J. H. REINHARDT.

GEOMETRICAL MACHINE.

APPLICATION FILED MAY 14, 1913.

1,092,170.

Patented Apr. 7, 1914.

2 SHEETS—SHEET 1.

Fig. 4.

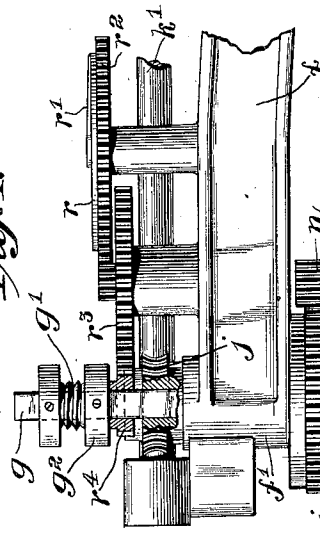


Fig. 1.

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2 SHEETS—SHEET 2.

Fig. 3.

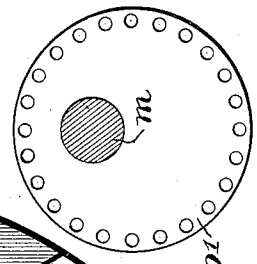
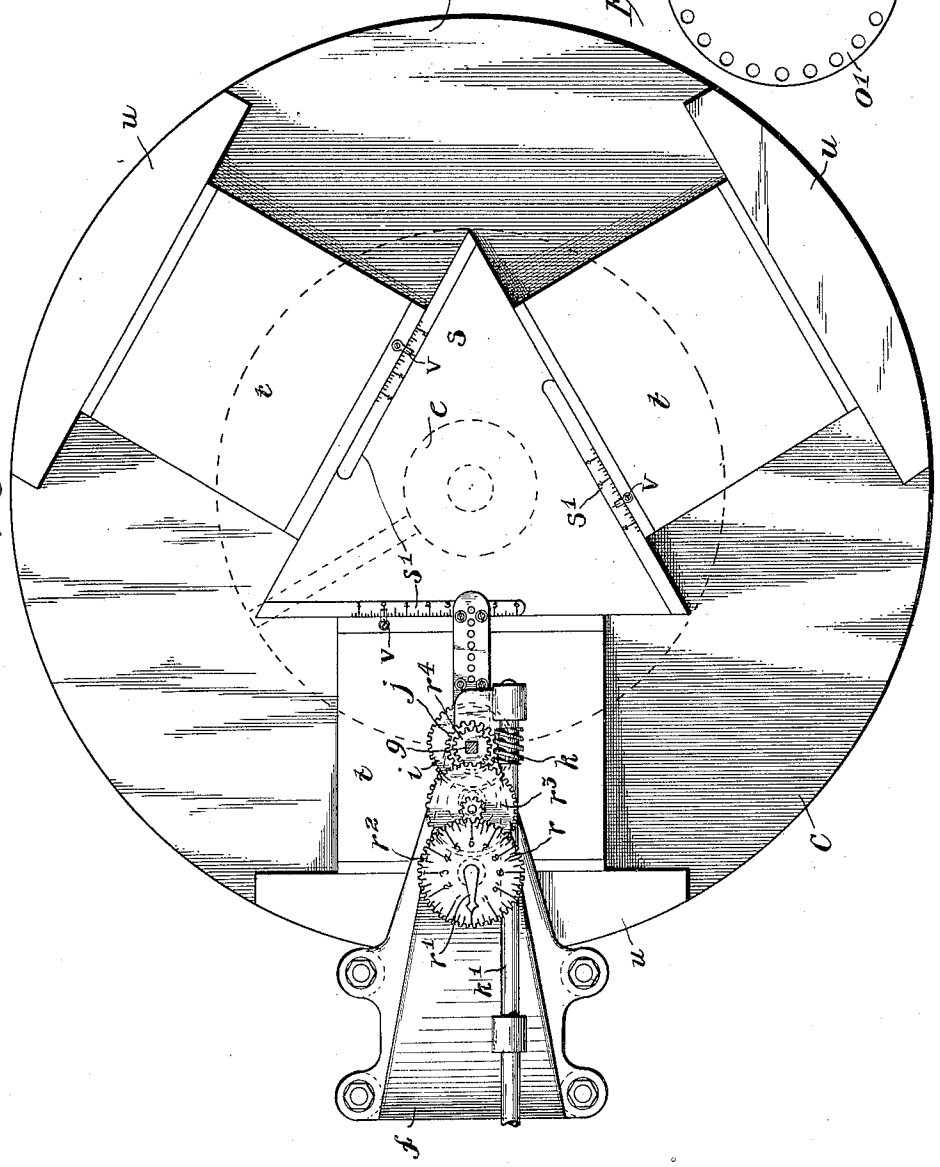


Fig. 2.



