April 17, 1956 H. REID 2,742,086

MACHINE FOR EDGE TRIMMING, NOTCHING AND PUNCHING THIN WALLED ARTICLES

Filed March 16, 1953 9 Sheets-Sheet 1

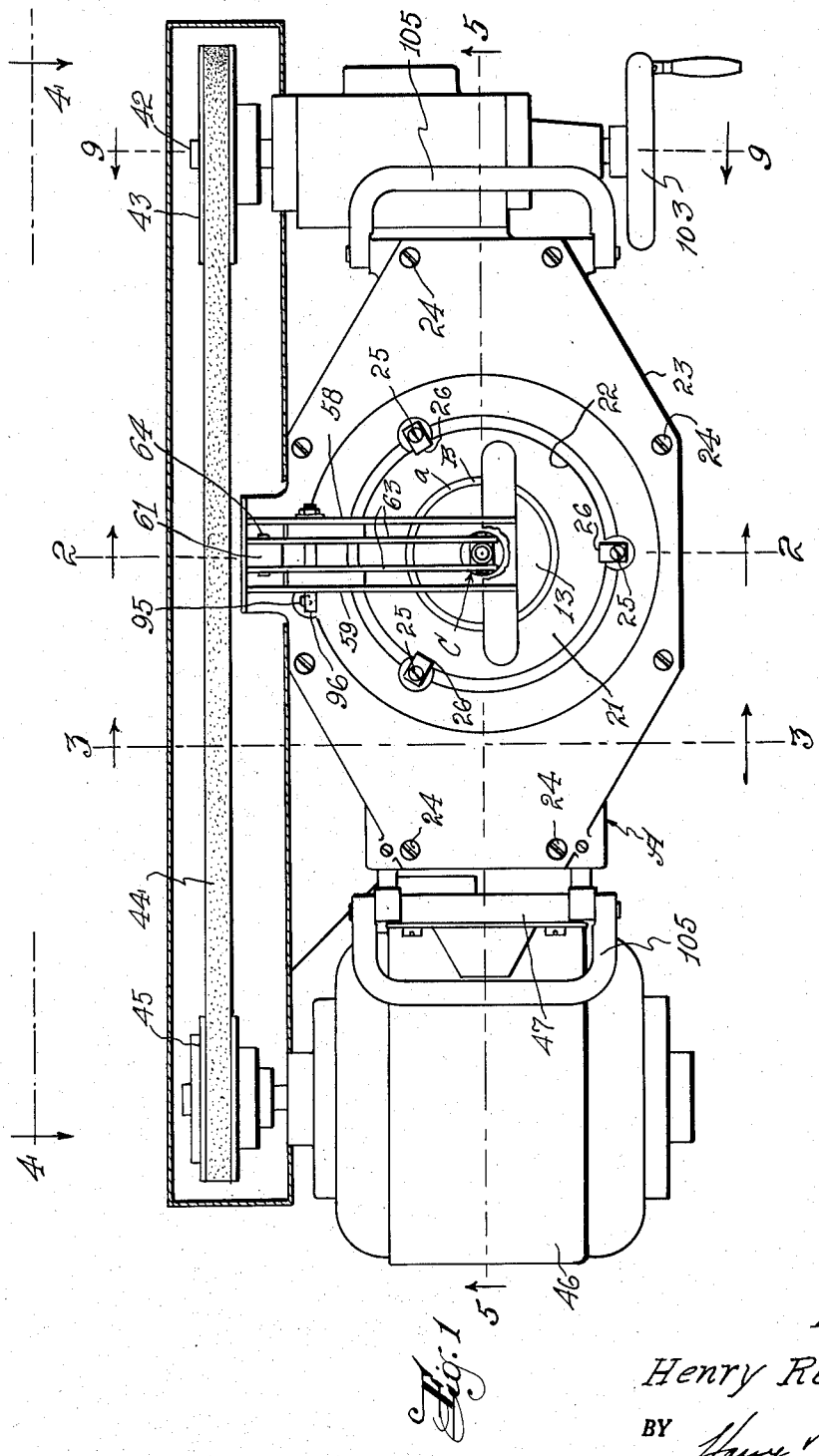


Fig. 1

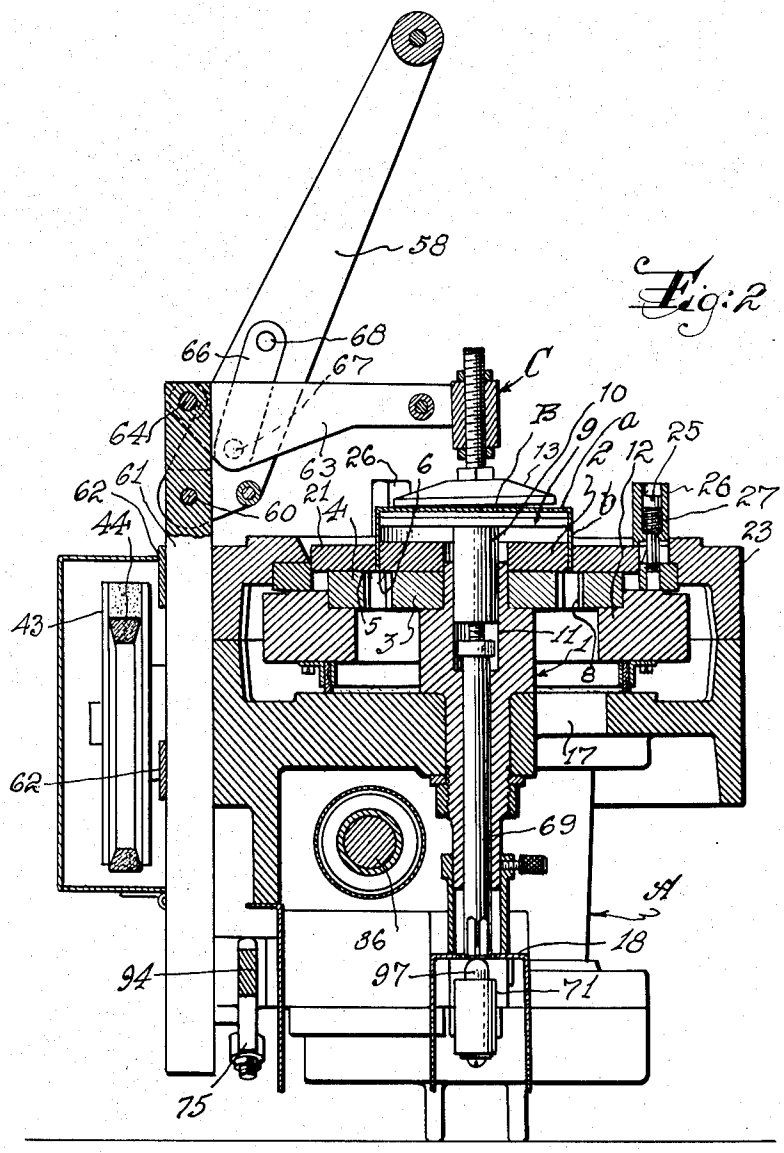
Inventor:
Henry Reid,
BY Harry B. Cook,
Attorney.

April 17, 1956 H. REID 2,742,086

MACHINE FOR EDGE TRIMMING, NOTCHING AND PUNCHING THIN WALLED ARTICLES

Filed March 16, 1953 9 Sheets-Sheet 2

Fig. 2



Inventor:

Henry Reid,

BY Harry R. Cook,

Attorney.

