

March 27, 1934.

F. L. BUSH ET AL

1,952,491

FORGING MACHINE

Filed Dec. 2, 1929

5 Sheets-Sheet 1

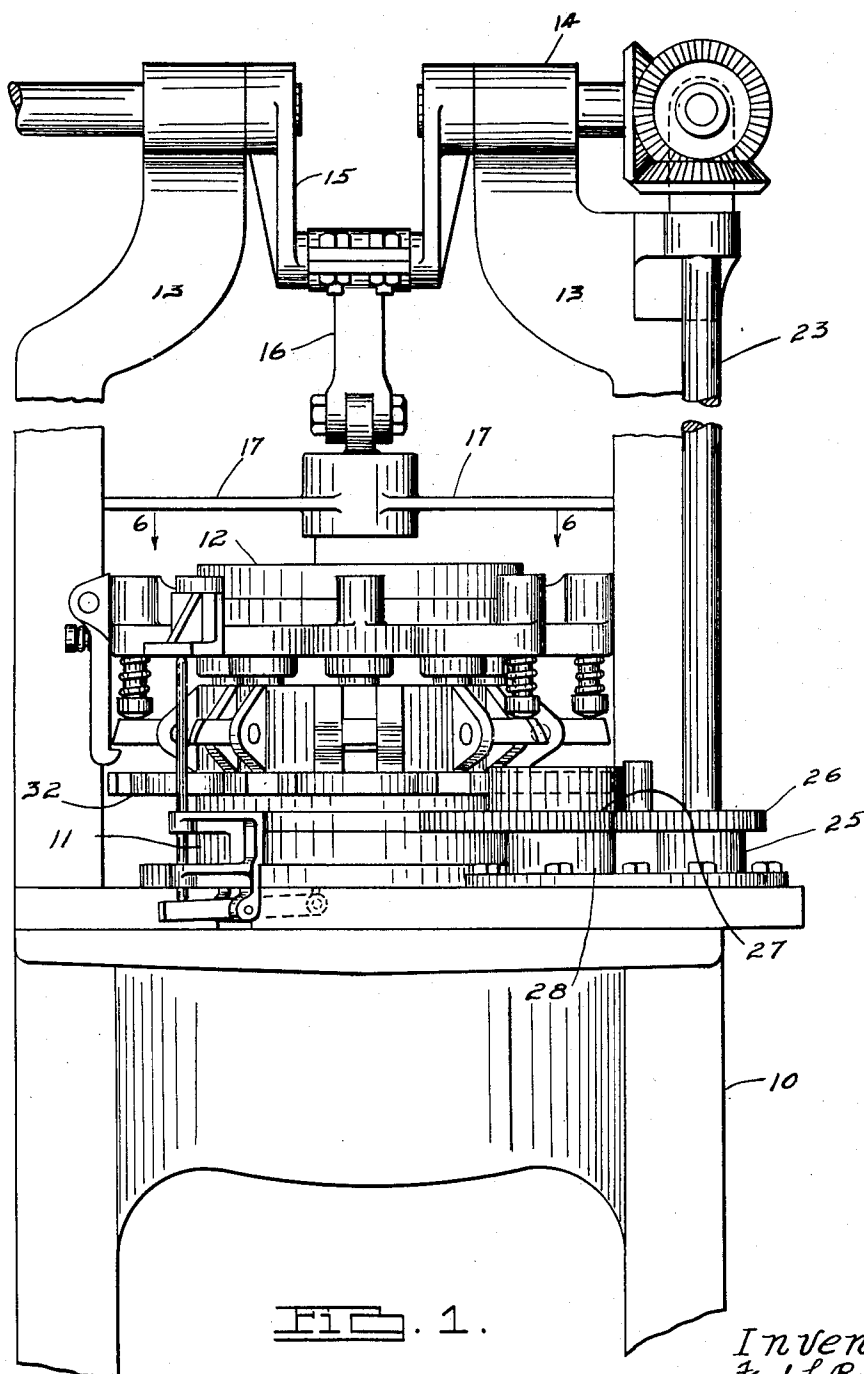


FIG. 1.

Inventor
Fred L. Bush
James E. Hill
Richard Hewig
by Harman Diskey, Counsel
Attorneys.

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F. L. BUSH ET AL

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5 Sheets-Sheet 2

FIG. 2.

