

Nov. 3, 1942.

T. D. PENTZ

2,300,698

PATTERN CONTROLLED OPERATION AND APPARATUS

Filed Nov. 22, 1940

5 Sheets-Sheet 1

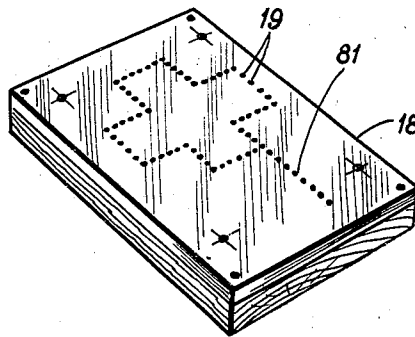
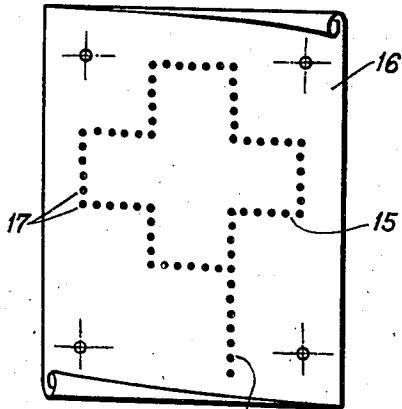


Fig. 2

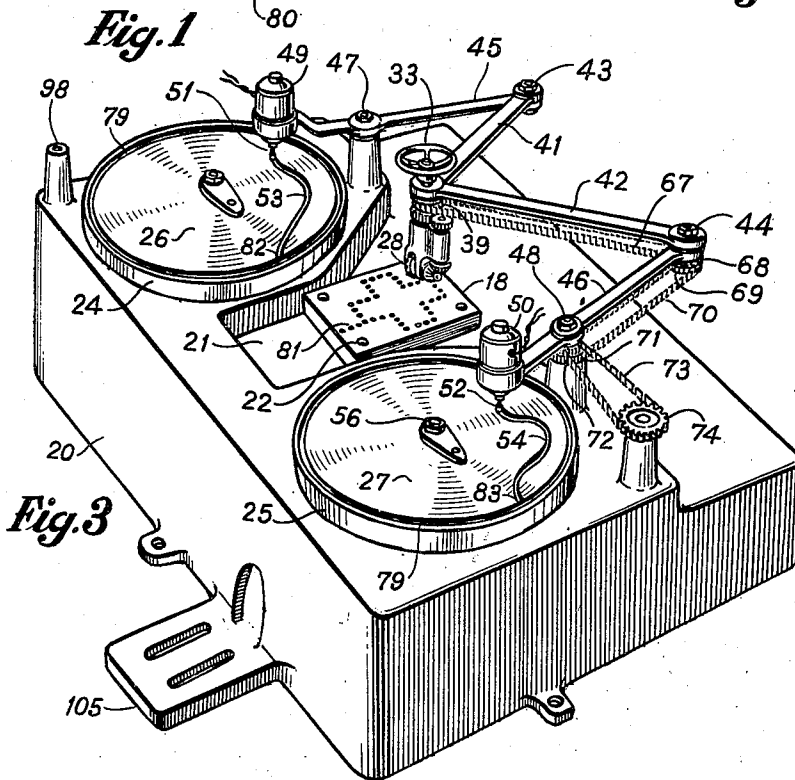


Fig. 3

INVENTOR.
Thos. D. Pentz
BY *Philip S. McLean* ATTORNEY

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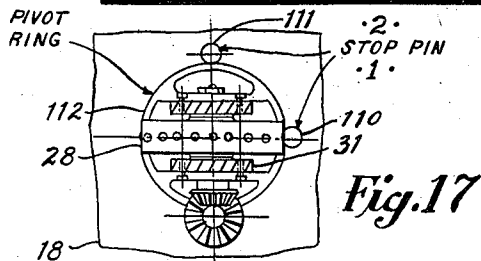
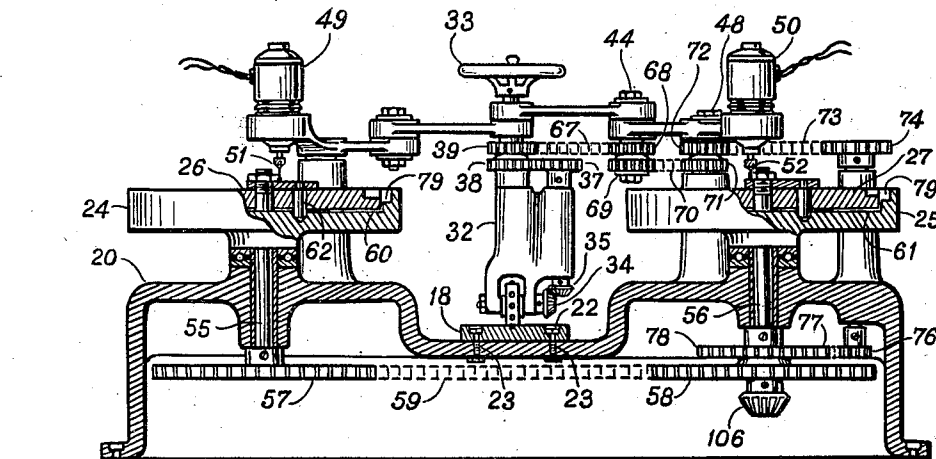