April 17, 1956 H. REID 2,742,086

MACHINE FOR EDGE TRIMMING, NOTCHING AND PUNCHING THIN WALLED ARTICLES

Filed March 16, 1953 9 Sheets-Sheet 3

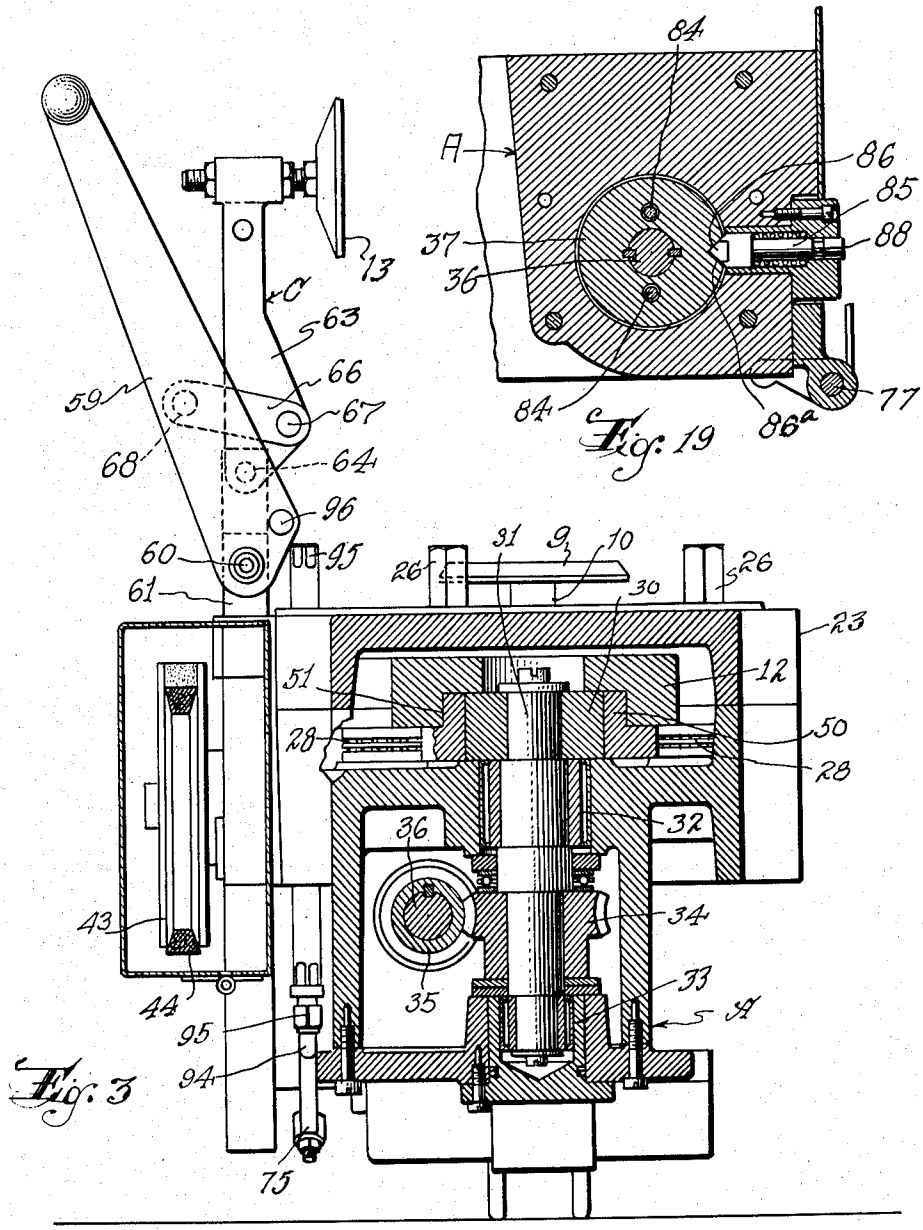


Fig. 19

Fig. 3

Inventor:

Henry Reid,

BY Harry R. Cook,

Attorney.

April 17, 1956 H. REID 2,742,086

MACHINE FOR EDGE TRIMMING, NOTCHING AND PUNCHING THIN WALLED ARTICLES

Filed March 16, 1953 9 Sheets-Sheet 4

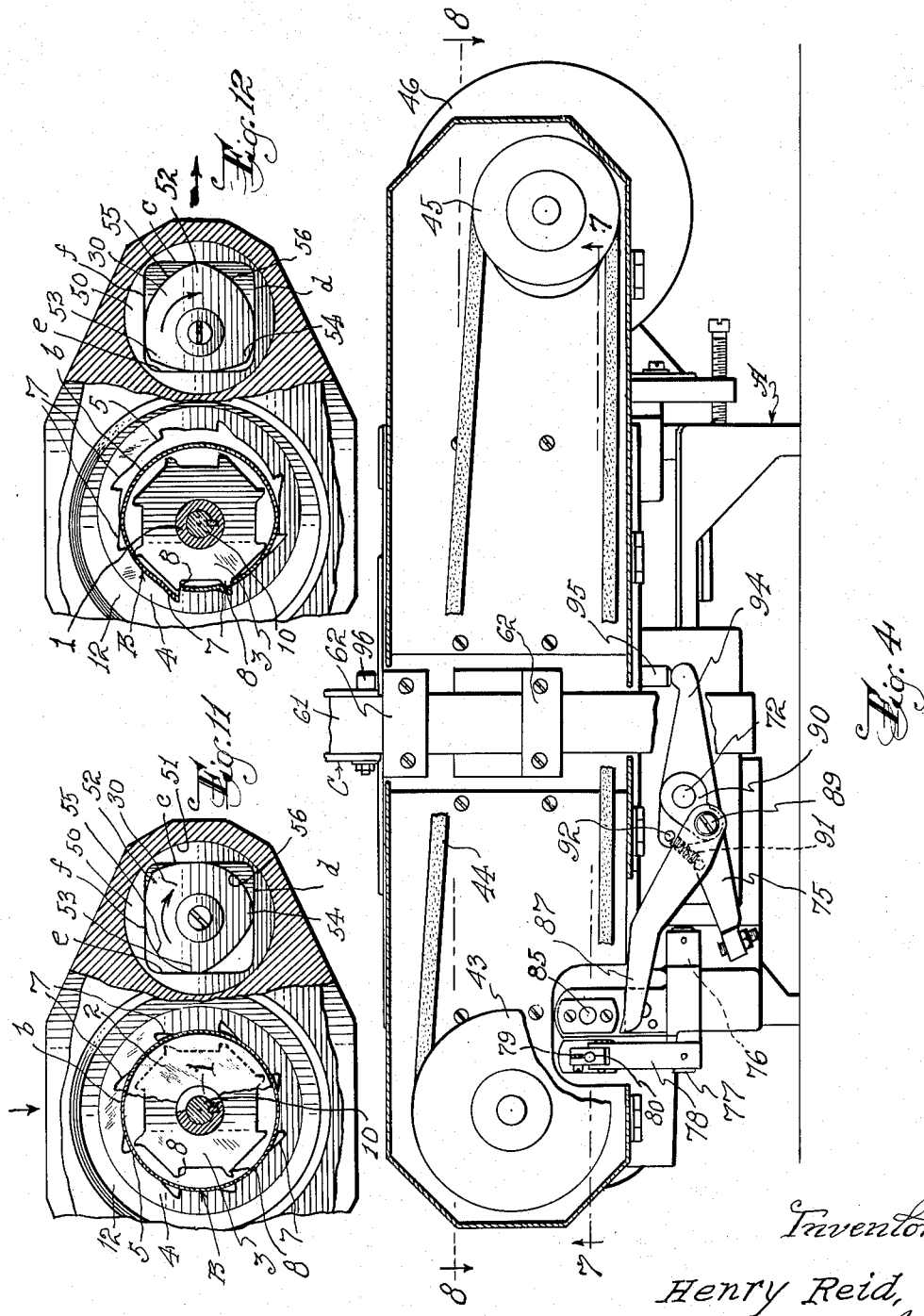


Fig. 4

Fig. 11

Fig. 12

Inventor:
Henry Reid,
BY Harry A. Cook,
Attorney.