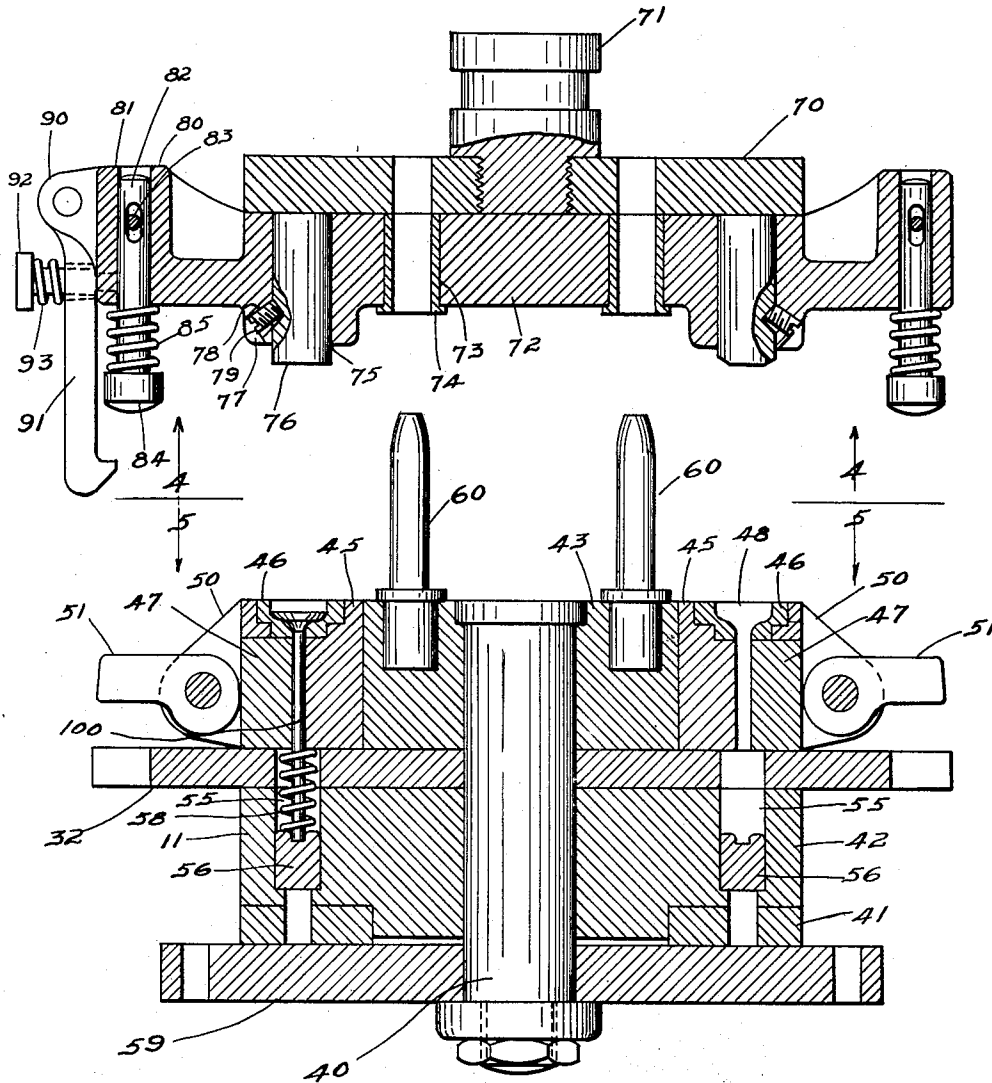


FIG. 3.

Inventor
 Fred L. Bush
 James B. Hill
 Richard H. Hering
 Harry L. Kirk, Jr.
 Attorneys.

March 27, 1934.