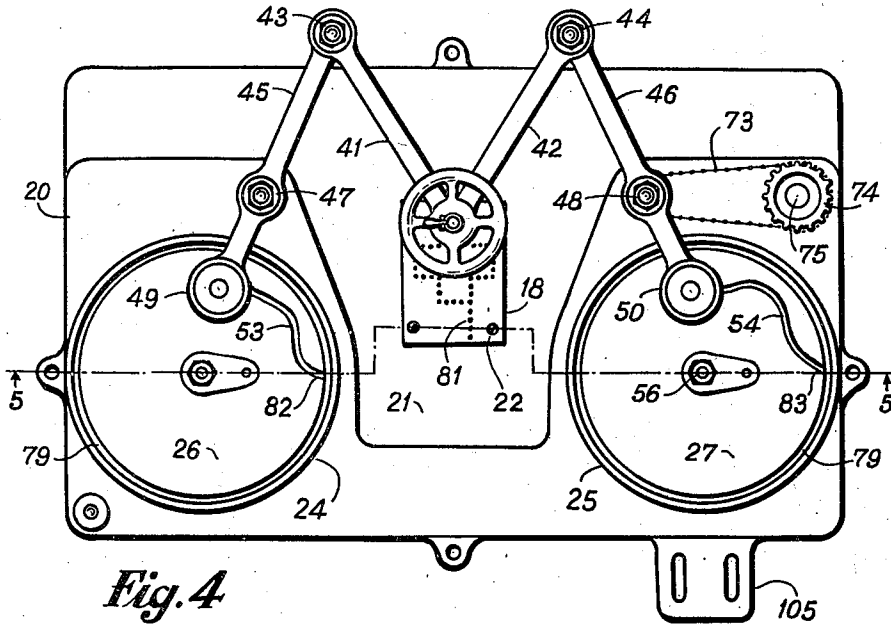
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5 Sheets-Sheet 2



INVENTOR.
Thos. D. Pentz
 BY *Philip S. [Signature]* ATTORNEY

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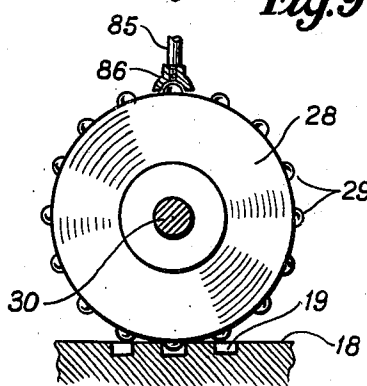
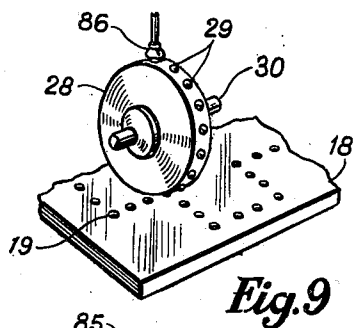
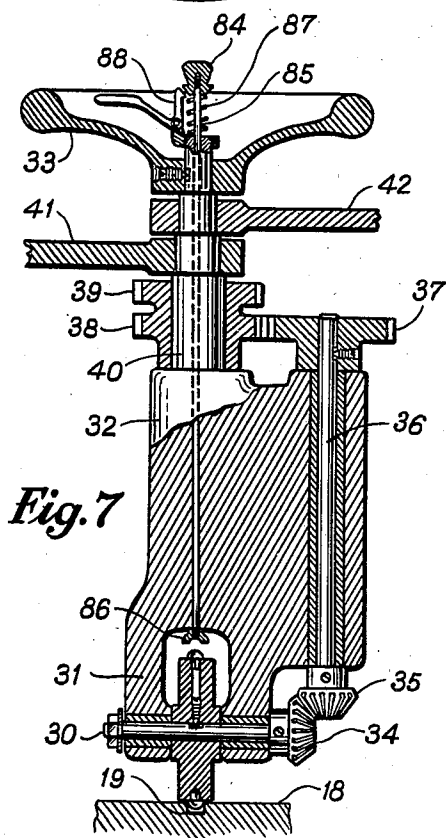
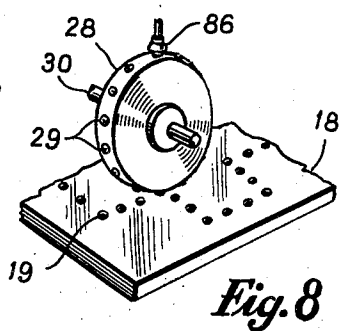
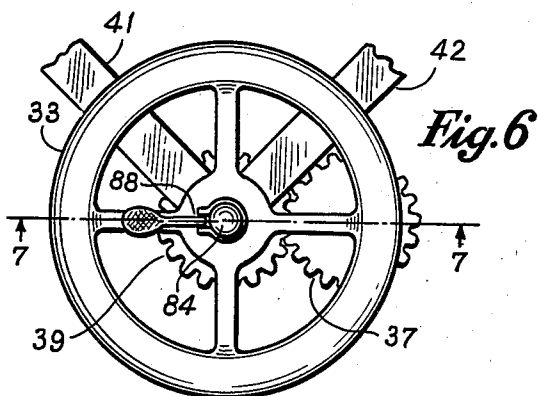
T. D. PENTZ

