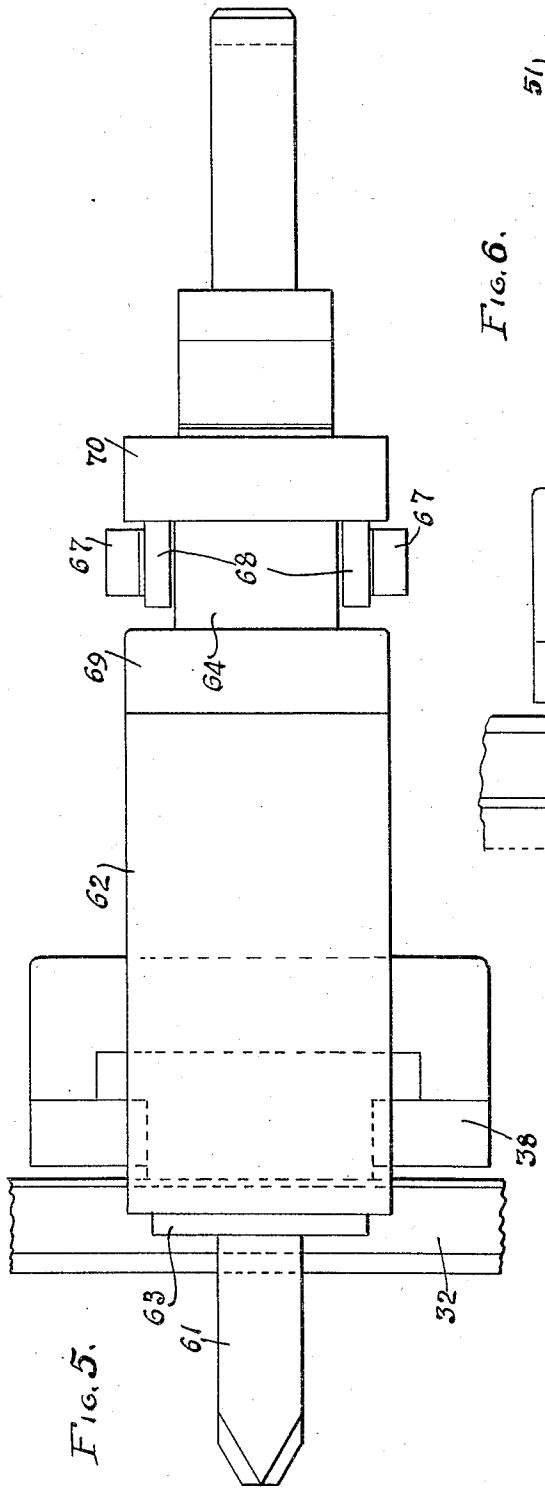


FIG. 5.

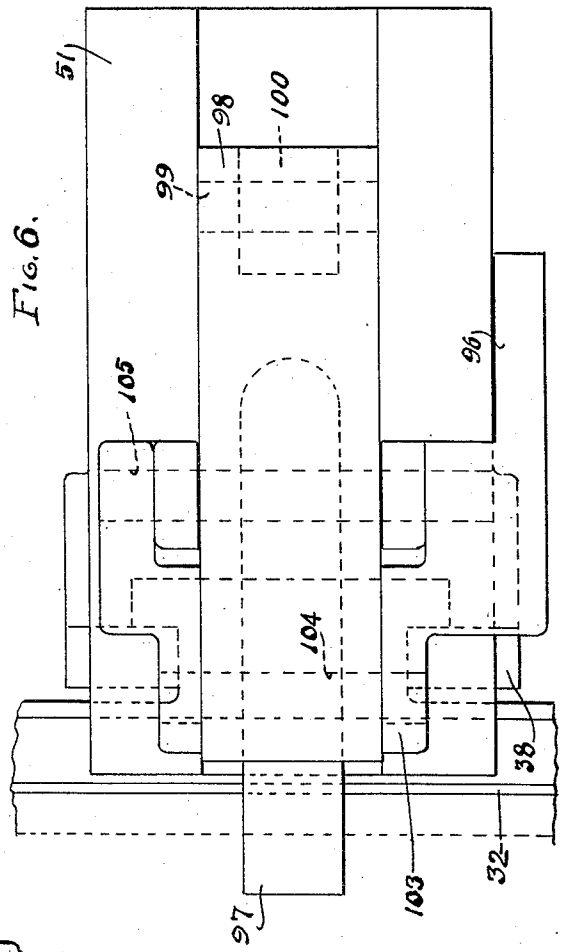


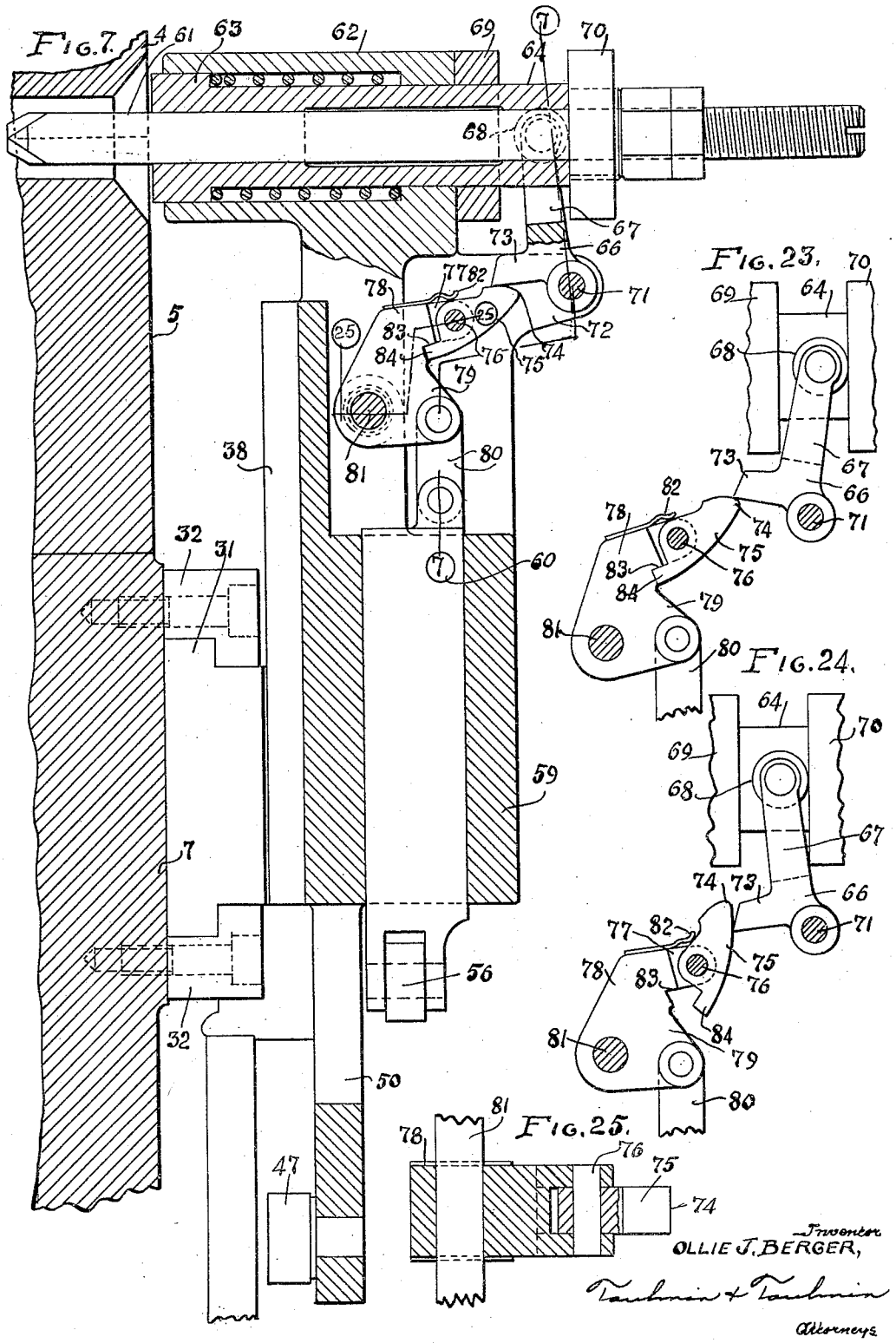
FIG. 6.