F. L. BUSH ET AL

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5 Sheets-Sheet 3

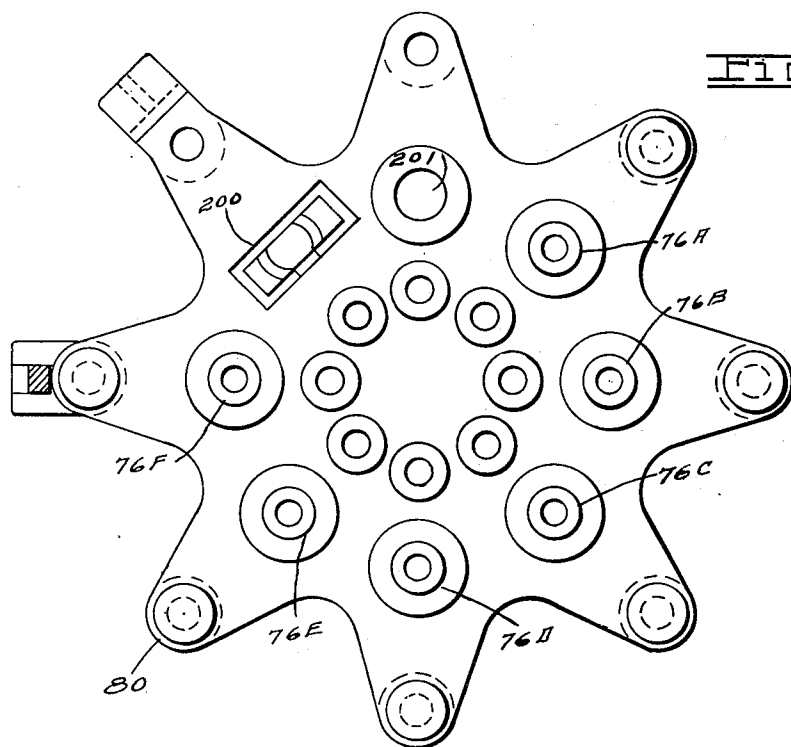
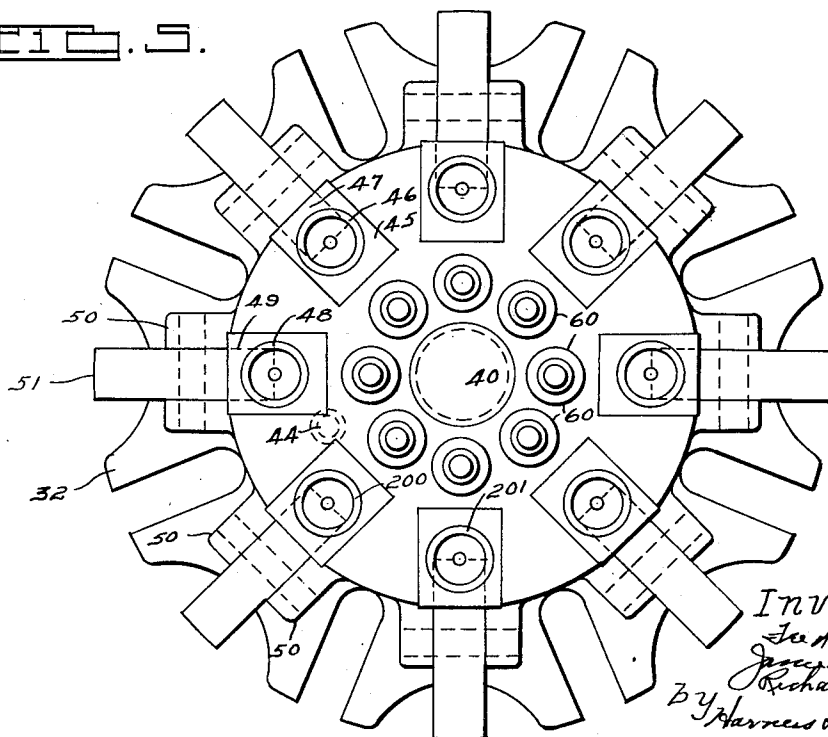


FIG. 5.



Inventor
F. L. Bush
James B. Hill
Richard H. H. H.
By *Harmon Siskin* *Curran*
Attorneys.

March 27, 1934.

F. L. BUSH ET AL

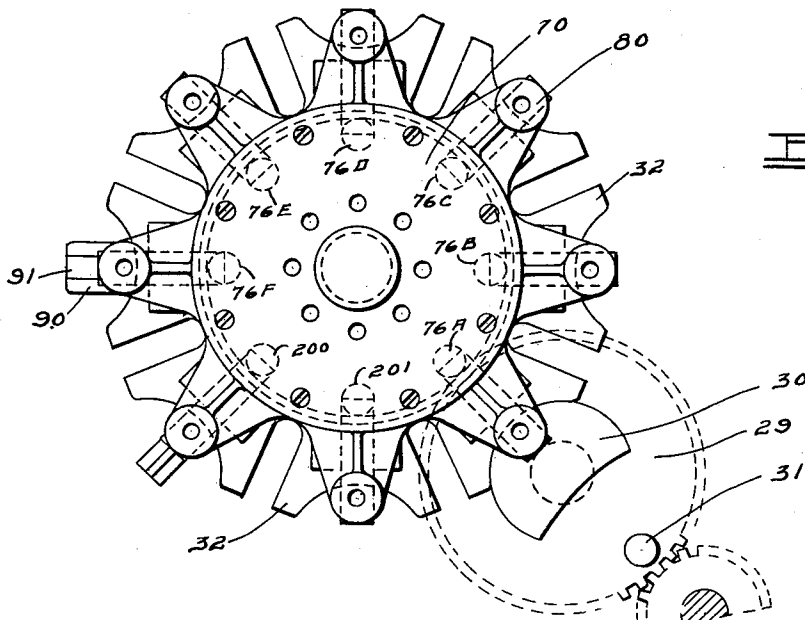
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5 Sheets-Sheet 4

FIG. 6.



100 X

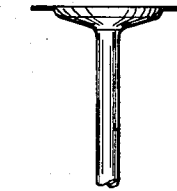


FIG. 6A.

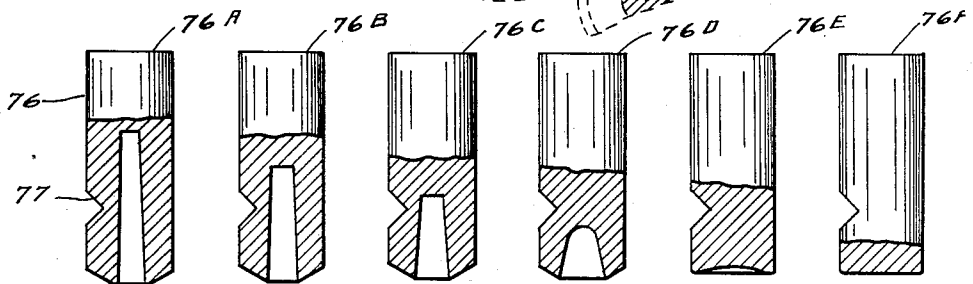


FIG. 7.