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5 Sheets-Sheet 3



INVENTOR
Thos. D. Pentz
 BY *Philip J. McLean* ATTORNEY

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T. D. PENTZ

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Fig. 11

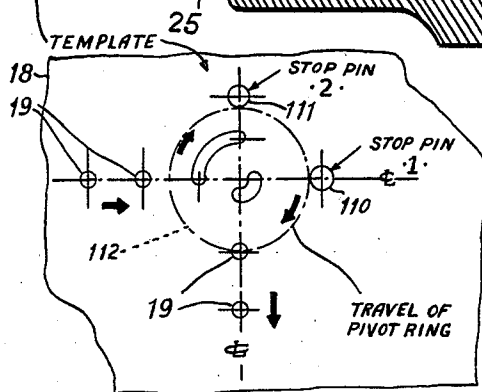
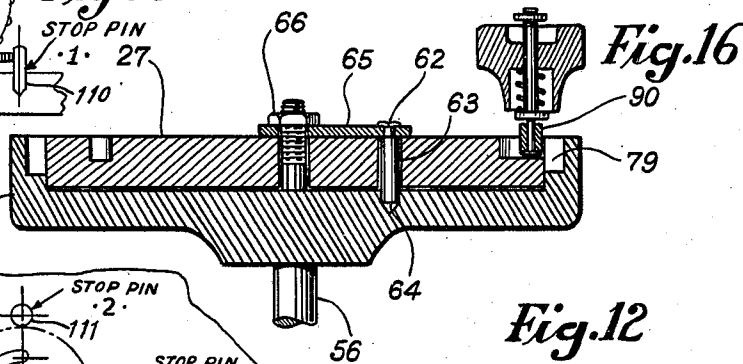
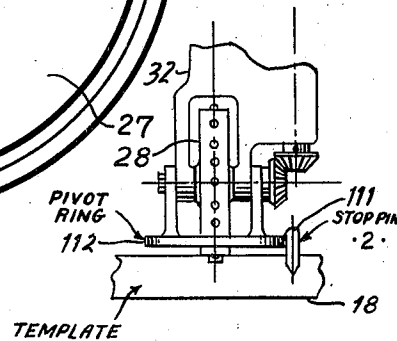
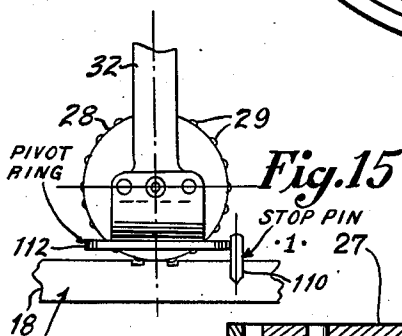
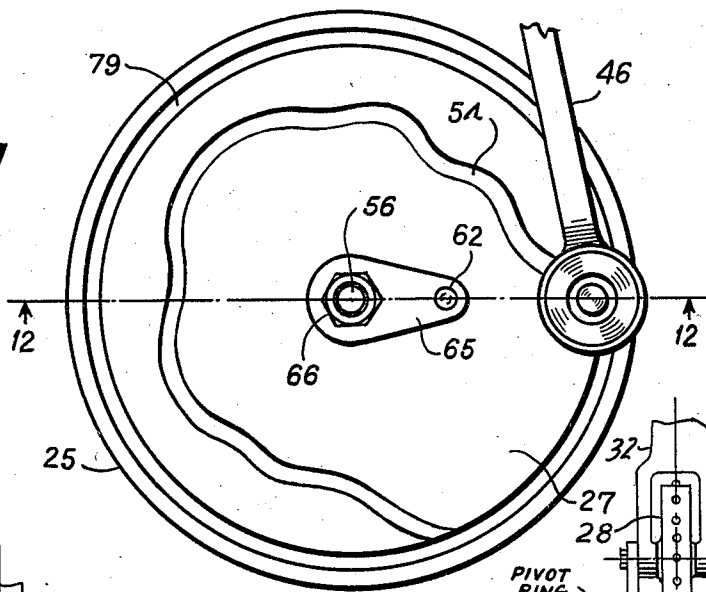


Fig. 18

Fig. 12

INVENTOR.