Inventor
OLLIE J. BERGER,
BY
Taulmin & Taulmin
Attorneys

Feb. 7, 1933. O. J. BERGER 1,896,692

AUTOMATIC FORGING MACHINE

Filed Sept. 30, 1929 14 Sheets-Sheet 6



Inventor
OLLIE J. BERGER,
Taubman & Taubman
Attorneys

Feb. 7, 1933. O. J. BERGER 1,896,692

AUTOMATIC FORGING MACHINE

Filed Sept. 30, 1929 14 Sheets-Sheet 7

Fig. 8.

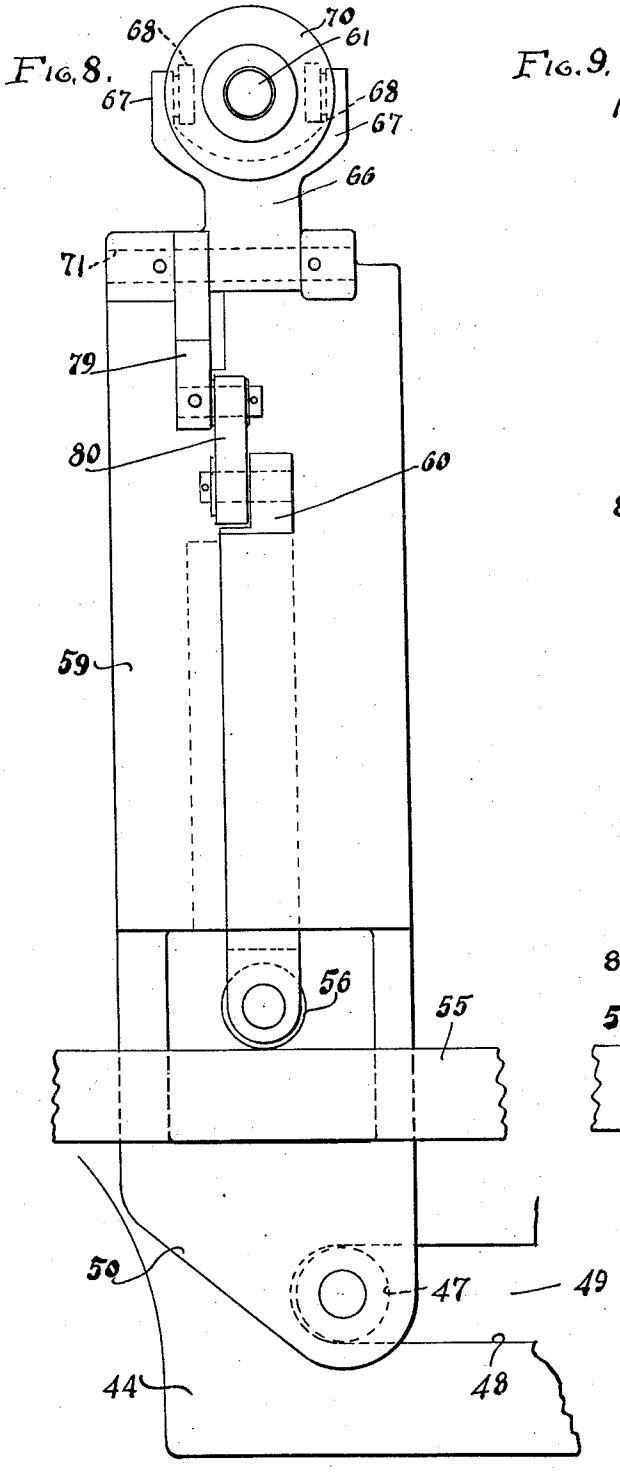
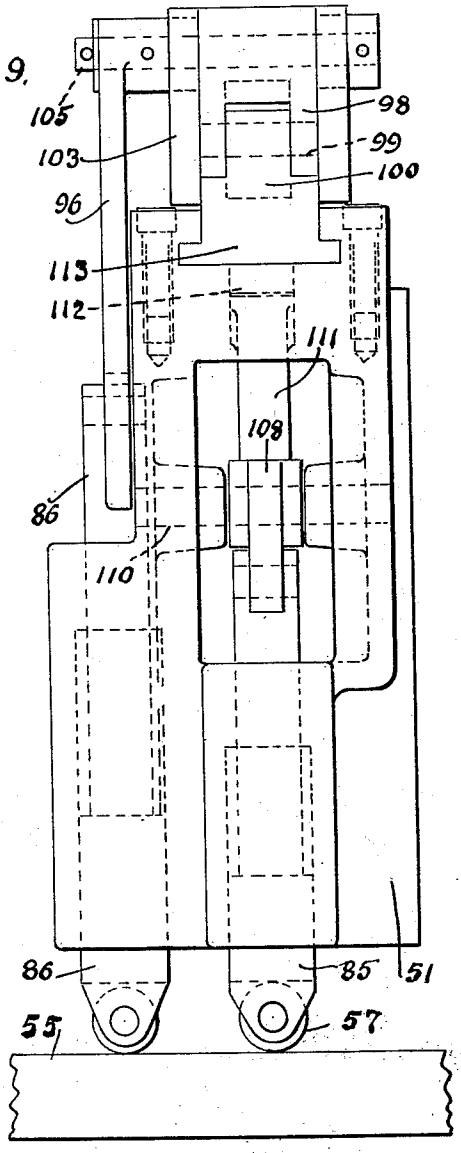


Fig. 9.