April 17, 1956 H. REID 2,742,086

MACHINE FOR EDGE TRIMMING, NOTCHING AND PUNCHING THIN WALLED ARTICLES

Filed March 16, 1953 9 Sheets-Sheet 5

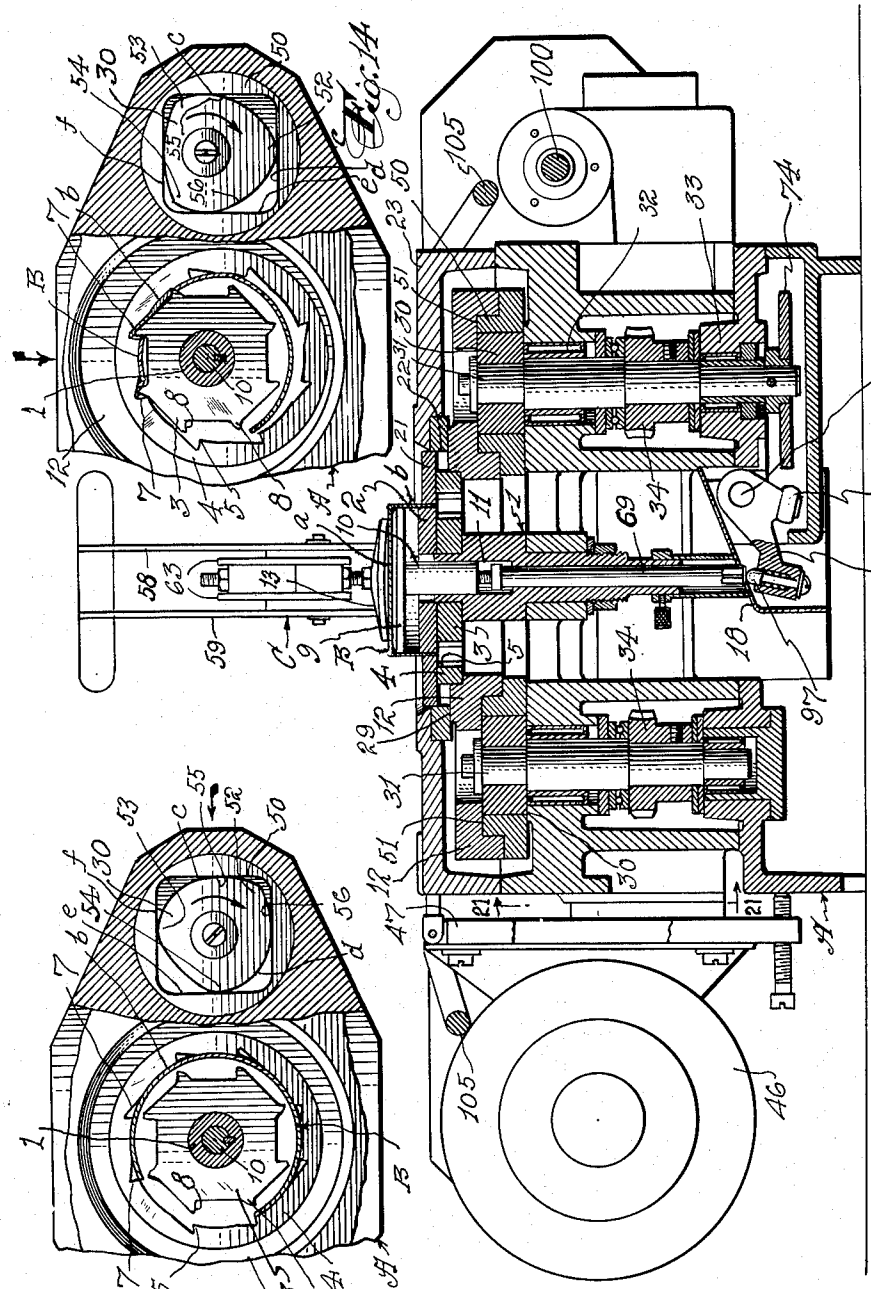


Fig. 5

Fig. 13

Fig. 14

Inventor:
Henry Reid,
BY Harry A. Cook,
Attorney.

April 17, 1956 H. REID 2,742,086

MACHINE FOR EDGE TRIMMING, NOTCHING AND PUNCHING THIN WALLED ARTICLES

Filed March 16, 1953 9 Sheets-Sheet 6

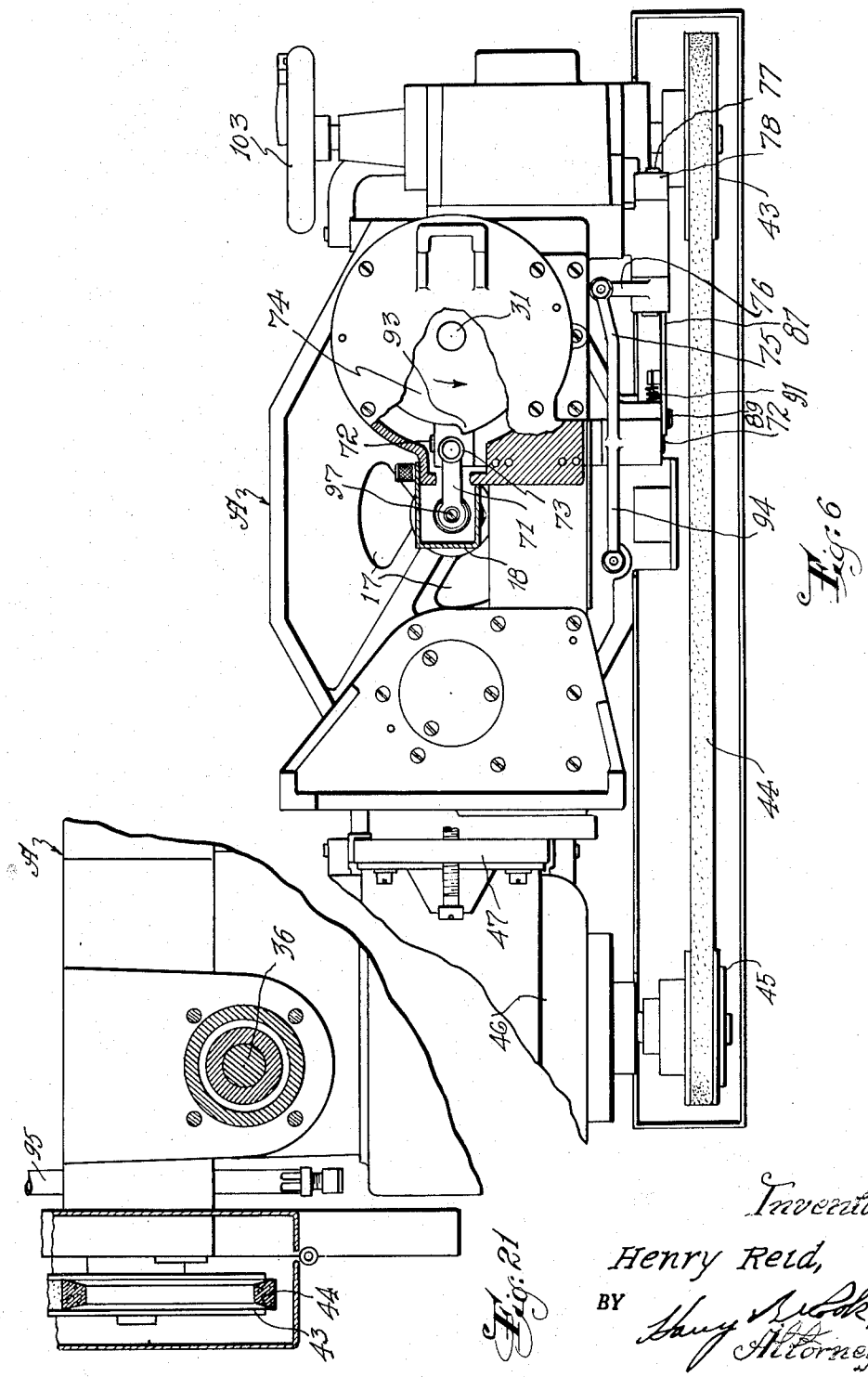


Fig. 6

Fig. 21

Inventor:
Henry Reid,
BY
Attorney.