Thos. D. Pentz

BY

Philip J. McKen, ATTORNEY

Nov. 3, 1942.

T. D. PENTZ

2,300,698

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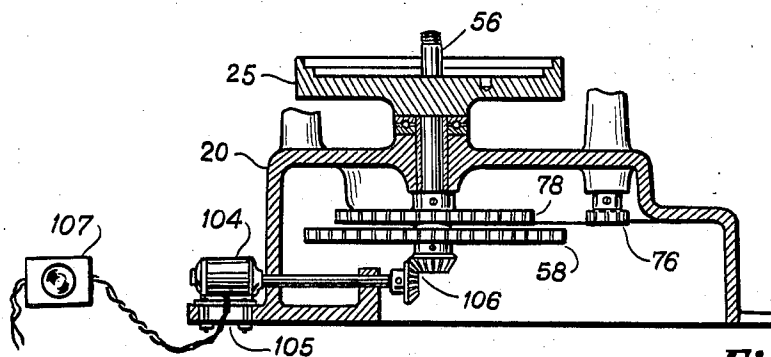


Fig. 13

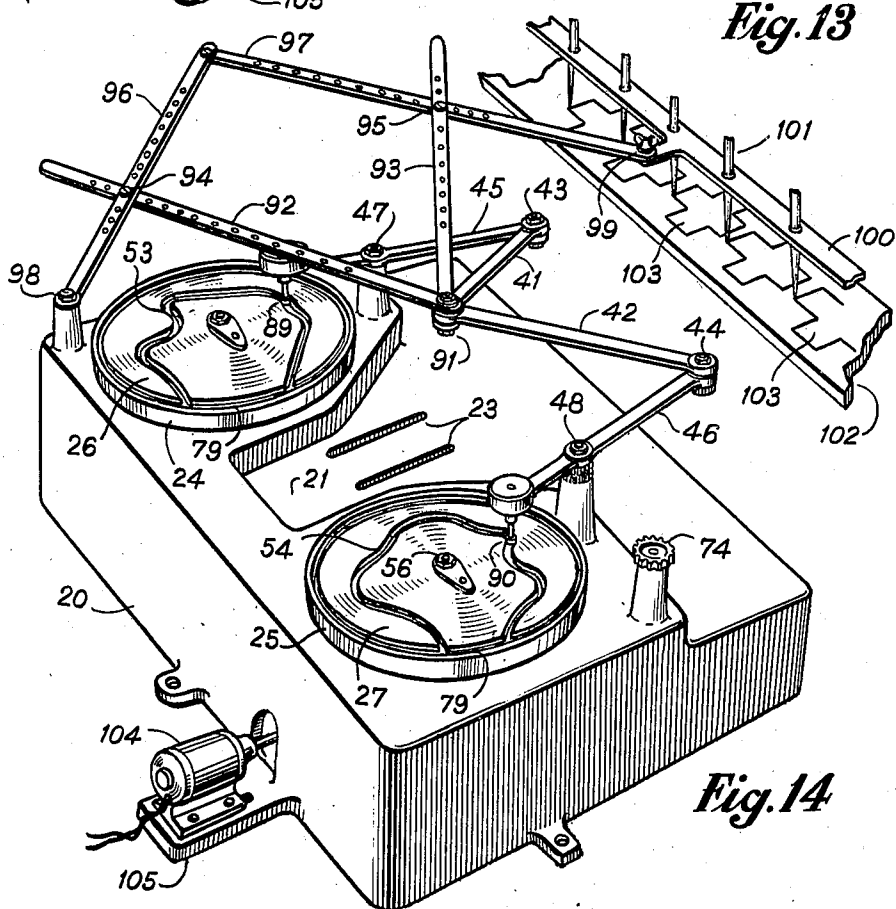


Fig. 14

INVENTOR.
Thos. D. Pentz
BY *Philip S. Moran* ATTORNEY

UNITED STATES PATENT OFFICE

2,300,698

PATTERN CONTROLLED OPERATION AND
APPARATUS

Thomas D. Pentz, Roselle Park, N. J.

Application November 22, 1940, Serial No. 366,692

12 Claims. (Cl. 90—13)

The invention here disclosed relates to the planning and performing of operations to effectuate various desired purposes.