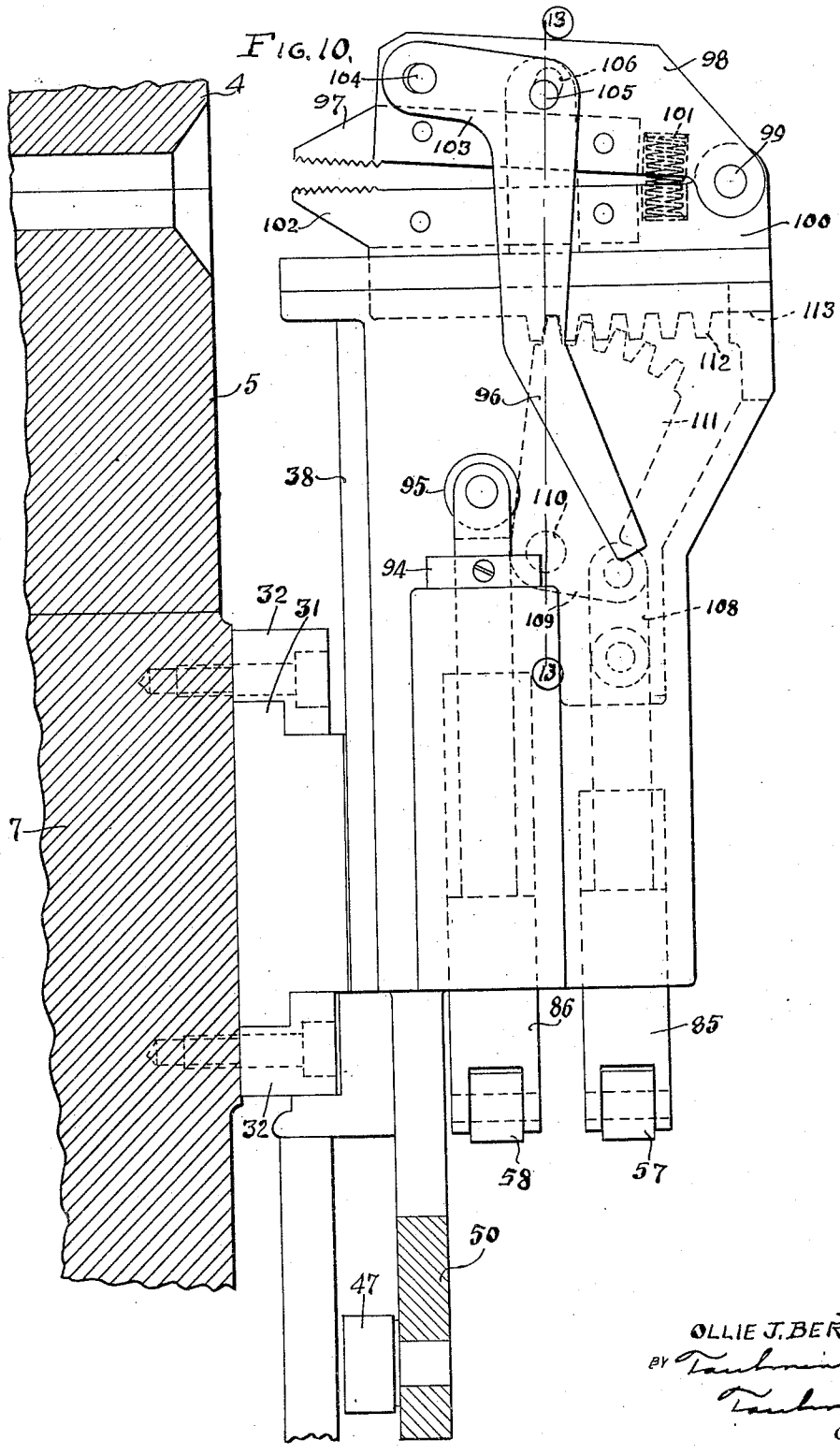
Inventor
OLLIE J. BERGER,
By Taubman & Taubman
Attorneys

Feb. 7, 1933. O. J. BERGER 1,896,692

AUTOMATIC FORGING MACHINE

Filed Sept. 30, 1929 14 Sheets-Sheet 8

FIG. 10.



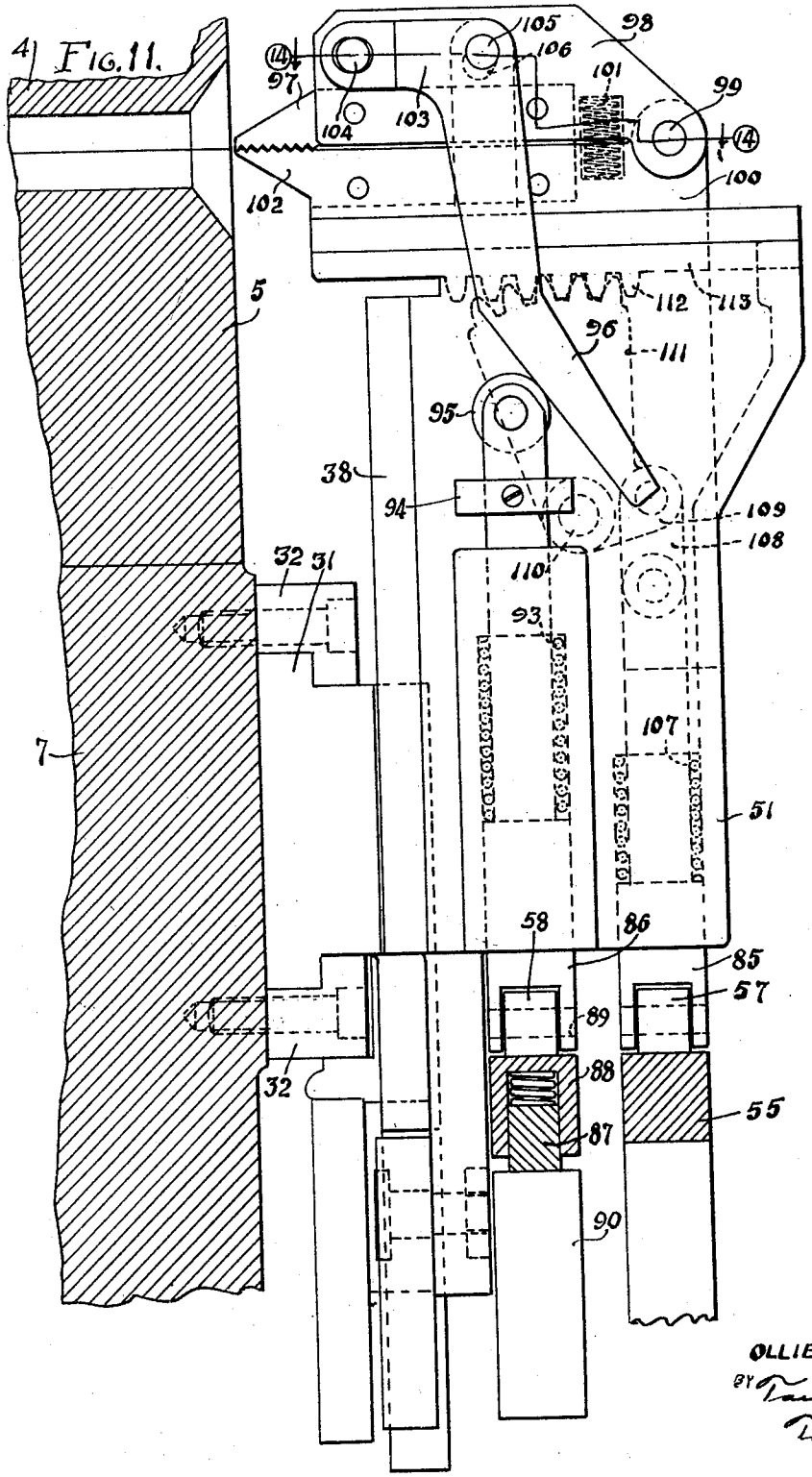
Inventor
OLLIE J. BERGER,
BY Taubman & Taubman
Attorneys

Feb. 7, 1933. O. J. BERGER 1,896,692

AUTOMATIC FORGING MACHINE

Filed Sept. 30, 1929 14 Sheets-Sheet 9

4) FIG. 11.