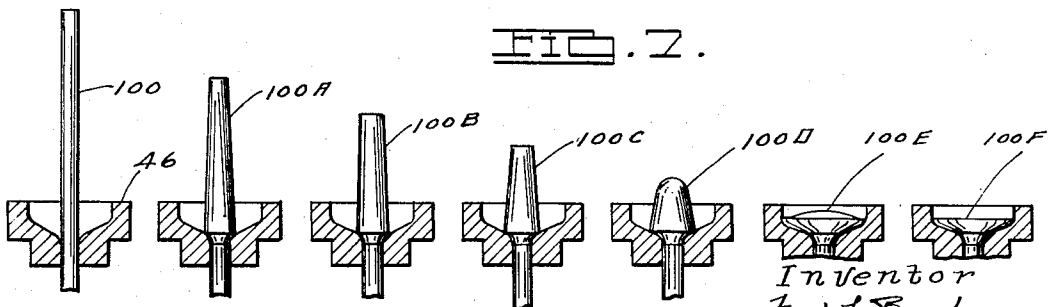


FIG. 8.

Inventor
Fred L. Bush
James C. Hill
Richard Herring
by
Harness Dickey Pearce
Attorneys.

March 27, 1934.

F. L. BUSH ET AL

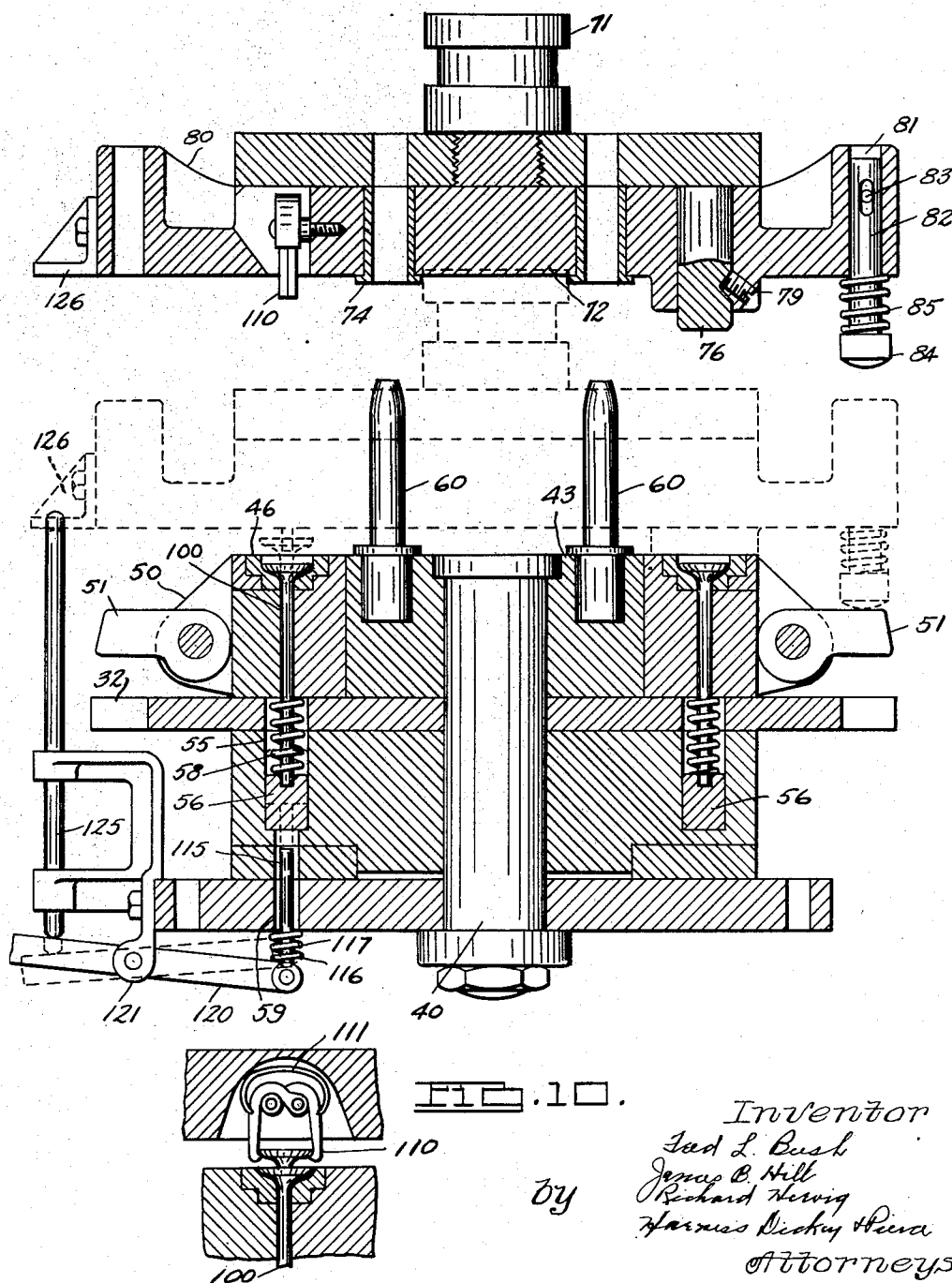
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FORGING MACHINE

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5 Sheets-Sheet 5

FIG. 9.