Broad objects of the invention are to enable desired operations to be carried out by working direct from an exact engineering drawing or the like and to provide mechanism for accomplishing such results which will be entirely practical and efficient.

Other desirable objects and the novel features of the invention through which all such objects are attained will appear and are set forth in the following specification.

The drawings accompanying and forming part of the specification illustrate one practical embodiment and application of the invention. Structure and the uses to which the invention may be put may be modified and changed all within the true spirit and broad scope of the invention as hereinafter defined and claimed.

Fig. 1 is a plan view representing an engineering drawing, showing by lines of spaced dots the outline of an object to be produced, such as a blank or blanks to be cut out of metal.

Fig. 2 is a perspective view of an engraving of the drawing, on a smaller scale, to fit the pattern machine and etched in "reverse," that is, to produce the dots of the drawing as small depressions, instead of in relief, as would be the case in an ordinary etched engraving.

Fig. 3 is a perspective view of a machine designed to take the etched pattern plate and set to form therefrom patterns in two synchronized discs, which latter will serve, on the same, or on a separate special reproducing machine to effect the movements necessary to create one or a plurality of similarly shaped blanks, outlines, tracings, or the like.

Fig. 4 is a plan view of the machine operating as in Fig. 3 for production of the pattern discs.

Fig. 5 is a vertical sectional view on substantially the plane of line 5—5 of Fig. 4.

Fig. 6 is an enlarged broken top plan view of the tracer mechanism.

Fig. 7 is a vertical sectional view of the latter as on substantially the plane of line 7—7 of Fig. 6.

Fig. 8 is a detail perspective view illustrating the tracer wheel as arriving on the inside corner of an etched pattern.

Fig. 9 is a similar view illustrating the tracer wheel as swung about at right angles on the corner point without rotation of the wheel about its axis.

Fig. 10 is a further enlarged broken sectional

detail illustrating engagement of the tracer wheel points or spurs in the depressions of the template or pattern plate.

Fig. 11 is a broken plan view of one of the record or pattern discs in place on its holder and serving as a cam engaged by a cam follower.

Fig. 12 is a vertical sectional view of the same, on substantially the plane of line 12—12 of Fig. 11.

Figs. 13 and 14 are broken sectional and perspective views respectively, illustrating transformation of the machine from recording to reproduction purposes and serving through pantographic connections to produce a multiplicity of blanks corresponding to the original engineering layout.

Figs. 15 to 18 illustrate a modified form of tracer mechanism; Figs. 15 and 16 being broken part sectional side and front views showing the tracing wheel as stopped against stop pins at the front and at the side respectively; Fig. 17 being a partial plan view and Fig. 18 being a diagrammatic view illustrating the action of turning the wheel to start it in a different direction from the center determined by the two stop pins.

For simplicity of illustration, the invention is disclosed as for producing simple cruciform blanks corresponding to that indicated at 15, in the drawing 16, pictured in Fig. 1. This may be considered as an exact engineering drawing of the shape desired but laid out by accurately spaced dots 17, instead of by the usual lines.

The purpose of the spaced dots is to produce, when an etched engraving is made, in reverse, from the drawing, correspondingly or proportionately spaced depressions forming a similar outline on a template from which patterns are formed by a special tracing operation.

The engraving etched in reverse from the spaced dot drawing is shown at 18, Figs. 2 and 3, in the form of a metal plate having an outline corresponding to the working drawing etched thereon in the equally spaced depressions 19. This etched plate may be of smaller size than the original working drawing to better fit the machine, any desired reduction being readily effected in the photo-engraving process.

Fig. 3 shows the etched design plate mounted on the recording machine and serving as a template or stencil for guiding a tracer wheel, which through a set of levers and drive connections actuates a pair of routing devices to cut co-related cam patterns in synchronously operated pattern discs.

The recording machine, as appears more fully in Figs. 4 and 5, consists in the present disclosure of a hollow base 20, provided at an intermediate point with a pad or table 21, for the support of the design plate 18, and which latter is indicated as secured by screws 22, extending down through slots 23, in such table, said plate being thereby accurately located between the rotary holders 24, 25, carrying the discs 26, 27, in which the pattern cams are cut.

The tracing wheel indicated at 28, is in the nature of a "feeler," keyed or geared to the design sunk in plate 18, by having small knobs or spurs 29, on its periphery to engage and mesh with the spaced depressions 19.

As best shown in Figs. 6 to 10, the tracer is carried by a shaft 30, journaled in a yoke 31, at the lower end of a carrier 32, which has affixed to the upper end of the same a hand wheel 33, by which the tracer can be guided and propelled over the design outlined on the plate.