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UNITED STATES PATENT OFFICE.

JAMES H. REINHARDT, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO AMERICAN BANK NOTE COMPANY, A CORPORATION OF NEW YORK.

GEOMETRICAL MACHINE.

1,092,170. Specification of Letters Patent. Patented Apr. 7, 1914.

Application filed May 14, 1913. Serial No. 767,501.

To all whom it may concern:

Be it known that I, JAMES H. REINHARDT, a citizen of the United States, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Geometrical Machines, of which the following is a specification, reference being had therein to the accompanying drawings, which form a part thereof.

My invention relates to geometrical machines, and more particularly to a machine adapted for use in connection with the production of plates for printing purposes.

The main object of the invention is to provide a machine of this character wherein a complicated design may be mechanically created upon a plate for producing so-called safety elements in bank notes, checks, drafts or other negotiable paper, the progress in the creation of which design will be so indicated as to permit the stopping and starting of the machine at any point, and the reproduction of any given design by a subsequent operation of the machine.

A further object is to provide a machine of this character wherein a plurality of superimposed designs may be incorporated in a single plate and, at the same time, each design will be dissimilar.

A still further object is to provide a machine of this character adapted to produce a plurality of plates for multi-color work, each of which plates is adapted for use with a different color and will have perfect register with the other plate or plates coöperating therewith to make up the full design.

A still further object is to provide a machine adapted to create a scroll-work, line design, erratic in its character, wherein the number of lines may be increased or diminished at the will of the operator, and the lines may be interrupted at any point to leave ends by means of which the design may be identified. And a still further object is to provide a machine of this character wherein an irregular eccentric design may be created by a mechanism having a regular cycle of operations.

The invention consists primarily in a machine embodying therein a support for the work, a rotary tool head adapted to be brought into engagement with the work, a rotary support for said tool head, the axis of which is concentric to the axis of said head, and means for simultaneously imparting rotary movement of said support and said head about their respective axes; and in such other novel features of construction and combination of parts as are hereinafter set forth and described, and more particularly pointed out in the claims hereto appended.

Referring to the drawings:—Figure 1 is a side elevation of a machine embodying my invention; Fig. 2 is a plan view thereof; Fig. 3 is a detail plan view of the preferred form of tool head; and Fig. 4 is a detail view of the main actuating mechanism and the dial actuating gear train.

Like letters refer to like parts throughout the several views.

In the embodiment of my invention shown in the drawings, *a* indicates the bed of the machine having a circular guide chamber *b* therein for an adjustable supplemental bed *c* provided with a cylindrical sub-base *d* adapted to seat in the chamber *b*. The sub-base *d* is provided with a screw-threaded stem *d'* adapted to coöperate with the clamp nut, *e*, in locking the adjustable base *c* in the desired position upon the bed *a* of the machine.

Carried by the bed *a* is an overhung or goose-neck frame *f*, projecting over the bed *c*, which frame has therein a vertical bearing *f'* for the shaft *g*. Upon the lower end of said shaft *g* and rotatable therewith is a support *h*, and mounted between said support and the frame *f* is a fixed circular rack *i* by means of which rotary movement is imparted to a rotary tool head or holder which will be more fully described hereinafter. The rack *i* is concentric with the axis of the shaft *g*.

Carried by the shaft *g* is a worm wheel *j* adapted to be driven by a worm gear *k* upon the shaft *k'* mounted upon the frame *f*. In the accompanying drawings, I have shown the shaft *k'* as being driven by means of a hand crank k^2, but any other form of driving means for said shaft may be substituted therefor if desired.