Inventor
OLLIE J. BERGER,
BY Taubman & Taubman
Attorneys

Feb. 7, 1933. O. J. BERGER 1,896,692

AUTOMATIC FORGING MACHINE

Filed Sept. 30, 1929 14 Sheets-Sheet 10

Fig. 12.

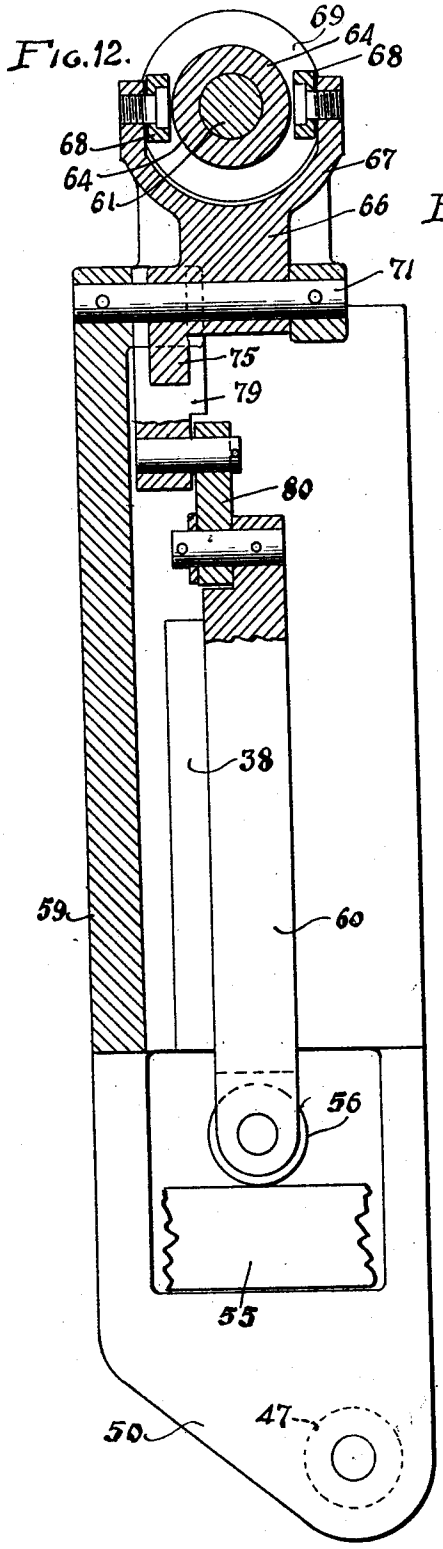
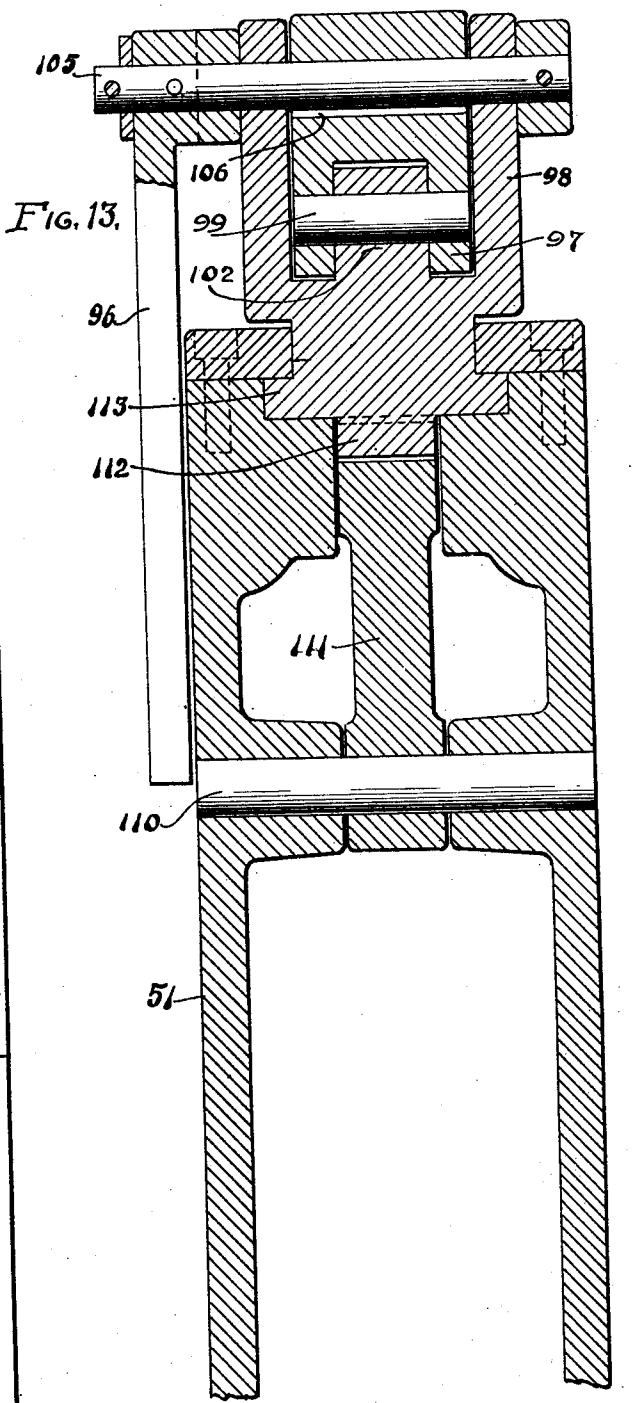


Fig. 13.



Inventor
OLLIE J. BERGER,
By Taubman & Taubman
Attorneys.

Feb. 7, 1933. O. J. BERGER 1,896,692

AUTOMATIC FORGING MACHINE

Filed Sept. 30, 1929 14 Sheets-Sheet 11

Fig. 14.

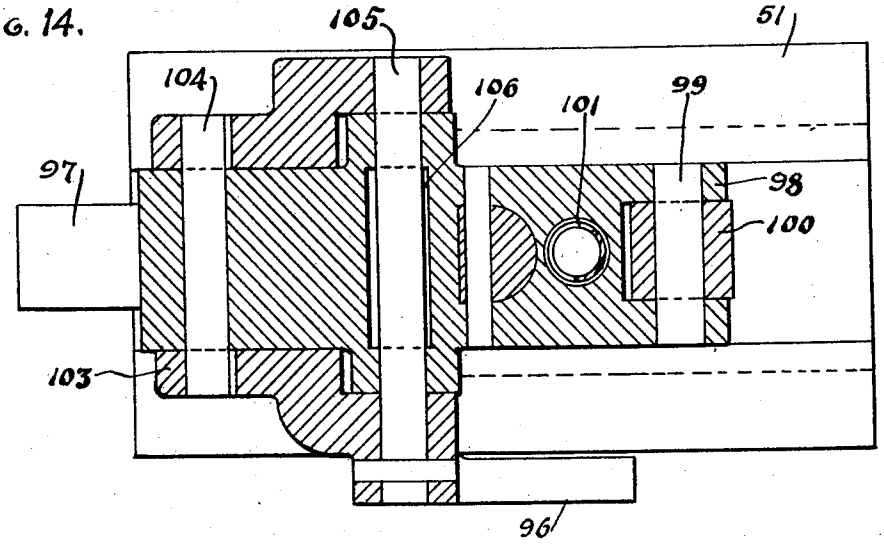
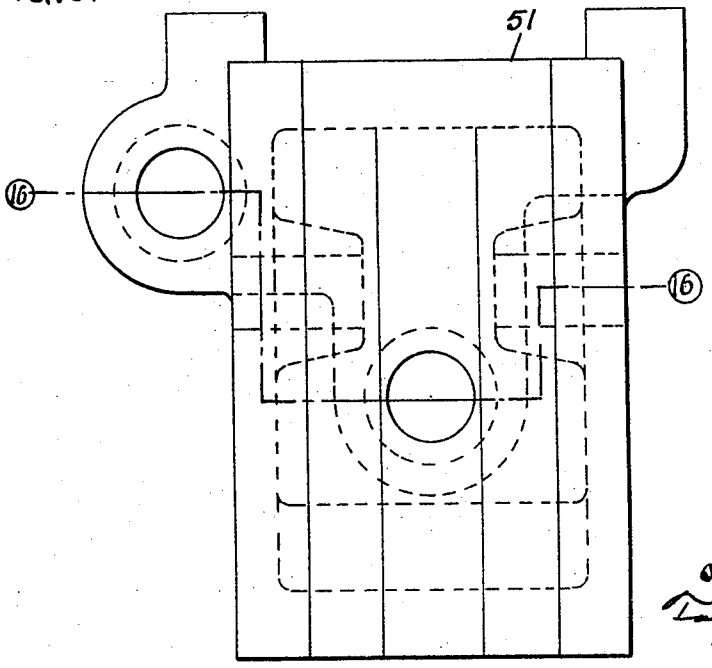