The rotary or linear travel of the tracer is transmitted through bevel gears 34, 35, vertical shaft 36, and spur gears 37, 38, to a sprocket gear 39, journaled on the upper shaft or neck portion 40, of the carrier, centrally over the tracer. Pivotaly engaged with this central or axial portion of the carrier above the gears 38, 39, are the ends of the two links 41, 42, which are pivotally engaged at their opposite ends at 43, 44, with the outer ends of the two levers 45, 46. These levers are pivotaly mounted on the base at 47, 48, intermediate their ends and for recording purposes, carry at their inner ends electric motors 49, 50, carrying the routers or tools 51, 52, for cutting the pattern grooves 53, 54, in the cam discs 26, 27.

The holders 24, 25, for the pattern discs are fixed on the upper ends of shafts 55, 56, and these shafts are connected at the bottom within a hollow base by sprocket gears 57, 58, and chain 59. Thus the holders are connected to turn in unison.

The pattern discs are shown as set in seats 60, 61, in the holders and centered by engagement over the upper ends of the shafts 55, 56. The discs are keyed to turn with the holders by pins 62, extending down through openings 63, in the discs 12, into key seats 64, in the holders. These key pins are shown as removably secured in place by being carried by radially projecting arms 65, removably secured over the upper threaded ends of the shaft 55, 56, by the nuts 66.

Rotary motion is imparted to the holders, during recording, in accordance with linear travel of the tracer by connections including the chain 67, Fig. 5, extending from the sprocket pinion 39, on the shank of the tracing wheel carrier to pinion 68, journaled on the elbow pivot 44, and which carries a pinion 69, for the chain 70, extending to pinion 71, on the pivot stud 48, of lever 46. The last mentioned pinion carries or has attached to it a pinion 72, from which the chain 73, extends to gear 74, on the upper end of vertical shaft 75, which carries at its lower end pinion 76, from which chain 77, extends to the gear 78, on the lower portion of the holder shaft 56.

Annular shoulders 79, cut within the rims of the holders 24, 25, provide annular reliefs about the edges of the pattern discs, where the routers will be free for starting and finishing purposes to effect a leading-in movement of the routers from such starting grooves. The drawing or plan 16, may be made with a leading-in and or

leading-out row of dots 80, Fig. 1, thus to provide the design sunk in the plate 18, with a lead-in and or lead-out row of depressions 81.

Recording

From the dot-line drawing Fig. 1, of the shape which it is desired to produce, the etched engraving, Fig. 2, is made in reverse, with the equally spaced depressions 19, forming a design corresponding to the original layout and proportioned in size to suit the size of the machine and other conditions.

The etched design plate is secured in its position on the table 21, Fig. 3, and the holders are rotated to bring them to the correct starting position. At such time, the tracer 28, should be below or forward of the design plate 18, with the levers 45, 46, swung inward at the top and outward at the bottom to locate the routers 51, 52, in the rest or inactive channels 79, in the rims of the disc holders 24, 25.

The routers 51, 52, are then in position to start cutting into the rims of the discs 26, 27, clamped in the holders. Accordingly, the tracer is advanced by handle 33, to mesh the knobs or spurs 29 on the wheel with the entry row of depressions 81, and thus to cause the cutters to cut entrance ways 82, 83, preliminary to the forming of the pattern grooves 53, 54.

The linear travel of the wheel through the gearing and sprocket chain connections described, effects a synchronous rotation of the pattern discs and the bodily travel of the tracer through the link and lever connections with the cutters, effects the cam form producing movements of the cutters, the cam patterns in the two discs may be alike or wholly unlike, depending upon the shape which is being traced, but in the end, two cam patterns will be produced which may be used in turn to recreate the original design.

To enable the tracing of sharp inside corners and the like, means are provided by which the tracing wheel may be swung bodily through any desired angle, upon any one of its spurs or teeth as a center.

The means for pivotally holding the tracing wheel are shown in Figs. 6 to 10, as comprising a push button 84, on the upper end of a rod 85, extending down through the center of a carrier 32, and having a cup 86, at the lower end engageable with the spur of the wheel at the top, which is directly opposite the spur at the bottom in engagement with the depression about which the wheel is to be turned. This push button construction is normally retracted by spring 87, and a finger releasable catch is shown at 88, for temporarily holding the push button down in the pivoting position.

When a point is reached where the tracer wheel is to be sharply angled, the button 84, is pushed down to lock the wheel on the depression about which it is to center, Figs. 8 and 10, and the wheel is then turned bodily about this axis in the direction in which it is then to travel, as indicated in Fig. 9, such movement being effected through the hand wheel 33, at the top of the carrier. When such a change in direction is effected, the locking or centering device is released by releasing the catch 88, which then leaves the tracer wheel free to be advanced over the design.