Inventor
 Fred L. Bush
 by James C. Hill
 Richard Newing
 James Dickie & Pina
 Attorneys.

UNITED STATES PATENT OFFICE

1,952,491

FORGING MACHINE

Fred L. Bush, James B. Hill, and Richard Hervig,
Battle Creek, Mich., assignors to Wilcox-Rich
Corporation, a corporation of Michigan

Application December 2, 1929, Serial No. 410,958

6 Claims. (Cl. 78—13)

This invention relates to forging machines of the type which simultaneously perform roughing and finishing operations upon a plurality of work pieces. The principal object of the invention is to provide a machine and a method for completely forming valves for internal combustion engines or like headed articles from blank stock.

Another object of our invention is to provide a machine and a method by which internal combustion engine valves or like articles may be completely forged without forming flash or salvage edge around the valve head.

Another object of the invention is to provide efficient means for securing the work pieces in the dies for each forging operation.

Another object of our invention is to provide means for releasing and removing the forging which is finished at each stroke of the machine.

With these and other objects in view our invention consists in the arrangement, combination and construction of the various parts of our improved device and the practice of our method, as described in the specification, claimed in our claims, and shown in the accompanying drawings, in which:

Fig. 1 is an elevation of the machine.

Fig. 2 is a vertical sectional view through the slide part of the machine positioned above the anvil part shown in Fig. 3.

Fig. 3 is a vertical sectional view of the anvil part.

Fig. 4 is a plan view of the under side of the slide part of the machine, looking in the direction of the arrows 4—4 in Fig. 2.

Fig. 5 is a plan view of the anvil part of the machine looking in the direction of the arrows 5—5 in Fig. 3.

Fig. 6 is a plan taken as indicated by the arrows 6—6 of Fig. 1.

Fig. 7 is an elevational view partly in section, of the various gathering and coining or finishing punches carried by the slide portion of the machine.

Fig. 8 is a vertical sectional view of the dies carried by the anvil part of the machine, with work pieces in their various forms positioned therein opposite the proper forming dies.

Fig. 8a is a vertical sectional view of a valve having a flash or salvage edge around the head which results from the present practice in forming valves and which our machine is designed to avoid.

Fig. 9 is a sectional view of the slide and anvil taken in vertical plane to illustrate the de-

vices for removing finished work from the machine.

Fig. 10 is a sectional detail of the device for lifting the finished valve from the anvil.

Our invention is illustrated in its embodiment in a machine for forging valves for internal combustion engines. Such valves are ordinarily formed from round bar stock by hot forging and upsetting one end of the bar to form the valve head and seat. Heretofore the blank has been formed up to the shape indicated by 100D in Fig. 8 by an upsetting machine and then to the form shown in Fig. 8a by a hammer which leaves a flash or salvage edge 100X which must be taken off in a separate operation. The use of different machines to complete the forging operations necessitates a transfer of the work from one machine to another. We have provided a single machine which will perform all the necessary forging operations on the work and turn out a completed forging without a flash or salvage edge at each stroke. The slight burr left around the edge of the valve head may be removed in the grinding operations in finishing up the valve. We have therefore effected a saving in machinery, labor and material.

Our machine is in the form of a press and comprises a reciprocating ram or slide which carries the upsetting punches, and a rotatable dial-like anvil member positioned in the path of the slide, which carries dies having the impression of the ultimate form of the forging, and which register with the upsetting punches carried by the slide. The anvil member is designed to hold the work pieces, and is rotated under the slide to bring the work pieces in successive register with the different punches carried by the slide, by means of a Geneva wheel actuated through gears and a shaft which are connected to the power shaft which operates the slide. The Geneva wheel may, of course, be driven separately if desired.