April 17, 1956 H. REID 2,742,086

MACHINE FOR EDGE TRIMMING, NOTCHING AND PUNCHING THIN WALLED ARTICLES

Filed March 16, 1953 9 Sheets-Sheet 7

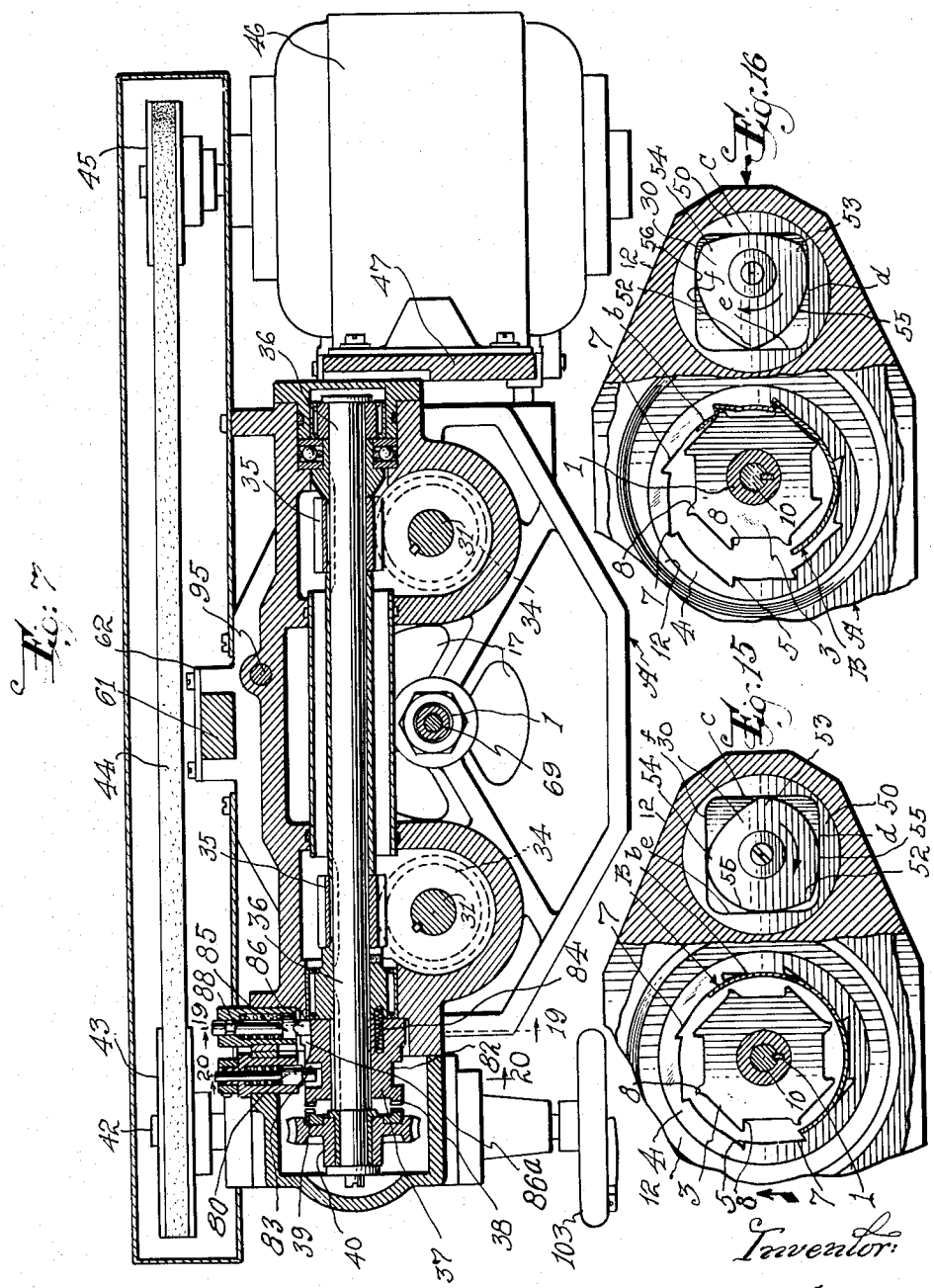


Fig. 7

Fig. 16

Fig. 15

Inventor:
Henry Reid,
BY Harry A. Cook,
Attorney.

April 17, 1956 H. REID 2,742,086

MACHINE FOR EDGE TRIMMING, NOTCHING AND PUNCHING THIN WALLED ARTICLES

Filed March 16, 1953 9 Sheets-Sheet 8

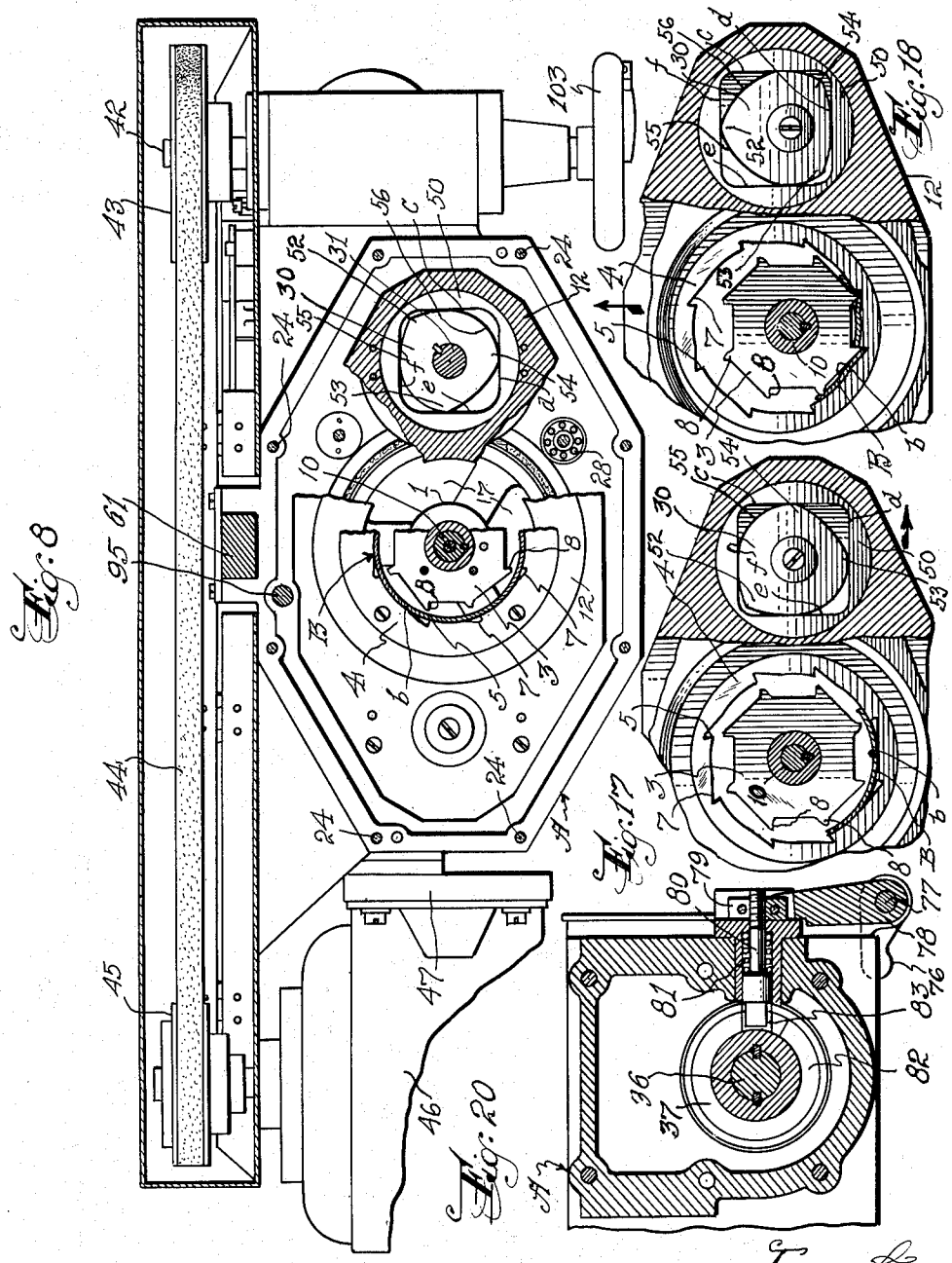


Fig. 8

Fig. 18

Fig. 17

Fig. 20

Inventor:
Henry Reid,
BY
Attorney.