Reproducing

Since the facsimile reproduction simply involves use of the patterns created from the orig-

inal design as cams to actuate through the same or a similar organization, the tools or instruments necessary to lay-out such design, the recording machine may be used for this second stage, or for reproduction purposes, an entirely separate machine may be employed.

Figs. 13 and 14 show how the single machine can be converted from one to the other use, by simply replacing the routers at the inner ends of the levers with cam follower rolls 89, 90, which will ride the grooves in the pattern discs and by substituting for the tracer the tool or instrument necessary to effect the reproduction or, where multiple reproduction is desired, connecting the inner ends of links 41, 42, with a pivot 91, forming the actuating center for the pantograph levers 92, 93, pivotally connected at 94, 95, with companion pantograph levers 96, 97, the first pivoted on the base at 98, and the second connected at 99, with an instrument or tool holder 100. The instruments or tools 101, carried by such holder, may be welding or cutting torches, operating on a metal bar 102, to form a plurality of units 103, corresponding to the design originally laid out.

Fig. 13 shows how, in using the same machine, a drive motor 104, is applied to the base at 105, which through bevel gearing at 106, operates the right hand holder shaft 56, the latter then driving the other holder through the chain and sprocket connections 57, 58, 59, between the two holder shafts. Since the synchronously turning cams driven by the motor 104, furnish all necessary propulsion for the reproducing instrument or instruments, the connecting chains employed during the tracing operation, any one or all of them, such as 67, 70, 73, 77, may be removed.

To maintain a constancy of motor speed which will assure thorough cutting, welding or other operations, the motor may be controlled photo-electrically, as indicated at 107, Fig. 13.

While illustrated as employed for cutting out certain desired shapes in metal, it will be appreciated that the invention may be used for many different purposes, such as welding, predetermined outlines, tracing or scribing required figures, routing, cutting, channeling or grooving, riveting, seaming, stitching, light projecting, chemically treating or otherwise performing desired operations according to a predetermined design or plan.

The invention is easily adaptable to these different purposes by the substitution of different instruments. By varying proportions of levers and other parts, patterns can be made and parts produced therefrom on different scales.

In the event that there is no depression at the exact center upon which the tracing wheel is to be turned, then special stop pins 110 and 111 at the front and at the side, Figs. 15, 16, or equivalent may be located on the design plate 18 and the tracer be equipped with a ring or curvilinear abutment member 112, concentric to the axis of bodily turning movement, which will contact said pins to determine the stopping point for one direction of movement and the starting of the tracing wheel at the proper angle from such stopping point.

When the tracing wheel is stopped by engagement of the ring 112, with pins 110 and 111, at the end of the travel in one direction, the wheel may then be turned by partial rotation of the direction governing hand wheel 33, Figs. 6 and 7, to face the tracing wheel in the proper direction to register with the continuing row of depressions

substantially as represented in the diagrammatic view, Fig. 18.

What is claimed is:

1. The herein disclosed method of forming desired outlines, which comprises preparing a drawing with lines formed by spaced dots, etching and engraving from said outline in reverse, to provide spaced depressions outlining the original design, operating a tracing wheel with correspondingly spaced spurs over said outline and meshing with said depressions, driving a pair of cam blanks according to the travel of said tracing wheel over said design and operating a pair of cam groove cutters over said cam blanks in accordance with movement of said tracing wheel in following said design.

2. In apparatus of the character disclosed, the combination of means for synchronously operating two cam blanks, means carrying a pattern of varying outline, a tracer mounted for universal movement to follow the varying outline of the pattern, said tracer and pattern carrying means having spaced elements cooperable to lead the tracer over the outline of the design, special means for stopping the tracer at points where the outline of the design changes in direction and for directing the tracer from such points in the changed direction of the design, cam forming tools operable over said synchronously operating cam blanks and levers forming part of the universal movement mounting for said tracer and connected to shift said forming tools over said cam blanks in accordance with movements of said tracer.

3. In a machine of the character disclosed, the combination of two rotatable cam blank carriers, levers pivoted to have their inner ends swing over said cam blank carriers, cam cutters on the inner ends of said levers, links pivoted together at their inner ends and having their outer ends pivotally connected with the outer ends of said levers, a pattern tracing wheel pivotally mounted on said pivotally connected inner ends of said links and driving connections from said tracing wheel for rotating said cam blank carriers synchronously in relation to linear travel of said tracing wheel.

4. In a machine of the character disclosed, the combination of two rotatable cam blank carriers, levers pivoted to have their inner ends swing over said cam blank carriers, cam cutters on the inner ends of said levers, links pivoted together at their inner ends and having their outer ends pivotally connected with the outer ends of said levers, a pattern tracing wheel pivotally mounted on said pivotally connected inner ends of said links and driving connections from said tracing wheel for rotating said cam blank carriers synchronously in relation to linear travel of said tracing wheel, said drive connections including flexible drive means extending along one of said links from the inner to the outer pivoted end of the same and from the outer pivoted end along the lever to which said link is pivoted to the fulcrum mounting of said lever.