Referring to Fig. 1 the numeral 10 indicates generally the standard upon which the machine is supported. The numeral 11 indicates generally the rotating dial-like anvil of the press. The numeral 12 indicates generally the slide which reciprocates relative to the anvil. Side stanchions 13 are provided on each side of the working members, and the main power shaft 14 is journaled in their upper ends. The power shaft is provided with a crank member 15 and a connecting rod 16 connects the crank with the slide 12. The stanchions 13 are provided with inwardly facing guide grooves (not shown) in which the guides 17, extending from either side of the slide,

work. A vertical shaft 23 is suitably geared at its upper end to the main power shaft 14, and has its lower end fitted in a bearing 25 on the bed of the press. A pinion 26 is attached to the lower end of the shaft 23 and engages a second pinion 27 journaled in an adjacent bearing 28 on the bed plate of the machine. On the upper surface of the gear 27 is secured the driving pin and stop cam of the Geneva wheel. This is shown more clearly in Fig. 6. The driving member of the Geneva wheel is designated generally by the numeral 29, the stop cam being designated by the numeral 30, and the driving pin or roller by the numeral 31. The driven member of the Geneva wheel, designated generally by the numeral 32, is secured to the anvil member 11 in a position to engage the driver 29.

The anvil member 11 is positioned and secured upon the bed plate of the machine by the pin 40 (Fig. 3) which constitutes the vertical axis of the anvil. A circular track member 41 is also secured to the bed plate around the pin 40 and serves as a track upon which the anvil 11 rotates. The anvil 11 comprises generally two parts, a lower part 42 upon which is placed the driven member 32 of the Geneva wheel, and the upper part 43 which is placed upon the upper side of the Geneva member 32. The members are all secured together by stud bolts 44 shown in Fig. 5.

Radially positioned and inset in the peripheral portion of the part 43 and equally spaced from each other are a number of blocks 45 in which are positioned the lower forming dies 46 which are all of the same shape, i. e., that of the finished valve. The lower outer portions 47 of the die blocks 45 are movable and are divided from the remainder of the blocks 45 along the line of a vertical plane passing through the center of the dies 46 at right angles to the radius of the anvil 11. This line is indicated by the numeral 48 in Figs. 3 and 5. These portions 47 are also divided from the remainder of the blocks 45 along the dotted lines indicated by the numeral 49 in Fig. 3. These portions 47 are slidable radially of the anvil 11 in order that they may be moved to grip and clamp the work pieces in the die. A pair of outwardly projecting ears 50 (Figs. 3 and 5) are formed on the peripheral edge of the upper portion 43 of the anvil on each side of the blocks 45, and pivotally supported between each pair of ears is a cam member 51 which is operable to crowd the movable block 47 inwardly against the blank positioned in the die block 45. When the cam members 51 are loosened, the blocks 47 are free to slide outwardly and release the work pieces for removal.

A well 55 is provided below each die block 45 and extends through the Geneva member 32 and into the lower portion 42 of the anvil. These wells are considerably larger than the opening through the die block in which the work pieces are clamped. The lower ends of these wells are shouldered and a plug 56 is positioned in each of them and supported by the shoulders formed therein. The plugs 56 are slidable in the wells and are designed to support the lower ends of the work pieces designated generally in Fig. 3 by the numeral 100. Coil springs 58 are positioned in each of the wells 55 and bear at one end against the plugs 56 and at the other against the bottoms of the die blocks 45 and are tensioned to maintain the plugs 56 in their lowermost positions. The wells 55 are extended in reduced bore through the bottom of the anvil member 42. A registering opening 59 is provided in the track 41 and

extends through the bed plate of the machine and will register with the wells 55 as they move to the unloading position of the anvil, and a kicker mechanism, hereinafter described, is positioned to operate a plunger through the opening 59 against the bottom of the plug 56 to kick the work piece 100 upwardly out of the die block 45 and the die 46.

Tapered guide pins 60 are secured in the upper part 43 of the anvil and extend upwardly thereabove, as shown in Fig. 2, and are adapted to register and enter suitable tapered bushings in the slide member 12.

The slide member 12 comprises generally a circular disc 70 in the central portion of which is secured the member 71 to which the guide slides 17 and connecting rod 16 are attached. To the under side of the disc 70 is secured by suitable stud bolts (not shown) a disc-like member 72 in which are openings 73 fitted with bushings 74 adapted to accommodate the guide pins 60. The openings 73 extend upwardly through the top disc 70. The peripheral portion of the disc member 72 is thickened and provided with sockets 75 in which are secured the upsetting punches designated generally as 76. The punches 76 are provided with notched portions 77 in their sides, more clearly shown in Fig. 7, designed to register with a diagonal threaded aperture 78 in the periphery of the disc 72 and in which a screw stud 79 is turned to engage in the notch 77 and secure the punch 76 in the socket 75. The punches 76 are arranged to register with the dies 46 in the anvil member 43 upon reciprocation of the slide.

Formed on and extending radially from the peripheral edge of the disc member 72 are brackets 80 in radial alignment with the punches 76. The outer ends of the brackets 80 are vertically elongated and provided with a vertical bore 81. Slidably positioned in this bore is a pin 82 which extends downwardly through the lower end of the bore. The pin 82 is secured in the bore 81 by means of a cross pin 83 which extends diametrically of the bore through an elongated slot in the pin, as shown clearly in Fig. 2. The extreme lower end of the pin 82 is formed with an enlarged head 84 and between the head and the lower end of the bracket 80 and around the pin 82 is positioned a coil spring 85 tensioned to force the bolt 82 downwardly and to act as a cushion when the head of the bolt 84 encounters the cam tightener 51 on the anvil member when the slide is moved downwardly to engage the anvil. The brackets 80 are provided opposite every punch socket in the slide. The pins 82 are omitted from the brackets at the unloading and loading stations, as the work clamps in the dies are not operated at those stations.