Fig. 15.



Inventor
OLLIE J. BERGER,
Taubman & Taubman
Attorneys

Feb. 7, 1933. O. J. BERGER 1,896,692

AUTOMATIC FORGING MACHINE

Filed Sept. 30, 1929 14 Sheets-Sheet 12

Fig. 16.

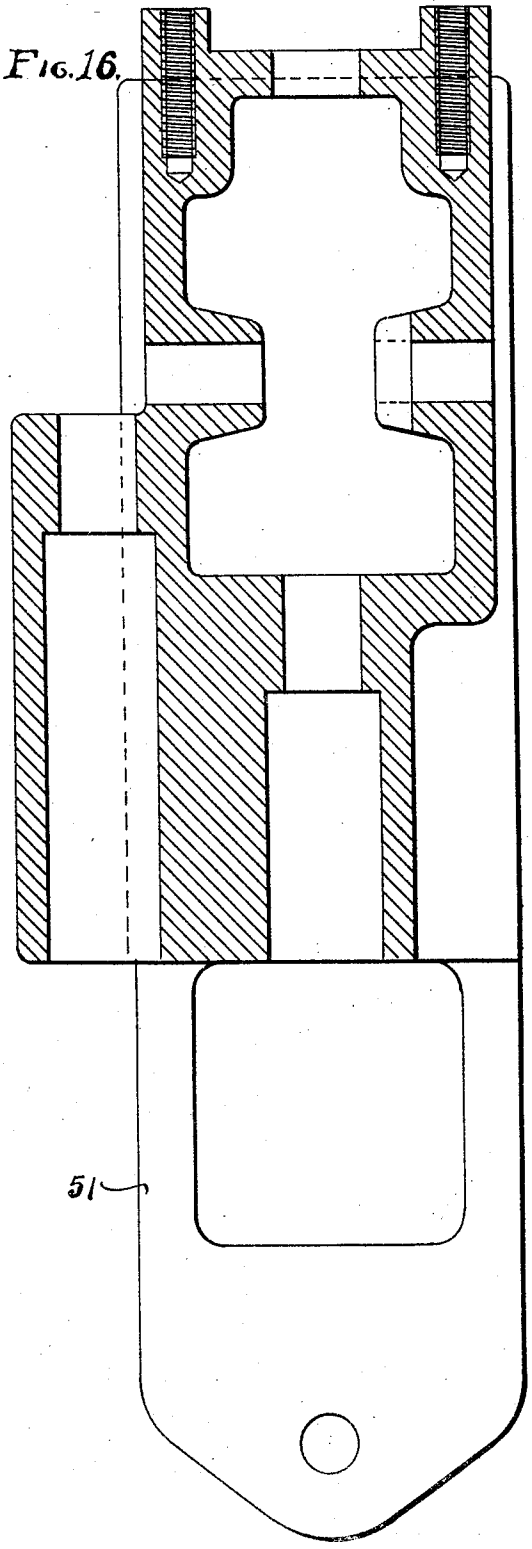
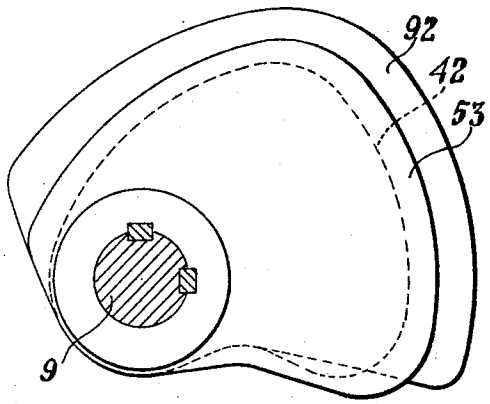


Fig. 26.