The support *h* has at one end thereof a bearing *h'* parallel with the bearing *f'* and eccentric thereto, which bearing is adapted to support the shaft *m* having mounted thereon a pinion *n* constantly in mesh with the circular rack *i* about the bearing *f'*. The arrangement of the support *h*, rack *i*

and shaft m is such that a clear field of rotation is afforded the support h while power may be readily applied to the shaft g. Mounted upon the lower end of the shaft m are the parallel disks o o' carrying a plurality of tool holders p arranged adjacent the periphery thereof, the disks o o' being mounted eccentrically thereof upon the shaft m so as to cause a tool in any of said holders to travel in a path differing from that of any other tool and describe dissimilar lines upon a work plate or sheet.

The end of the support h opposite the bearing h' thereon also carries a plurality of tool holders q, each of which is adapted to describe a true circle upon the work plate or sheet, and any number of which may be used according to the capacity of the machine. In Fig. 1 of the accompanying drawings, I have shown only two of the tool holders q and three tool holders p, as this number is sufficient to illustrate the construction and mode of operation of the machine, and one or more of these holders may be used as desired.

To permit the tools to be brought into and out of engagement with the work plate or sheet, the shaft g is made vertically adjustable, the adjustment being accomplished by means of the screw threads g' upon the upper end of said shaft and the adjustment nut g^2 carried thereby.

The worm wheel j is slidably mounted upon said shaft to permit this vertical movement without loss of adjustment of the driving mechanism, said shaft, in the form of the invention shown, being made square as shown in Fig. 4, to permit this sliding movement of said wheel.

To compensate for the raising and lowering of the support h, the pinion n may be of greater width than the rack i as shown in Fig. 1 of the drawings.

Mounted upon the frame f is a dial r rotatable under a fixed finger r' by means of a gear r^2 and the gear train r^3, the last gear r^4 of which is splined upon the shaft g. In the form of the invention shown, the dial r has twelve major graduations, each of which is divided into four equal minor graduations, the major graduations each indicating one complete revolution of the shaft g, and each minor graduation indicating a quarter or such revolution. Any number of graduations may be employed, however, it being merely necessary to so proportion the gear train r^2, r^3 and r^4 as to cause the rotation of the shaft g to be accurately indicated by said dial and the index finger r' therefor.

By making the rack i and the gear n in exact ratio, each tool or tools carried by the rotary tool holder p may upon each revolution of the support h be brought to the starting point, thus completing a cycle in the operation of the machine as indicated by each major graduation upon the dial r. To make the design more complicated, however, I preferably provide the rack i with teeth in number greater or less than an exact ratio with those in the gear n, thus causing one complete revolution of the shaft g and support h to result in a fraction under or a fraction over a plurality of complete revolutions of the tool holders p. For example, assuming that the gear n has twelve teeth and the rack i has forty-eight teeth, one rotation of the support h will bring each holder p to the starting point at the completion of its fourth rotation. If, however, the rack i has only forty-seven teeth, or forty-nine teeth, the gear n at the completion of one full rotation of the support h will be brought to a position one twelfth of a rotation short of, or one twelfth of a rotation beyond, the starting point, thus requiring twelve complete rotations of the support h to bring each of the holders p to the starting point.

The eccentricity of the disks o, o' in conjunction with the construction above referred to, will increase the complexity of the design as the variance in the radius of any tool p, operative at the starting point, will be determined by the degree of eccentricity of that point relative to the independent axis of rotation of the disks o o'.

A design created by my machine will be eccentric, will have no regular outline or contour except as defined by the tools carried in the holders q, and will vary with the number of tools employed, and the starting and stopping points to which the machine is set as indicated by the dial r.

Distinctive characteristics will be imparted thereto through the broadening of the lines at the points of their intersection with other lines about the center and throughout the body of the design. By reason of the fact that tools may be arranged upon opposite sides of the axes of the plates o o', each of which will describe an independent scroll or helix by reason of the simultaneous rotary movement of the support h and of the disks o o', which helices will be of a diameter determined by the radius upon which each tool acts relative to the shaft m, a plurality of designs will be superimposed one upon the other, the tone quality being darkest toward the center of the design.

As an additional element of safety, it is sometimes desirable to make the scrolls of a plurality of colors. In plate printing each color requires a separate plate, and in order to permit the production of a plurality of plates, I make the work bed c adjustable so that a series of plates may be successively brought beneath the tools and the position of the portion of the design

upon each plate may be accurately determined.