April 17, 1956 H. REID 2,742,086

MACHINE FOR EDGE TRIMMING, NOTCHING AND PUNCHING THIN WALLED ARTICLES

Filed March 16, 1953 9 Sheets-Sheet 9

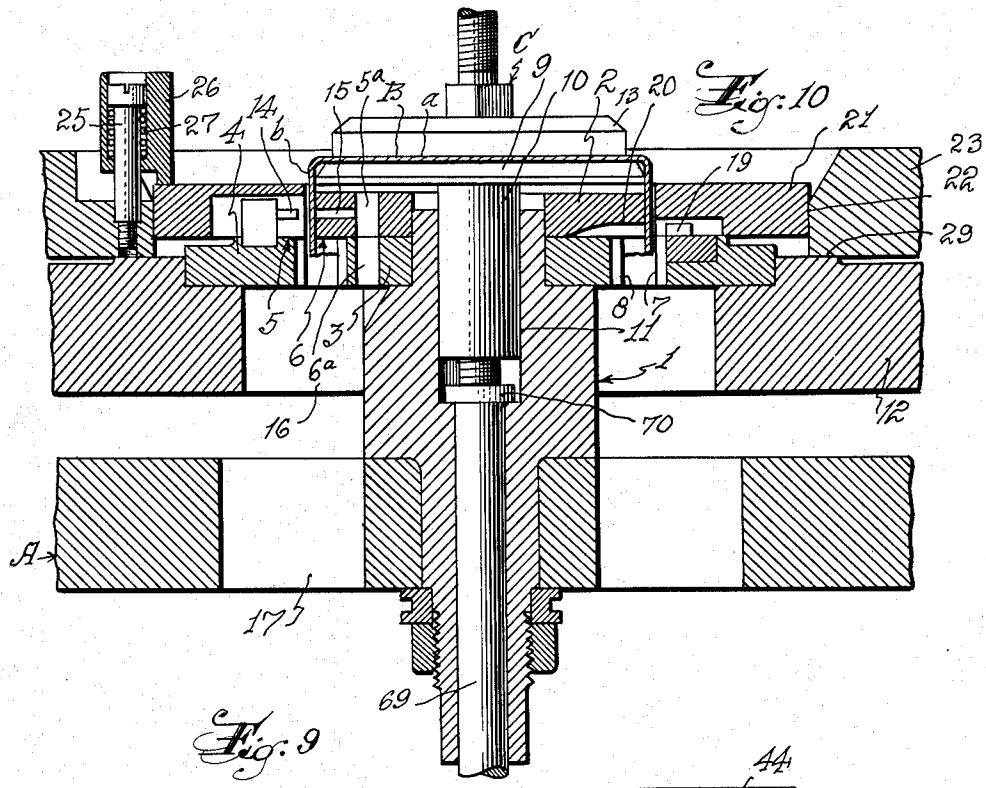
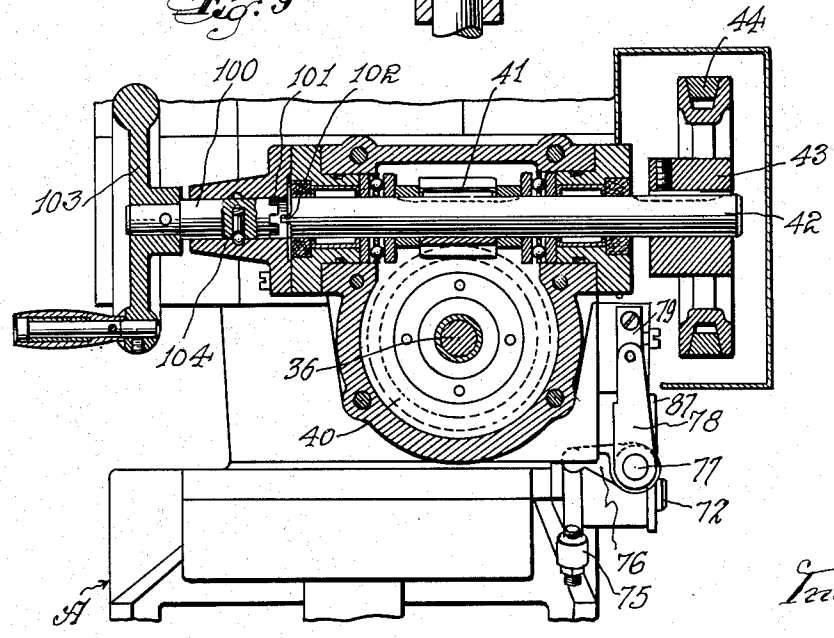


Fig. 10

Fig. 9



Inventor:
Henry Reid,
BY Harry A. Cook,
Attorney.

United States Patent Office 2,742,086 Patented Apr. 17, 1956

2,742,086

MACHINE FOR EDGE TRIMMING, NOTCHING, AND PUNCHING THIN WALLED ARTICLES

Henry Reid, West Orange, N. J.

Application March 16, 1953, Serial No. 342,356

9 Claims. (Cl. 164—47)

This invention relates in general to a machine for trimming the edges and punching, notching and embossing the walls of thin-walled articles, such as cans, cups, boxes, covers and tubing, particularly such articles having irregular edges formed by pressing or drawing sheet metal blanks or by extrusion.

Machines for flat edge trimming and notching drawn shells are known, and one object of the present invention is to provide a machine which shall not only produce the same or better results than known machines but which shall be small and compact, light in weight, relatively inexpensive and safe in operation, a secondary object being to provide such a machine which comprises a complete unit that itself can perform all of the operations required and can be easily transported and moved about to different positions for operation, even upon a bench, as desired.

Trimming machines of this general character have also been provided with a cutting die movable along each of angularly related straight lines to and from a central position by reciprocating cams and levers, the die being moved through a sequence of positions by movement of the cams in one direction and the sequence of movements of the die being reversed upon reversal of movement of the cams. Other machines provide for cutting of the article throughout its circumference by continuous movement of the die in one direction.

Another object is to provide a machine of this general character which shall include a punch and a die encircling the punch to receive between them a wall to be operated upon, and means for moving said die in successive cycles, each cycle comprising a plurality of steps in succession in the same direction around the punch, and each step consisting of movement of the die along a straight line to and from a central position concentric with said punch, whereby a plurality of such walls in rapid succession can be trimmed and, if desired, at the same time embossed, perforated and notched without change in direction of sequence of said steps of movement of the die so as to insure quick, economical and accurate operations on such walls.

Another object is to provide in such a machine a punch and a die encircling the punch and having an annular cutting edge or a plurality of angularly related edges so that the die shall be moved along straight lines radially of the punch or perpendicular to said angularly related cutting edges, as the case may be.

A further object is to provide such a machine which shall include a novel and improved construction and combination of driving mechanism for said die and means for starting and stopping said driving mechanism.