The end of the bracket 80 which is opposite the finishing punch shown to the right in Fig. 2, is provided with a pair of ears 90 between which is pivotally supported a hook 91 which is adapted to slip over the end of a cam tightener 51 on the anvil when the slide is moved to its lowermost position, and engages the under side thereof and lift the cam tightener 51 when the slide moves upward on its return stroke. This loosens the cam tightener 51 at the end of the stroke of the finishing punch and permits the block 47 to be slid outwardly so that the work piece may be removed. A stud bolt 92 passes through the shank of the hook 91 and is turned into the end of the bracket 80. The aperture in the hook 91 is large enough so that the shank may move longitudinally on the bolt 92. Between the head of the

bolt 92 and the shank of the hook 91 and around the shank of the bolt 92, is positioned a coil spring 93 tensioned to hold the hook in position to engage the cam tightener 51.

5 Referring now to Figs. 7 and 8, it will be observed that the work pieces are upset and finished by six different operations which necessitate the use of six punches, or more or less, depending upon the type of valve being made and the stock used. The punches which appear in line in Fig. 10 7 are designated generally by the numeral 76. The dies which are positioned in line in Fig. 8 and beneath the punches, are designated generally by the numeral 46, and the work pieces shown 15 in the dies 46 are designated generally by the numeral 100. The punches are designated as 76a, 76b, 76c, 76d, 76e, and 76f, in the order of their operation upon the work pieces. The dies 46 are all of the same configuration, while the 20 punches are of different configuration. The dies 46 are made deep and the punches, particularly the finishing punches 76e and 76f, are made to fit the dies exactly so that no edge flash such as indicated at 100X in Fig. 8a will be formed. The 25 dies are also made solid so that no joint flash will be formed in the valve head. The anvil member is provided with eight of the dies 46 equally spaced in the peripheral portion of the anvil 43. The hammer is provided with six punches shown 30 in Fig. 7, equally spaced about the peripheral portion thereof to register with the dies 46 and engage the work therein when the hammer is reciprocated. The two extra stations for dies in the anvil are to provide unloading and loading 35 stations.

40 The form of the blank 100 from which the valve is forged is that shown in the die at the left in Fig. 8. The lower portion of the blank is broken away but it extends through the die 46 and the block 45 and its lower end rests upon the plug as 46 shown in Fig. 2.

In Fig. 6 the numerals 200 and 201 designate the unloading and loading stations respectively. These stations are also designated in Fig. 4.

45 The means for removing the finished work from the machine is shown in Figs. 9 and 10. The punch socket 76 in the slide that registers with the unloading station 200 is formed to permit a pair of tongs 110 to be mounted therein. Each of 50 the tongs is hung on a separate pivot in the opening and a band spring 111 is positioned in the opening 76 with its ends bearing upon the backs of the tongs and normally tending to force the free ends of the tongs together. The free ends 55 of the tongs are rounded and hooked and adapted to slide over the valve head and hook thereunder. Positioned in the opening 59 in the bed plate of the machine is a rod 115. A collar 116 is secured to the lower end of the rod 115 and forms a bearing for one end of a coil spring 117 which is 60 positioned around the rod and bears against the under side of the bed plate and is tensioned to force the rod downwardly. A lever 120 is pivotally hung between a pair of ears 121 secured to the under side of the bed plate. One end of the lever bears against the end of the rod 115 and the other end against an operating rod 125 which extends through the bed plate at one side 65 of the anvil. The top of the rod 125 is struck, on the downstroke of the slide, by a member 126 secured to that bracket 80 on the slide, which is positioned above the unloading station 200, and by means of the lever 120 causes the rod 115 70 to strike the plug 56 and force the finished valve

upwardly from the die and against the ends of the tongs 110, which spread apart and hook under the valve head and lift the valve clear of the anvil on the return stroke of the slide. The operator removes the finished valve from the 80 tongs.

In operation, the blank 100 is inserted in the die 46 which is at the loading station 201. The machine is started and, by means of the Geneva 85 wheel, which is timed to rotate the anvil through one-eighth of its circumference at each movement, will move the die 46 containing the blank 100 to a position immediately beneath the first gathering punch 76a. As the blank reaches this 90 position the hammer comes down and causes the punch 76a to strike the blank 100, gathering it to the form indicated by the numeral 110a in Fig. 8. The next movement carries the work beneath the punch 76b where it is again struck, and each successive movement carries it beneath 95 the punches 76c, 76d, 76e, 76f. The punches 76a, 76b, 76c, 76d and 76e are gathering or roughing punches, and they form the blank successively as shown in Fig. 8. The punch 76f is the finishing or coining punch, and strikes the blank to 100 the ultimate valve shape shown at the extreme right in Fig. 8, and without leaving any flash around the head. After the finishing stroke the anvil moves the die and valve to the unloading position 200 and the kicker mechanism previously 105 described operates to remove the finished valve.