Inventor
OLLIE J. BERGER,
BY
Taulman & Taulman
Attorneys

Feb. 7, 1933. O. J. BERGER 1,896,692

AUTOMATIC FORGING MACHINE

Filed Sept. 30, 1929 14 Sheets-Sheet 13

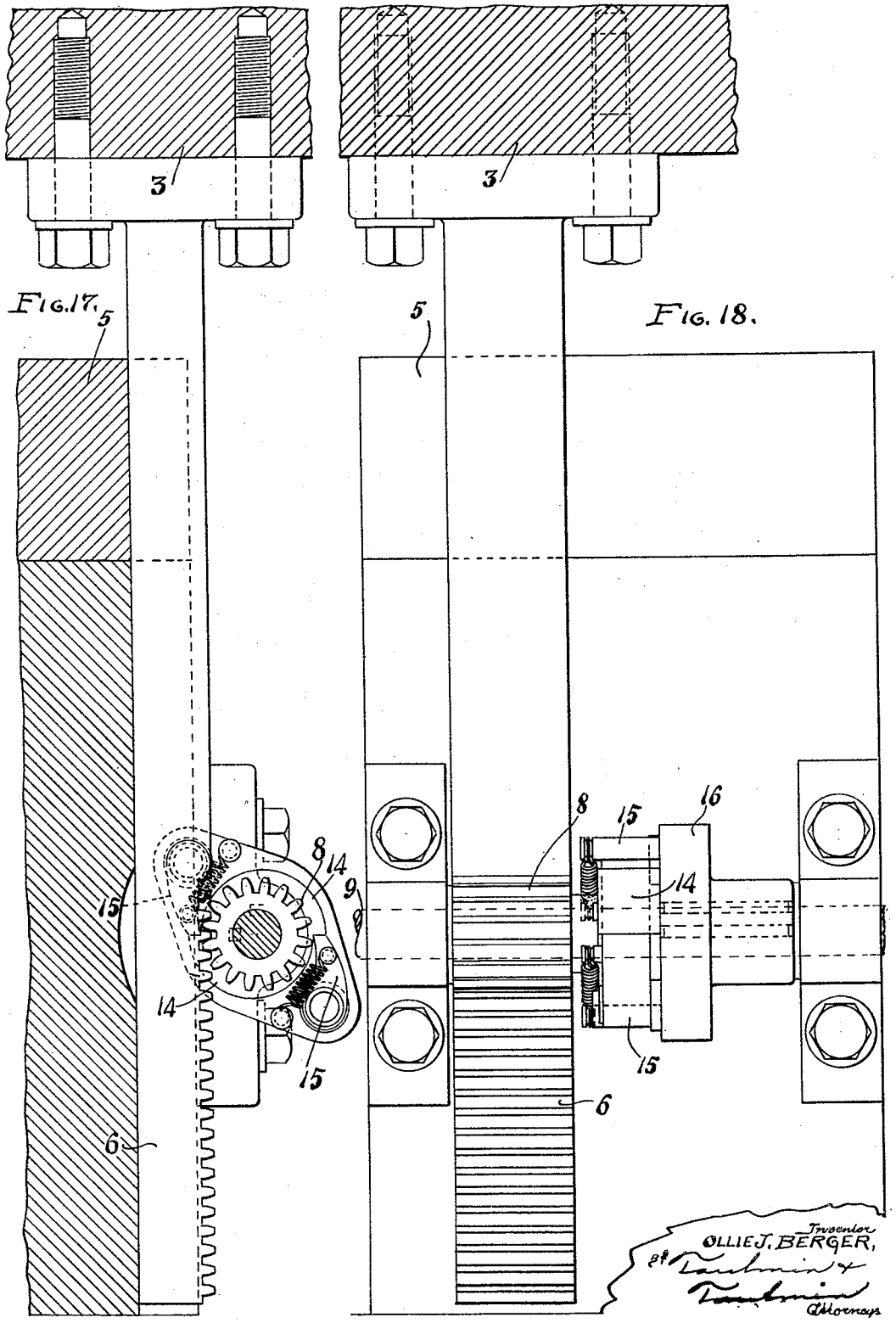


Fig. 17.

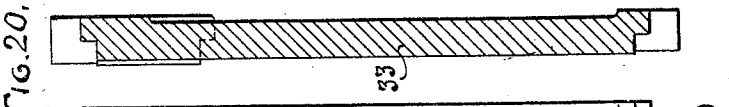
Fig. 18.

Feb. 7, 1933. O. J. BERGER 1,896,692

AUTOMATIC FORGING MACHINE

Filed Sept. 30, 1929 14 Sheets-Sheet 14

FIG. 20.



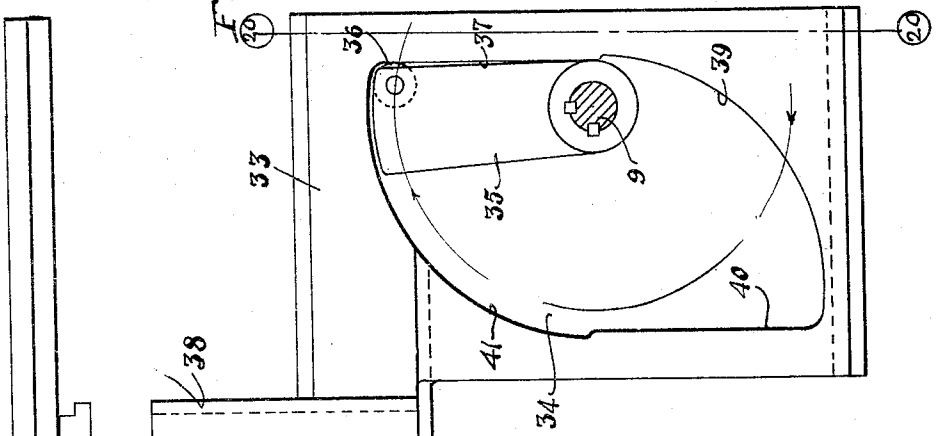
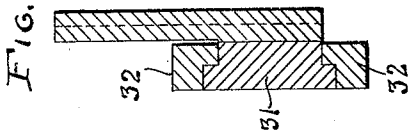


FIG. 22.

FIG. 19.

FIG. 21.



Inventor
OLLIE J. BERGER,
By Taubman & Taubman
Attorneys

Patented Feb. 7, 1933

1,896,692

UNITED STATES PATENT OFFICE

OLLIE J. BERGER, OF CHICAGO, ILLINOIS

AUTOMATIC FORGING MACHINE

Application filed September 30, 1929. Serial No. 396,161.

My invention relates to an automatic forging machine and a method of forging, particularly non-ferrous materials.

It is my object to provide a machine for forging and a method of forging by which articles may be formed of metal through its successive stages automatically handled from the furnace to a complete product and in such a manner that forging losses, scrap and the wear on forging dies will be reduced to a minimum.

It is my object to produce forging in groups automatically with the minimum of hand labor and to eliminate multiple forging machines and individual manual handling of each piece which is now the custom in the art. While my invention is designed of non-ferrous materials yet it is adaptable to ferrous materials.

It is the object of my method to provide slugs of metal of such diameter as to fill the die impression and to form by successive stages and successive dies utilizing the flash as a connector between the articles formed to retain them in groups and to facilitate their movement from one form position to another until finally finished when the flash is removed.

It is my object to provide preferably an automatic delivery of heated slugs, the movement of the slugs from the blocking operation to the finishing operation and thence to the trimming operation. It will be understood that any number of these steps may be employed according to the type of metal being handled and the design of forging.

It is a further object to provide means for maintaining the center distance between impressing to a fixed distance so as to permit of a synchronized, automatic picking up of a work unit and its movement to a next succeeding position for another operation.

It is my object to hold the flashing to a uniform weight and size to facilitate this purpose. By the automatic presentation of a standard size material always in the same position to the forming mechanism, it is possible to do this.

It is a further object to use less costly dies and to prolong their life by spreading the forging operations over a series of operations as the parts are automatically moved from one position to the other.

It is a further object to so design the mechanism that the forging dies can be made in section and doweled in place. Worn portions can therefore be easily replaced.

Referring to the drawings:—

Figure 1 is a side elevation of the machine partly in section;

Figure 2 is an end elevation thereof;

Figure 3 is a section on the line 3—3 of Figure 2;

Figure 4 is a section on the line 4—4 of Figure 2 showing in plan the arrangement of the machine with the upper half of the punch and die mechanism removed;

Figure 5 is a top plan view of the pincher mechanism;

Figure 6 is a top plan view of the jaw mechanism;

Figure 7 is a side elevation partially in section of the pincher mechanism; and

Figure 8 is a rear elevation of the pincher mechanism;

Figure 9 is a rear elevation of the jaw mechanism;

Figure 10 is a side elevation of the jaw mechanism in open position with the die members in section;

Figure 11 is a similar view with the jaw member closed;

Figure 12 is a section on the line 12—12 of Figure 7 through the pincher mechanism;

Figure 13 is a section on the line 13—13 of Figure 10 showing the jaw mechanism;

Figure 14 is a section on the line 14—14 of Figure 11 looking downwardly;

Figure 15 is a plan view of the jaw supporting mechanism with the jaws removed;

Figure 16 is a section on the line 16—16 of Figure 15 showing the jaw supporting casting in section;

Figure 17 is a detail elevation with the ram in section and the operated shaft in section showing the rack, pinion and pawl mechanism for intermittent operation of the operated shaft;

Figure 18 is a similar view showing the parts in elevation from one end thereof;

Figure 19 is a side elevation of the sliding bar with the cam for right and left movements with three vertical guides for the carriers attached;

Figure 20 is a section on the line 20—20 of Figure 19;

Figure 21 is a section on the line 21—21 of Figure 19;

Figure 22 is a top plan view of Figure 19;

Figure 23 is a fragmentary view showing the parts in connection with the pincher mechanism in position ready to trip;

Figure 24 is a similar view showing the parts with the spring released and the plunger on the downward stroke;

Figure 25 is a section on the line 25—25 of Figure 7;

Figure 26 is a side elevation of the operating cams.