Other objects are to provide in a machine of this character a novel and improved compact arrangement of simple and inexpensive parts, which shall be reliable and durable; to provide novel and improved means to automatically stop the operation of the die and simultaneously eject the workpiece; to construct and arrange such parts

so as to provide for easy and quick breaking and disposition of the scrap chips that are formed during the trimming, punching and notching operations; and to obtain other objects, advantages and results that will be brought out by the following description in conjunction with the accompanying drawings in which

Figure 1 is a top plan view of a machine embodying the invention with portions of the casing of a belt drive mechanism illustrated in section;

Figure 2 is an enlarged transverse vertical sectional view approximately on the plane of the line **2—2** of Figure 1, showing the work about to be clamped in position to be operated upon;

Figure 3 is a similar view approximately on the plane of the line **3—3** of Figure 1 showing the work removed from the machine and the work holder in inoperative position;

Figure 4 is a rear elevational view of the machine approximately from the plane of the line **4—4** of Figure 1 with portions broken away and shown in section;

Figure 5 is a vertical sectional view approximately on the plane of the line **5—5** of Figure 1;

Figure 6 is a bottom plan view of the machine with portions broken away and other portions shown in section;

Figure 7 is a horizontal sectional view approximately on the plane of the line **7—7** of Figure 4;

Figure 8 is a fragmentary plan view of the machine with portions removed and other portions broken away and shown in section, on the plane of line **8—8** of Fig. 4, for clearness in illustration;

Figure 9 is a transverse vertical sectional view approximately on the plane of the line **9—9** of Figure 1;

Figure 10 is a greatly enlarged fragmentary vertical sectional view through the punch, the die and the die-actuating plate, with a workpiece in position to be operated upon;

Figure 11 is a fragmentary schematic plan view with portions broken away and shown in section of the punch, the chip or scrap breaker, the die, the die-actuating plate and one of the cams for reciprocating said plate, showing the relation of the parts with the die in central or concentric position with respect to the axis of the punch;

Figure 12 is a similar view showing the actuating cam moved through an angle of 45° from the position shown in Figure 11, and a corresponding change in position of the die, and with the punch entirely omitted;

Figure 13 is a view similar to Figure 12 showing the actuating cam moved through the next 45° of rotation with the die returned to its central position;

Figure 14 is a similar view showing the next 45° step of movement of the cam and the corresponding movement of the die;

Figure 15 is a like view showing the next 45° step of movement of the cam and the return of the die to its central position;

Figure 16 shows the next 45° step of movement of the cam and the corresponding movement of the die;

Figure 17 illustrates the cam at the end of its next 45° step of movement and the die in its central position;

Figure 18 shows the position of the cam and die at the end of the next 45° step of movement of the cam;

Figure 19 is a fragmentary vertical sectional view approximately on the plane of the line **19—19** of Figure 7;

Figure 20 is a similar view approximately on the plane of the line **20—20** of Figure 7; and

Figure 21 is a vertical sectional view approximately on the plane of the line **21—21** of Figure 5.

Specifically describing the invention, the machine includes a main frame or base A which supports approximately centrally of the base a post **1** to which is affixed

in any suitable manner a punch 2 and a scrap or chip breaker 3. Cooperating with the punch and scrap breaker is a die 4 that has a cutting edge 5 to cooperate with the cutting edge 6 of the punch (see particularly Fig. 10). The punch and die shown are of circular shape but they may be of any desired form to suit the contour of the workpiece. The die encircles the punch, and has scrap-breaking notches 7 on its inner periphery to cooperate with corresponding teeth 8 on the outer periphery of the scrap breaker 3 (Figs. 8, 10 and 11).

A support for a workpiece B is mounted coaxially with the punch above the upper end of the latter and comprises a disk 9 and a stud 10 secured to one side thereof and slidably mounted in a recess 11 in the upper end of the post 1. The workpiece is shown as comprising an inverted cup-shaped article having a base portion *a* and an annular wall *b* which is to be edge-trimmed, punched and notched. The workpiece is placed on the work support disk 9 with the free edge of its wall disposed below the plane of the cutting edges 5 and 6 of the die and punch as best shown in Figure 10 and the die is mounted on an actuating plate 12 to reciprocate in its own plane and cooperate with the punch to shear the edge of the wall *b* of the workpiece and simultaneously break the scrap, chip or strip that is sheared off said edge as shown, for example, in Figure 12. During the shearing operation, the workpiece is held against axial movement by a work holder generally designated C which includes a clamping plate 13, the workpiece being shown in course of placement on the punch in Figure 2 and as firmly clamped in operating position in Figure 10.

When it is desired to punch the wall *b* of the workpiece, a suitable punch 14 is mounted on the die to cooperate with a hole 15 in the punch 2 as the die travels from left to right in Figure 10. The punch 4 has an opening 5*a* registering with an opening 6*a* in the scrap strip breaker to permit the slug resulting from the punch operation to fall by gravity through openings 16 and 17 in the die actuating plate 12 and frame A respectively onto a chute 18 and thence into an out-of-the-way position.

When it is desired to notch the edge of the wall *b* of the workpiece or article B, a lug 19 may be fixed on the die 4 in alignment with a recess 20 in the punch 2 so that movement of the die 4 from right to left in Figure 10 will force the lug 19 into cooperation with the recess 20 so as to shear the desired contour on the edge of the wall *b*. The scrap resulting from the formation of the notch is a part of that trimmed normally from the edge of the article and may fall by gravity through openings 16 and 17 onto the chute 18. Should a lug rather than a notch be required in the edge of the wall *b*, transference of the lug 19 to the punch and of the recess 20 to the die would produce the desired effect.

To prevent the operator or extraneous objects from coming into contact with the moving parts of the die, as well as to avoid any distortion of the article B during the shearing, punching and notching operations, a closure plate 21 is removably mounted in a recess 22 in a main cover plate 23 that is secured to the frame A as by screws 24, said closure plate being spring pressed into engagement with the cutting edge 5 of the die by spring clamps spaced circumferentially of the opening 22 on the cover plate and each including a stud 25 on which is reciprocable a clamping sleeve jaw 26 that is rotatable about the stud into and out of engagement with the closure plate and is normally yieldingly pressed toward the cover plate by a spring 27. The closure plate 21 has a central opening of a size and shape corresponding to the periphery of the wall *b* to serve as a guide during the insertion of the article B into the machine and also to prevent distortion of the article by the cutting members. The closure plate also acts as a guard to prevent injury to the operator by the cutting members.

The die actuating plate 12 is shown as mounted for movement in its own plane on ball bearings 28 that are secured on the top surface of the frame A, and the actuating plate is held against displacement from said bearings by the cover plate 23 that frictionally bears upon the outer surface of the die-actuating plate preferably in a zone encircling the die as indicated at 29 in Figures 5 and 10.

The die actuating plate 12 is moved in successive cycles, each cycle comprising a plurality of steps in succession in the same direction around the punch and each step consisting of movement of the die plate along a straight line to and from a central position concentric with the punch. As shown, the die actuating plate is moved by two identical cams 30 that are mounted on the respective shafts 31 which are journaled in bearings 32 and 33 in the main frame A and are synchronously driven through worm gears 34 keyed on the shafts 31 and meshing with worms 35 on a countershaft 36 that is journaled in the frame (Figs. 3 and 7). The countershaft 36 has a clutch member 37 keyed but longitudinally movable thereon, and said clutch member is formed with teeth 38 on one face thereof to cooperate with the teeth on the face of a juxtaposed clutch member 39 that is carried by a worm gear 40 which is rotatable but longitudinally non-movable on the countershaft 36 and meshes with a worm 41 that is keyed on a jackshaft 42 journaled in the main frame A and having a pulley 43 keyed thereon and driven by a belt 44 from a drive pulley 45 that is fixed on the shaft of an electric motor 46 that is adjustably mounted by any suitable type of bracket 47 on one end of the frame of the machine. Preferably the adjustable mounting 47 is such as to permit the belt 44 to be tightened.

In operation, the motor 46 may run continuously and the clutch 37—39 is thrown in automatically as the clamp C is forced into work-clamping position; and the shafts 31 and cams 30 are thus rotated synchronously for a predetermined period of time to actuate the die for performing the necessary operations on the workpiece, after which the clutch is automatically thrown out and the workpiece B is automatically ejected as will be more fully described hereinafter.

Each cam 30 cooperates with an annular follower 50 that is fitted into an opening 51 in the die actuating plate 12 (Figs. 3, 5 and 11); and in accordance with the present embodiment of the invention, the cams and the followers are formed to reciprocate the die to and from its central position concentric with the punch along four straight lines radial to the center of the punch and perpendicular to each other.

Each cam has on its peripheral surface a primary lobe 52 and two complementary lobes 53 and 54 which are contoured to coact with the side walls of the corresponding follower upon rotation of the cam so that the two cams will move the die actuating plate 12, which is really a follower plate, along a line radial to the center of the punch each time the primary lobe of one cam is moved successively into and out of contact with any of the four sides of the corresponding follower, it being understood that the cams are synchronous so that the lobe of one cam will engage a side of its follower at the same time that the lobe of the other cam engages the corresponding side of its follower; and each cam has curved surfaces contoured for engagement with each side of the follower during said movement of the primary lobe to prevent all other movements of the follower along lines radial to the center of the punch.