The bed *c* is provided with a poly-sided guide *s*, each side of which is provided with graduations *s'* by means of which a work holder *t* may be accurately and similarly positioned with relation to each said guide. Opposite each side of the guide *s* is a parallel guide *u*, for retaining the holder in the proper position. Any suitable means may be used for locking the holder in the adjusted position.

An index finger *v* is mounted upon each holder, which finger is utilized in conjunction with the graduations *s'* in positioning said holder.

In the accompanying drawings, the guide means is shown as being in the form of an isoceles triangle, but the form of this guide is immaterial to the invention. As more than three colors are rarely used, however, the form of the invention shown is preferable as being suitable for three color work in creating these designs.

The operation of the herein described machine is substantially as follows:—In the use of the machine, the holders *p q* may have mounted therein in any desired manner, markers or cutters, the first of which may be utilized in laying out a design, and the latter of which may be used in actually producing said design upon a plate, either as a graver for removing the metallic surface of the plate, or for removing a resist upon the surface of the plate so that the plate may be subsequently acid etched to secure the desired depth of cut in the plate. The work sheet, whether the same be a metallic plate or a sheet of paper, is secured upon a work holder *t* and said holder is brought below the frame *f* by movement of the bed *c* which is then set in position by means of the nut *e*. If the work is not positioned below the tools as desired, the work holder *t* may be adjusted between the guides *s* and *u*, the amount of adjustment and ultimate position of said holder being determined by the graduations *s'* so that if desired the same design may be reproduced in the same position upon a different plate. The dial *r* is then preferably set at zero and the nut g^2 turned to permit gravity to bring the tools or markers into contact with the work. Power is then applied to the shaft *k'* through the crank handle k^2 or otherwise, thus, through the worm *k* and worm wheel *j* rotating the shaft *g* and the support *h* carried thereby and rotatable therewith. In the form of the invention shown in the drawings, the worm *k* and wheel *j* are so proportioned that ten complete revolutions of the shaft *k'* are required to accomplish one full rotation of the shaft *g*. The movement of the support *h* will cause the gear *n* to travel about the stationary rack *i* while in mesh therewith, thus simultaneously imparting to the tools *p* simultaneous rotary movement about the axes of the shafts *g* and *m*, resulting in each tool carried by the holders *p* describing a helix of irregular form.

In the form of the invention shown in the drawings, the gear *n* and circular rack *i* are in diameter approximately as 1 is to 4, so that with quarter rotation of the support *h*, the disks *o o'* will have described approximately one complete rotation. I say approximately because the rack *i* has incorporated therein an additional tooth or teeth equaling one twelfth of the number of those in the gear *n*. Upon the completion of the first rotation of the shaft *g*, therefore, each tool in the holders *p* will have passed the starting point so that the line formed thereby will not join with the starting point of this line, but will terminate beyond said point. This operation is continued and if it is desired to use a continuous line design formed by each tool, the support *h* must make twelve complete rotations. By using a plurality of tools, circularly arranged about the disks *o o'*, a plurality of intersecting lines may be formed with each rotation of the support *h* and said disks *o o'*. To form a design having no ends to any of the lines entering thereinto, the shaft *k'* must, in the form of the invention shown, be turned 120 times, the result being a mass of intersecting lines having various tone qualities, but having no regularity which can be readily determined or duplicated.

If it be desired to make more than a single cut, the operation of the machine may be repeated, the nut g^2 being actuated after each complete cycle so as to vary the position of the tools relative to the work. The dial *r* will at all times indicate the progress of each cycle of the machine, so as to permit the adjustment above referred to and insure uniformity in the depth of cut throughout the design upon the plate.