Referring to the drawings in detail, 1 and 2 indicate guide frames for a ram 3 carrying the upper die 4 which is adapted to engage the lower die 5. The ram 3 actuates the rack 6. 7 is a foundation or bed for the mechanism. The rack 6 actuates in turn a pinion 8 carried on the driven shaft 9 which is supported by the brackets 10 mounted on the bed 7. Beveled gears 11 are mounted on either end of this shaft 9. These gears 11 mesh with driven beveled gears 12 carried by the driven shaft 13. This shaft 9 also acts as a cam carrying shaft which carries the cams for actuating the material handling mechanisms. The driven shaft 13 actuates a similar shaft 9 at the other end of the machine.

The pinion 8 and a ratchet 14 turn together loosely on the shaft 9. The ratchet 14 is engaged by pawls 15 which are pivoted on the plate 16 which is keyed to the shaft 9. Thus the shaft 9 makes one complete revolution for each press movement. Thus the press movement and the movement for actuating the material handling mechanism is synchronized, as the elevation of the ram permits actuating the material to a new position.

Method and apparatus for forming

Referring particularly to Figures 3 and 4, it will be noted that the lower die 5 carries a work receiving slot 17 adjacent to pin 18 to which is guided by the ram 19 from the furnace.

The work 20 in uniform, extruded rod form, cut to a predetermined length, as for instance 5 inches, is moved by the material handling mechanism of this invention to the blocking dies 21 and 22 where it is formed with a flash 23. Upon opening of the dies the plurality of formed blocks so forged are connected by the flash 23 and are moved as a unit to the finishing dies 24 and 25. From this point they are moved to the trimming dies 26 and 27. Hence the formed article 28 drops by gravity through the chute 29 while the flash 23 is blown to one side of the air nozzle 30. Any number of blocking and finishing operations may be provided for successive stages but I have simply shown the typical mechanism for each of these operations for the purpose of simplicity.

Material handling mechanism

It is my object to provide material handling mechanism which will move the raw material, semiformed material and finished material to and from the successive positions.

For this purpose I have provided mechanism that have these general movements:

(a) Move toward center of die to pick up the work;

(b) Raise up the work;

(c) Move the work to the right;

(d) Lower the work to its new position for a new operation;

(e) Release the work and move backwardly from the center of the die to the side thereof to permit the dies to close;

(f) Move to the left to the initial position for a new material handling operation.

All of the foregoing movements take place on the up stroke of the press. All parts remain stationary while the die closes. As soon as the die opens the above foregoing six movements are repeated.

In the drawings I have illustrated as attached to the block 7 supporting the lower die 5, a slide 31 held in place by guide plates 32 which permit being removed from left to right and right to left.

Mechanism for imparting fore-and-aft movement to the work

Carried on one end of the sliding bar 31 is a depending cam frame generally designated 33. It is a rectangular body forming a frame within which is a cam surface. Through the opening 34 in this frame projects the shaft 9 on which is carried the fore-and-aft cam 35 having a cam roller 36. The shaft 9, fore-and-aft cam 35 and its roller 36 travel in a clockwise direction. The vertical flat portion of the cam surface on the inside of the frame at 37 when engaged by the roller 36 will move the slide 31 and its associated material handling mechanism which are carried on the vertical slides 38 to the right hand. While the roller 36 is traveling on the arcuate cam surface 39 the mechanism is at rest as far as movement to either the right or left is concerned. While the roller 36 is traveling along the vertical cam surface 40 the mechanism is being moved back to the left hand side. While it is traveling along the cam surface 41 the mechanism is at rest so far as right and left hand movement is concerned.

During these periods of rest the material handling mechanism is either withdrawn while the form operation is taking place or

is being inserted to grasp the material at the end of the forming operation preparatory to moving the material to a new position due to the subsequent right hand movement of the slide 31 under the impetus of the cam 35 and its roller 36 engaging the surface 37.

Elevating and lowering mechanism for the work

The work is handled as hereinafter explained by the mechanism which grips it at either side to lift it and move it to a new position. This mechanism consists first of a pincher for grasping the raw stock and after the first formation of the raw stock with a flash, the work is then handled thereafter by jaws which grasp the flash at either end.

In order to perform the first of these operations that is, not lifting the work, I provide cams 42 on the shaft 9 which in turn engage cam rollers 43 that are carried on horizontally disposed bars 44 that have slotted ends 45 through which bolts 46 project for guiding the bars 44 in a vertical direction, such bolts being carried upon the base 7. As these cams raise and lower the work carriers, whether pincher or jaws, will be elevated due to the engagement of the rollers 47 with the side walls 48 of the slot 49 of the bars 44. These rollers are connected to the lower ends of the supporting work-handling frames, such as the pincher frame 50 and the file jaw frame 52 each of which is slidably mounted upon the dovetail guide 38 which guides in a vertical path. Such guide 38 is attached to the slide 31 so that the entire frame 50, 51 or 52 may travel with its roller 47 horizontally with the slide 31 by reason of the accommodation of the slot 49 in the horizontally stationary elevating bar 44 while the slide 38 accommodates the vertical movements of the frame 50, 51 and 52 by reason of engagement of the roller 47 and the slot 49 of the vertically movable bar 44.

Operating mechanism for the inward and outward movement of the working clamps

As the work must be engaged and disengaged and the pincher or jaws for that purpose must be moved inwardly or outwardly I have provided the following mechanism for effecting this inward and outward movement which also brings about, through associated mechanism as will be explained in connection with each of the work-handling groups, the clamping and unclamping of the work.

The movement of the work-engaging mechanism inwardly and outwardly is effected through the cam 53. There is an individual cam 53 mounted on either end of each shaft 9. This cam engages with a cam roller 54 mounted on the ends of a bar 55 which is likewise slotted at its end and guided on the pins 46. The roller 56 of the pincher mechanism and the rollers 57 and 58 of the respective jaw mechanisms ride on the top of this bar 55 and are elevated and lowered with their associated mechanisms as will be hereinafter explained in connection with each of those groups of mechanisms, such as the pincher mechanism and the jaw mechanism.

Thus the operating mechanism for handling the work, when the upper die is lifted with the ram by the inward movement of the work-engaging mechanism under the influence of cam 53 and the bar 55, engages the rollers 56, 57 and 58; then the work-engaging mechanism is lifted bodily through the influence of the cams 42 and bars 44 engaging the rollers 47 on the frames 50, 51 and 52; and then these frames are moved to the right hand because the frames are mounted on the guide 38 and carried on the slide 31 which is operated by the cam 35. The rollers 47, 56, 57 and 58 permit of horizontal movement with respect to the bars 44 and 55 without disturbing the relationship of those parts for vertical movement. Upon termination of the right hand movement of the work carriers with their work the bars 44 and 55 descend allowing the work first to be lowered into position in the new location and then for the work-engaging means to disengage the work and be withdrawn by the lowering of the bar 55 whereupon the cam 35 operating eventually upon the slide 31 and the guides 38 will restore the work-engaging means, frames 50, 51 and 53 to the initial position during which period the upper die 4 and the ram 3 will descend for another operation upon the work in its new positions.