The cam and follower are more fully described and claimed in my copending application Serial No. 336,219 filed February 11, 1953, to which reference may be had for a detailed explanation of the cam mechanism.

In Fig. 11 one cam and its follower are shown in their relative positions when the die is concentric with the center of the punch, and the other cam is similarly disposed. As the cams are rotated from that position in

the direction of the arrows, the primary lobe of each cam moves into engagement with the side *c* of the follower and thus actuates the die away from said central or concentric position, to the right, as shown in Fig. 12 so as to cause cooperation of the die and punch edges **5** and **6** at the left hand side of Figs. 10 and 12 to shear the edge of the wall *b* of the article B. When the punch **14** is present, said motion of the die will also cause a hole to be perforated by the punch **14**. At the same time, the teeth **8** of the scrap breaker **3** will engage the teeth **7** on the inner periphery of the die **4** so as to break any scrap strip or chip that may be located between the parts as shown in Fig. 12 and said scrap strips or chips will be disposed of through the openings **16** and **17**. During the next 45° step of movement of the cams, the lobes **52** are moved out of contact with the sides *c* as shown in Figure 13 and the die is returned to its central position along the same straight line. On the next 45° step of movement of the cams, the lobes **52** engage the sides *d* of the followers next adjacent the sides *c* so as to move the die away from its central position in the direction of the arrow at the upper portion of Fig. 14 along a straight line radial to the center of the punch and perpendicular to the line of movement just described. At the same time the strip-breaking surfaces of the breaker **3** and die break up the scrap strip. Successive 45° steps of movement of the cam and the corresponding movements of the die are shown in Figures 15 to 17 inclusive, the cams successively moving into and out of engagement with the sides *e* and *f* of the followers and eventually returning to their original positions shown in Fig. 11. Thereupon, the work clamp C is automatically actuated into its work-releasing position and the workpiece or article B is automatically ejected from the die and punch.

It will be observed that when the lug **19** is present, a notch will be formed thereby as the die moves to the left in Figure 10 as shown in Figure 16.

It will be understood by those skilled in the art that the size and shape of the polygonal annular followers **50** may be modified as required to effect movement of the follower plate **12** along the desired straight lines the desired distances, the high point of each primary lobe **52** always being a distance from the axis of rotation of the cam equal to the radius of a circle inscribed in the opening of the follower plus the length of the desired movement of the follower from its central position concentric with the axis of rotation of the cam; and the high points of the complementary lobes are spaced from said axis a distance equal to the radius of said inscribed circle. The surfaces of the cams between the complementary lobes constitute the drops of the cams and permit the hereinbefore described movement of the followers and die, and the sides of the lobes **52** as well as surfaces **55** and **56** on the peripheries of the cams slidably engage respective sides of the followers during said movements of the primary lobes.

The work-holding clamp C is shown as including an operating arm which comprises two parallel sections **58** and **59** that are pivotally connected at one end, as indicated at **60** to a bar **61** that is vertically adjustably mounted on the rear side of the main frame, being slidable through brackets **62** in which the bar can be clamped so that the bar **61** can be moved upwardly or downwardly to adjust the work-holding clamp to articles of various heights. A pair of work-holding arms **63** are pivotally mounted at **64** on said bar between said sections **58** and **59** of the operating arm and have affixed thereto the work-clamping disk or head **13**. Two links **66** are pivotally connected at one end as indicated at **67** to the arms **63** and at their other ends as indicated at **68** to the sections **58** and **59** of the operating arm so that when the operating arm is in substantially to the left of a vertical position, the work-clamping arm **63** will be swung into

an out-of-the-way position with respect to the work-holding disk **9**, as shown in Figure 3.

When the work clamp is in this position, the work-holding disk **9** is elevated above the punch **2** in position to receive the workpiece, the disk **9** being held in this position by a push rod **69** slidably mounted in the post **1** and abutting an adjustable screw **70** (Fig. 10) in the lower end of the stud **10**. After the workpiece has been applied to the disc **9**, the operating arm **58**, **59** of the work clamp is swung downwardly or to the right in Fig. 3 so as to cause the clamping plate **13** to engage the workpiece B as best shown in Fig. 2, whereupon continued swinging of the operating arm in the same direction will press the workpiece and disc **9** downwardly to firmly clamp the work in position to be operated upon as shown in Fig. 10. The links **66** and their pivots **67** and **68** are so located that the pivot **67** may swing beyound the dead center point between the pivots **60** and **68** so as to firmly lock the work clamp in work-clamping position. The push rod **69** and work-holding disc **9** are normally pressed upwardly by one arm **71** of a bell crank lever that is mounted on a stub shaft **72** journaled at the bottom of the frame (Figs. 5 and 6) and having a roller **73** on its other arm that cooperates with a cam **74** on one of the cam shafts **31**. On the shaft **72** is also mounted a double arm lever (Figs. 4 and 6) having a hub portion mounted on the shaft **72** and having one arm **75** underlying and in spaced relation to an arm **76** (see also Figs. 9 and 20) on a rock shaft **77** journaled in the main frame on which is also mounted a forked arm **78** that has a split screw-threaded connector **79** pivotally mounted between the arms of the bifurcation and threadedly connected to one end of a clutch pin **80** which is slidably mounted in the main frame and normally influenced by a spring **81** into the groove **82** of the clutch member **37**, on one side wall of which is a lug **83** which normally engages said clutch pin to force the clutch member **37** against the influence of springs **84** (see also Figs. 7 and 19) to separate the clutch face **38** from the clutch face **39**.

The other arm **94** of the double armed lever underlies and engages a push rod **95** vertically slidable in the machine frame A with its upper end projecting above the cover **23** (see Figs. 1, 3 and 4). The operating arm of the work clamp has a stud **96** which engages said push rod and pushes it downwardly when the work is clamped in operating position so as to swing the double armed lever **74**, **75** and cause the lever arm **75** to engage the arm **76** and thereby swing the arm **78** outwardly to disengage the clutch pin from the lug **83**, thereby permitting engagement of the clutch members **38**, **39** and consequently driving the shaft **36** and the cam shafts **31**. At the same time, a rod **85** (see Fig. 19) has a beveled end **86** acting as a detent normally seated in a recess **86***a* in the clutch member and is held in its outermost position by a finger **87** that engages a circumferential groove **88** in the rod **85**. The finger **87** is pivotally connected at **89** to an arm **90** on the stub shaft **72**, being normally caused to move with the shaft **72** by means of a tension spring **91** having one end connected to the finger **87** and its other end connected to a stud **92** on a projection of the lever arm **75**. The stud **92** also serves as a stop to limit upward movement of the finger **87** in Fig. 4 under the influence of said spring.

The roller **73** is normally juxtaposed to the low point of the cam **74** as shown in Figures 5 and 6 and the roller is forced into engagement with the cam as the work clamp forces the work into clamping position, the push rod **69** pressing against the spring influenced pin **97** to swing the bell crank lever counter-clockwise in Figure 5. After the machine has been started as above described by engagement of the clutch members **38**, **39**, the cams **30** will be operated to actuate the die and perform the necessary trimming, punching, notching or embossing operations until the lobe **93** on the cam **74** (Fig. 6) urges the

roller 73 in the direction to swing the bell crank lever in the clockwise direction (Fig. 5) whereupon the lever arm 75 will cause the release of the arm 78 to permit the clutch pin 80 to be thrown into the path of the lug 83 on the clutch member 37 and thereby cause said clutch member to be thrown out of engagement with the clutch member 39 and stop the actuation of the die. Simultaneously the lever arm 94 will strike the push rod 95 to cause the latter to engage the stud 96 and lift the work clamp into open position as shown in Fig. 3, and immediately thereafter the bell crank 71 will push upwardly on the push rod 69 through the yieldingly mounted pin 97 so as to force the work-holding disc 9 upwardly and eject the workpiece or article B from the die. Also the finger 87 will be released from the groove 88 of the rod 85, permitting the beveled end 86 to snap into the recess 86*a* of the clutch member 37 thus retaining the shaft 36 at the proper point for the beginning of the next operation. Another workpiece will then be inserted into the machine, and the same sequence of steps in the same direction around the punch will be performed on the workpiece.