5. In a machine of the character disclosed, the combination of two rotatable cam blank carriers, levers pivoted to have their inner ends swing over said cam blank carriers, cam cutters on the inner ends of said levers, links pivoted together at their inner ends and having their outer ends pivotally connected with the outer ends of said levers, a pattern tracing wheel pivotally mounted on said pivotally connected inner ends of said links, driving connections from said tracing wheel

for rotating said cam blank carriers synchronously in relation to linear travel of said tracing wheel, a pattern supported in position to be engaged by said tracing wheel, said pattern being formed by a substantially flat support having a row of closely spaced depressions outlining the shape of the pattern and said tracing wheel having projections spaced to mesh in said spaced depressions.

6. In a machine of the character disclosed, the combination of two rotatable cam blank carriers, levers pivoted to have their inner ends swing over said cam blank carriers, cam cutters on the inner ends of said levers, links pivoted together at their inner ends and having their outer ends pivotally connected with the outer ends of said levers, a pattern tracing wheel pivotally mounted on said pivotally connected inner ends of said links, driving connections from said tracing wheel for rotating said cam blank carriers synchronously in relation to linear travel of said tracing wheel, said tracing wheel being mounted for bodily turning movement on an axis substantially coinciding with the axis of pivotal connection between the inner ends of said links and means for imparting bodily turning movements to said tracing wheel on said axis to follow the outline of a pattern.

7. In a machine of the character disclosed, the combination of two rotatable cam blank carriers, levers pivoted to have their inner ends swing over said cam blank carriers, cam cutters on the inner ends of said levers, links pivoted together at their inner ends and having their outer ends pivotally connected with the outer ends of said levers, a pattern tracing wheel pivotally mounted on said pivotally connected inner ends of said links, driving connections from said tracing wheel for rotating said cam blank carriers synchronously in relation to linear travel of said tracing wheel and a hand wheel at the pivotal connection between the inner ends of said links and mounted for propelling said tracing wheel along a pattern and for turning said tracing wheel to face the same in the direction of extent of said pattern.

8. In a machine of the character disclosed, the combination of two cam carriers journaled on substantially parallel axes, levers fulcrumed on axes substantially parallel to said first mentioned axes and having their inner ends extending over said cam carriers, means on said inner ends of said levers to engage cam blanks on said carriers, links pivotally connected together at their inner ends and pivotally connected at their outer ends to the outer ends of said levers, synchronous drive connections between said cam carriers and operating connections extending from said pivotally connected inner ends of said links.

9. In a machine of the character disclosed, the

combination of a base, rotatable cam carriers on said base, levers fulcrumed on said base at one side of said cam carriers with their inner ends extending toward said cam carriers and their outer ends extending away from said cam carriers, links pivotally connected together at their inner ends and having their outer ends pivotally connected to the outer ends of said levers, cam cutters on the inner ends of said levers, a pattern mounted beneath the connected inner ends of said links, a wheel for tracing said pattern mounted on said pivotally connected inner ends of said links and means for imparting rotation to said cam carriers in synchronous relation to linear travel of said tracing wheel over said pattern.

10. In a machine of the character disclosed, the combination of a base, rotatable cam carriers on said base, levers fulcrumed on said base at one side of said cam carriers with their inner ends extending toward said cam carriers and their outer ends extending away from said cam carriers, links pivotally connected together at their inner ends and having their outer ends pivotally connected to the outer ends of said levers, means on the inner ends of said levers for cooperation with cam elements on said cam carriers, drive connections extending from said pivotally connected inner ends of said links and gearing connecting said cam carriers to rotate in unison.

11. In a machine of the character disclosed, the combination of a machine base, shafts journaled in parallelism on said base and connected to rotate in unison, means for fixing cam members on said shafts, levers fulcrumed on said base at one side of and substantially parallel with said shafts, with the inner ends of the levers extending toward said shafts and the outer ends extending away from said shafts, means on the inner ends of said levers for cooperation with cam elements rotated by said shafts, links in relatively inclined relation between the outer ends of said levers, means pivotally connecting the inner ends of said links and means pivotally connecting the outer ends of said links to the outer ends of said levers.

12. In a machine of the character disclosed, the combination of a pattern and a tracing wheel cooperable therewith, said tracing wheel being mounted for bodily turning movements and having a curvilinear abutment member substantially concentric with the axis of such bodily turning movements, stops on said pattern positioned for engagement by said curvilinear abutment member and means for effecting turning of said tracing wheel when so engaged with said stops to face the tracing wheel in the direction to follow the outline of the pattern.

THOMAS D. PENTZ.