Pincher mechanism

The pincher frame 50 which carries the roller 47 at its lower end and the inside of which is guided on the slide 38 is provided with a tubular portion 59 that carries the plunger 60 on the lower end of which is the roller 56 which engages the top of bar 55. With this plunger 60 is connected the mechanism for moving the pincher 61 into and out of engagement with the work. The upper end of this frame 59 is provided with a horizontally disposed guiding sleeve 62 in which operates a piston 63 and a piston rod 64 against a spring 65. Monuted on this piston rod 64 which with the piston 63 forms a sleeve for supporting the pincher 61, is a yoke 66 having arms 67 on the end of which arms are the rollers 68.

Mounted between on either side of the rollers are shoulders 69 carried by the sleeve 64, the shoulder 70 carried by the pincher 61. The roller 68 works between these shoulders.

The yoke 66 is mounted on the pin 71 carried on the ear 72 of the frame 50. This yoke 66 is provided with a laterally extending

finger 73 which engages with the cam nose 74 of a pivoted trigger 75 which is pivoted at 76 between the jaws 77 of a bell crank, one arm of which 78 carries the jaws 77 and the other arm of which 79 is connected to the link 80 that in turn is pivotally connected to the slide 60. This bell crank is pivoted to the frame 50 at 81. The arm 78 of the bell crank is provided with a spring 82 for engaging the finger 75. It is also provided with a shoulder 83 which acts as a stop for the nose 84 of the finger 75. The operation of the pincher is as follows as will be seen from the successive positions in Figures 7, 23 and 24. In Figure 7 the parts are in position for the plunger 60 to move upwardly to withdraw the pincher 61 and piston sleeve 64 with piston 63 against the spring 65 which withdrawing movement continues until the parts are about in position shown in Figure 23 where the finger 73 is about to slip off of the cam surface 74 of the trigger 75. The mechanism is now in position ready to trip with the spring 65 compressed.

The plunger 60 continues its upward movement to the end of its stroke and then upon its downward stroke as shown in Figure 24, the finger 75 can ride over the nose 73 against the resistance of spring 82.

Clamping mechanism

A single one of the clamping mechanism will be explained but it will be understood that they are similar in construction so that an explanation of one will explain all. The frame 51 carrying the roller 47 slides vertically in the guide 38 of the transverse slide 31. This frame 50 carries the slides 85 which support the rollers 57 that move the jaws forwardly and backwardly and the slide 86 which actuates the clamping and unclamping of the jaws.

Jaw clamping and unclamping mechanism

The slide 86 carries a spring-pressed friction member 87 in a cup 88 pivoted on the slide 86 at 89. The member 87 rides upon the transverse bar 90 which carries rollers 91 at the end thereof that ride upon the surface of the cam 92. There is a cam 92 mounted on the shaft 9 at each corner of the machine. Thus the slide 86 is reciprocated against its spring 93 within the casing 51. The upper end of the slide 86 is provided with a shoulder 94 for limiting its downward movement under the influence of spring 93. This upper end carries a roller 95 that engages with the depending arm 96 that actuates the movable jaw 97 that is detachably carried in the pivoted jaw carrier 98 that is pivoted at 99 upon the stationary jaw carrier 100. Between these two carriers is a spring 101 which resists the closing movement of the jaw carrier 98 with respect to jaw carrier 100 which brings together the movable jaw 97 and the stationary jaw 102.

By utilizing removable jaws different thicknesses of work can be accommodated and different lengths.

The depending lever 96 is provided with horizontally disposed upper end 103 which is loosely mounted on the pin 104 on the forward end of the movable jaw carrier 98. It also carries a pin 105 which is loosely mounted in the slot 106 in the jaw carrier 98. Thus the lever comprising arm 96 and 103 is moved to closed position by the roller 95 in connection with the lever 96 and moved to open position by the spring 101 when it is permitted to operate by the withdrawal of lever 96 from engagement with the roller 95.

Mechanism for moving jaws inwardly and outwardly

As heretofore described the bar 55 engaging the roller 57 will actuate the slides 85 within the casing 51. This will be against the resistance of spring 107. The upper end of slide 85 is connected to a pitman 108 that in turn is connected to a bell crank 109 pivoted at 110 the other arm of which is formed into a segmental rack 111 engaging the teeth 112 of rack 113 that is formed on the bottom of the stationary jaw carrier 100, which is slidably mounted in the upper end of the casing 51.

The bar 90 guided by the depending guide member 114 operates within the base 7.

Summary of method of operation

When the work 20 rolls down the incline 19 into the trough 17 against the stops 18 the ram is down and is just about to lift the upper die 4. As the ram lifts the rack 6 it actuates the shaft 9 as heretofore described which sets in motion the cams 35, 42, 53 and 92. The first movement is effected through the cam 42 which elevates the carriers in their uppermost operating position.

It will be understood that I desire to comprehend within my invention such modifications as may be clearly embraced within the scope of my claims and invention.

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

1. In a work-clamping and moving means, stationary and movable jaws pivoted to one another, yielding means spreading said jaws, a lever for closing said jaws, a vertical slide for engaging said lever to close the jaws, a support for said slide and for slidably supporting said jaws, a second vertical slide on said support, a segmental rack pivoted on said support operatively connected with said second slide and a rack on said jaws operatively engaged by the segmental rack for reciprocating said jaws on said support where-

by successive movement of said slides will close the jaws and reciprocate them.

2. In a work-clamping and moving means, stationary and movable jaws pivoted to one another, yielding means spreading said jaws, a lever for closing said jaws, a vertical slide for engaging said lever to close the jaws, a support for said slide and for slidably supporting said jaws, a second vertical slide on said support, a segmental rack pivoted on said support operatively connected with said second slide, a rack on said jaw operatively engaged by the segmental rack for reciprocating said jaws on said support whereby successive movement of said slides will close the jaws and reciprocate them, means for moving vertically said support without disturbing the jaw operating mechanism and means for moving horizontally the foregoing mechanism without disturbing its operation.

3. In a forging machine including several sets of dies for successive operation of the workpiece, a manipulator including a pair of movable jaws situated on opposite sides of the machine for gripping each end of a workpiece, each jaw having means for reciprocating the same to clear the dies, means for moving the jaws horizontally to gripping position, and means for moving the jaws past the several sets of dies for successively placing the workpiece therein, in combination with means for operating said several means in unison for the simultaneous actuation of said jaws for manipulating said workpiece through said machine.

4. In a forging machine including several sets of dies for successive operation of the workpiece, a manipulator including a pair of movable jaws situated on opposite sides of the machine for gripping each end of a workpiece, each jaw having means for reciprocating the same vertically to clear the dies, means for moving the jaws horizontally to gripping position, and means for moving the jaws past the several sets of dies for successively placing the workpiece therein, in combination with means for operating said several means in unison for the simultaneous actuation of said jaws for manipulating said workpiece through said machine.

In testimony whereof, I affix my signature.

OLLIE J. BERGER.