It will be understood that the ratio between the driving gears 34 and 35 may be varied to suit different purposes, but that under all circumstances the cam shafts 31 and die will be started in operation by and upon the clamping of the work in operating position, and operation of cams 30 and die will be automatically stopped by the cam 74.

Should it be desired to operate the machine by hand, for example in adjusting the setting of the die, punch and chip breaker, a stub shaft 100 (Fig. 9) may be journaled to rotate and move longitudinally in the machine frame in line with the jackshaft 42 and be provided with notches 101 to engage lugs 102 on the end of said jackshaft; and a hand wheel 103 may be attached to the stub shaft for causing engagement and disengagement of the shaft 100 to and from the shaft 42 and for rotating the shaft 42 when the stub shaft 100 is interlocked with the shaft 42. A suitable spring latch 104 is provided for holding the stub shaft in its inoperative position.

It will also be understood that the machine could be used for embossing by simply providing dies of the proper form; and the ends of long tubes can be trimmed if desired, the punch and dies normally being fully exposed for easy insertion of long articles such as tubes, as well as cans, covers and the like.

The machine is so light in weight that it can be easily picked up and carried from place to place, and for convenience, handles 105 may be pivotally connected to the ends of the frame near the top thereof.

The particular manner of driving the die eliminates complicated guides and slides that are common to most machines of this general type; and the machine of the invention is simple, compact, small and inexpensive, easily portable, reliable and durable and capable of performing trimming, punching, notching, embossing and like operations at least as well if not more effectively than the known complicated and expensive machines. Furthermore, the machine can operate upon workpieces in rapid succession, accurately and at low cost.

While I have shown and described the invention as embodied in certain structural details, it will be understood that this is primarily for the purpose of illustrating the principles of the invention, and that many modifications and changes can be made in the construction of the machine within the spirit and scope of the invention.

A workpiece having a circular or hollow cylindrical wall has been described primarily as an example, and the invention also contemplates the operation upon walls of other configurations, for example, continuous polygonal walls, flat walls disposed at angles to each other, and so on, and the term "annular" as used in the claims should be interpreted accordingly.

What I claim is:

1. A machine for operating upon a workpiece having an annular wall, comprising a frame, a punch and a die in encircling relation thereto to receive said wall between them and having cooperative cutting edges, and means for actuating said die in a flat plane in successive cycles, each cycle comprising a plurality of steps in succession in the same direction around said punch and each step consisting of movement of said die along a straight line to and from a central position concentric with said punch, said means for actuating said die including a plate on which said die is mounted and having two annular polygonal cam followers each having straight angularly related inner walls, said plate being mounted on said frame to move in a flat plane, two cams journaled in said frame and rotatable synchronously about parallel axes, each cam being rotatable in one of said followers with its periphery in direct slidable engagement with the walls of the follower, each cam having a primary lobe and at least one complementary lobe contoured to coact with the walls of the corresponding follower upon rotation of the cams to move said plate and die in said flat plane along said straight lines to and from said central position each time said primary lobe of each cam moves into and out of contact with a wall of its follower that corresponds to a wall of the other follower, the periphery of each cam having a curved surface in engagement with each wall of the corresponding follower during said movement of said primary lobes to prevent movement of said plate and die in all other directions in said plane, movement of said plate and die being constantly directly controlled by said cams.

2. A machine as defined in claim 1 with the addition of driving means for synchronously rotating said cams, and means for starting said driving means and for automatically stopping said driving means after one complete revolution of said cams.

3. A machine as defined in claim 1 with the addition of a clamp for holding said annular wall in operating position between said punch and die, and with the addition of means operated by said clamp as said annular wall is clamped in operating position to automatically start said means for actuating said die, and automatic mechanism for stopping said means for actuating said die after a predetermined time.

4. A machine for operating upon a workpiece having an annular wall, comprising a frame having a top surface and a fixed post projecting upwardly above said top surface, a punch fixedly mounted on said post above said top surface, a die encircling said punch to receive an annular wall between said die and punch, said die and punch having coacting portions to operate on said wall, a die-carrying plate mounted on said top surface of the frame to move in its plane perpendicular to the axis of said punch and having an opening through which said post extends, said die being mounted on said plate concentrically with said opening, means for actuating said plate in said plane to cause coaction of said die and punch upon said annular wall, a cover plate on said frame above said top surface enclosing said die-carrying plate and having an opening concentric with said punch and of larger diameter than said die, and a closure plate removably fitted in said opening over said die and having a hole the wall of which is in opposed and closely encircling relation to said punch and through which hole said annular wall may be inserted between the punch and die.

5. A machine as defined in claim 1 with the addition of a work-supporting plate disposed outwardly of and coaxially with said punch and movable toward and from said punch, a work clamp having a work-engaging element movable toward and from said work supporting plate so as to grip said workpiece therebetween and hold the workpiece in operating position, a mechanism operated by said work clamp as said workpiece is clamped in said operating position for starting said means for actuating said die-carrying plate, means including parts of said mechanism for automatically stopping said means for actuating said die-carrying plate and for automatically releasing said

work clamp and actuating said work-supporting plate to eject said workpiece.

6. A machine for operating upon a workpiece having an annular wall comprising a frame having a top surface and a fixed post projecting upwardly above said top surface, a punch fixedly mounted on said post above said top surface, a die encircling said punch to receive an annular wall between said die and punch, said die and punch having coacting portions to operate on said wall, a die-carrying plate mounted on said top surface of the frame to move in its plane perpendicular to the axis of said punch and having an opening through which said post extends, said die being mounted on said plate concentrically with said opening, means for actuating said plate in said plane to cause coaction of said die and punch upon said annular wall, a work-supporting plate disposed outwardly of and coaxially with said punch and movable toward and from said punch, a work clamp having a work-engaging element movable toward and from said work-supporting plate so as to grip said workpiece therebetween and hold the workpiece in operating position, a mechanism operated by said work clamp as said workpiece is clamped in said operating position for starting said means for actuating said die-carrying plate, means including parts of said mechanism for automatically stopping said means for actuating said die-carrying plate and for automatically releasing said work clamp and actuating said work-supporting plate to eject said workpiece.

7. A machine for operating upon a workpiece having an annular wall comprising a frame having a top surface and a fixed post projecting upwardly above said top surface, a punch fixedly mounted on said post above said top surface, a die encircling said punch to receive an annular wall between said die and punch, said die and punch having coacting portions to operate on said wall, a die-carrying plate mounted on said top surface of the frame to move in its plane perpendicular to the axis of said punch and having an opening through which said post extends, said die being mounted on said plate concentrically with said opening, means for actuating said plate in said plane to cause coaction of said die and punch upon said annular wall, a work clamp to hold a workpiece in operating position, means including a lever movable in opposite directions for starting and stopping respectively said means for actuating said die-carrying plate, a push-rod movable in one direction to coact with said lever and swing it in one direction to starting position, and means on said work clamp to engage and push said push-rod in said direction as the work clamp is moved to clamp the workpiece in operating position.

8. A machine as defined in claim 7 with the addition of automatic means to actuate said lever in the opposite direction to stop said machine.

9. A machine as defined in claim 8 wherein the last-named means includes a control cam operable in timed relation to said means for actuating said die-carrying plate, a lever cooperative with said cam and the first-mentioned lever, and wherein said post is tubular and said work-supporting plate has a stud slidable in said tubular post, and with the addition of a push-rod slidably mounted in said post and engageable with said stud and slid by the second-mentioned lever when the latter is actuated by said cam, whereby to actuate said work-supporting plate away from said punch to eject said workpiece from between said punch and said die.

References Cited in the file of this patent

UNITED STATES PATENTS

1,717,612	McNeil	June 18, 1929
1,946,992	Tormyn et al.	Feb. 13, 1934
2,374,301	Olney	Apr. 24, 1945
2,521,974	Hartup	Sept. 12, 1950
2,629,439	Hartup	Feb. 24, 1953