When the slide comes down against the anvil, the bolt heads 84 strike the ends of the cam tighteners 51 and cause the blocks 47 to be forced 110 tightly against and clamp the work pieces securely in the die blocks 43. At the finishing station, and as the hammer moves upwardly from the stroke, the hook 91 releases the cam tightener 51 so that the block 47 may slide outwardly when the work piece is struck by the 115 kicker mechanism at the unloading station.

When the machine is in full operation, six work pieces are being operated upon simultaneously. One piece is being struck by the first 120 gathering punch 76a, another by the second gathering punch 76b, another by the third gathering punch 76c, another by the fourth gathering punch 76d, another by the fifth gathering punch 76e, and the sixth by the finishing punch 76f. 125 As the slide moves upwardly the anvil is rotated so that the die carrying the finished valve moves to the unloading station 200 where upon the next movement of the slide it is removed as previously explained. The die then indexes to the loading 130 station 201 where the operator inserts a blank in the die, which is then moved to position to be struck by the punch 76a.

It is obvious that the number of operations necessary to completely forge the valve may vary 135 according to the type of valve being made and the stock used, and that the dies and punches and indexing of the anvil may be changed accordingly.

The machine may be operated by a single operator, and will produce a materially greater number of finished forgings in a given time than 140 will the separate roughing and finishing machines now in use.

Formal changes may be made in the specific embodiment of the invention described, without departing from the spirit or substance of the broad invention, the scope of which is commensurate with the appended claims. 145 150

What we claim is:

1. A machine for continuously and completely forming forgings comprising a reciprocable slide and a rotatable anvil, roughing and finishing punches mounted in successive order in said slide, a plurality of like dies carried by said anvil and adapted to hold work pieces, means for reciprocating said slide relative to said anvil, means for rotating said anvil in coordination with the reciprocations of said slide to bring the dies and work pieces carried thereby successively into register with the punches carried by said slide, means on said anvil for locking work pieces in said dies, means on said slide for securing said locking means during each forging operation, means on said slide for releasing the locking means holding each finished forging, and means for releasing each finished forging from its die.

2. In a machine of the class described, the combination of a dial shaped slide, a dial shaped anvil, a series of six progressively shaped punches radially positioned in said slide, a series of eight like dies radially positioned in said anvil to register with said punches, means in said anvil for clamping each work piece in each of said dies, while it is being worked upon by the plunger means carried by said slide for actuating the clamping means for each die in register with a punch, and means to rotate the anvil to successively register the dies with the punches.

3. In a machine of the class described, the combination of a rotating anvil having a plurality of work holding dies therein, a reciprocating slide having a plurality of punches therein adapted to register simultaneously with certain of said work holding dies, work lifting means carried by said slide and cooperating with one of said dies so as to seize the work therein during the working stroke of said slide and to lift the same upon the return stroke, means in said anvil actuated upon the working stroke of said slide for moving work in register with said work lifting means to a position to be engaged thereby, and means to rotate the anvil to successively register the dies with the punches.

4. In a machine of the class described, the combination of a rotating anvil having a plurality of work holding dies therein, a reciprocating slide having a plurality of punches therein

adapted to register simultaneously with certain of said work holding dies, work lifting means carried by said slide to register with one of said dies and adapted to seize the work therein during the working stroke of the slide and to lift the same upon the return stroke, means connected with the anvil for moving the work in the die to a position to be engaged by said work lifting means, and means to rotate the anvil to successively register the dies with the punches.

5. In a machine for continuously and completely forming poppet valves from stem size bar stock and without forming salvage on the valve head, the combination of a rotating anvil, a plurality of like dies adapted to hold work pieces positioned therein and each having the shape of the ultimate valve head and of a depth greater than the thickness of the ultimate head, and having a socket for receiving the valve stems, clamps for locking the valve stems a reciprocable slide, a complete set of gathering and finishing punches therein adapted to closely fit into said dies, means for reciprocating said slide relative to said anvil and driving said punches into said dies, means for rotating said anvil to bring said dies simultaneously and progressively into register with said punches at each stroke of said slide.

6. A machine for continuously and completely forming forgings including, in combination, a punch holder, an anvil, roughing and finishing punches mounted in successive order on said holder, a plurality of like dies carried by said anvil and adapted to hold work pieces, means for relatively reciprocating said holder and said anvil, means for relatively rotating said anvil and said holder in coordination with said reciprocations to bring the dies and work pieces carried thereby successively into register with the punches carried by said holder, means on said anvil for locking work pieces in said dies, means on said holder for securing said locking means during each forging operation, and means on said holder for releasing the locking means engaging each finished forging.

FRED L. BUSH.
JAMES B. HILL.
RICHARD HERVIG.