In multi-color work, the operation of the machine may be interrupted at any point, the bed *c* carrying a second plate upon the succeeding work holder *d* brought to position beneath the frame *f*, and the work resumed upon this plate at the point where it was interrupted upon the preceding plate, it being merely necessary to properly position the work holder and the plate thereon and bring the tools out of contact with the preceding plate and into contact with the succeeding plate, thus permitting each of the lines entering into the design to be partially of one color and partially of another. Furthermore, by reference to the dial *r*, the tool may be brought into and out of engagement with the work at certain stages in the cycle of operation of the machine, while being brought into engagement with

the succeeding plate during such portions of the cycle, thus permitting alternate lengths of one continuous line to be made in different colors, the register always being absolutely accurate. Furthermore, if desired, tools in some of the holders *p q* may be used in connection with one plate and other tools may be used therein in connection with another plate or plates, thus permitting the incorporation in the design of continuous lines differing in color. Additional eccentricity may be imparted to a design by not operating the machine through one entire cycle, thus leaving ends of the lines exposed which may be used for identification purposes.

By keeping a record of the condition of the dial during different stages of the operation, such as the starting point, stopping point, or point of interruption of the work for color changes, any design may be duplicated by means of the machine, but by reason of the great mass of independent intersecting variable color lines, it is practically impossible to duplicate the design in any other way, particularly as at the intersection of the lines, the width of the lines will vary and when different colors are used the colors will be superimposed so as to prevent the separation of the colors by photographic methods.

Markers or cutters may or may not be used in the holders *q*, as desired, or cutters may be used in said holders during a portion of each cycle of operation of the machine. The effect of such cutters or tools is to describe a circle or circles upon the plate concentric with the axis of the shaft *g*, which circles may intersect the lines of the scroll work made by the tools in the rotary holders *p*, or as an outline border for such lines.

It is not my intention to limit the invention to the precise details of construction shown in the accompanying drawings, it being apparent that such may be varied without departing from the spirit and scope of the invention.

Having described the invention, what I claim as new and desire to have protected by Letters Patent, is:—

1. A geometrical machine embodying therein a support for the work, a rotary tool head, a rotary support for said tool head, the axis of which is concentric to the axis of said head, and means for imparting simultaneous rotary movement of said support and said head about their respective axes.

2. A geometrical machine embodying therein a support for the work, a rotary tool head, a plurality of tool holders carried thereby arranged at different distances radially of the axis of rotation of said head, a rotary support for said tool head, the axis of which is eccentric to the axis of said head, and means for imparting simultaneous rotary movement of said support and said head about their respective axes.

3. A geometrical machine embodying therein a support for the work, a rotary tool head, a rotary support for said tool head, the axis of which is eccentric to the axis of said head, a tool holder carried by said support and spaced away from said tool head, and means for imparting simultaneous rotary movement of said support and said head about their respective axes.

4. A geometrical machine embodying therein a support for the work, a rotary tool head, a plurality of tool holders carried thereby arranged at different distances radially of the axis of rotation of said head, a rotary support for said tool head, the axis of which is eccentric to the axis of said head, a tool holder carried by said support and spaced away from said tool head, and means for imparting simultaneous rotary movement of said support and said head about their respective axes.

5. A geometrical machine embodying therein a support for the work, a rotary tool head, a rotary support for said tool head, the axis of which is eccentric to the axis of said head, means for imparting simultaneous rotary movement of said support and said head about their respective axes, indicating means whereby the location of said tool head and said support will be indicated at all times during the operation of the machine, including therein an indicator dial, and an index finger, and means operative by said support for actuating said indicating means.

6. A geometrical machine embodying therein a support for the work, a rotary support, a fixed rack arranged concentrically with, and about the axis of rotation of, said support, a rotary tool head carried by said support comprising a tool holder, a shaft, and a gear thereon in mesh with said rack, and means rotating said support, whereby said rotary tool head will be turned in a fixed circle and will receive independent rotary movement while moving in said circle.

7. A geometrical machine embodying therein a support for the work, a rotary support, a fixed rack arranged concentrically with, and about the axis of rotation of, said support, a rotary tool head carried by said support comprising a tool holder, a shaft, and a gear thereon in mesh with said rack, means rotating said support, whereby said rotary tool head will be turned in a fixed circle and will receive independent rotary movement while moving in said circle, indicating means whereby the location of said tool head and said support will be indicated at all times during the operation

of the machine, including therein an indicator dial, and an index finger, and means operative by said support for actuating said indicating means.

8. A geometrical machine embodying therein a support for the work, a rotary support, a fixed rack arranged concentrically with, and about the axis of rotation of, said support, a rotary tool head carried by said support comprising a tool holder, a shaft, and a gear thereon in mesh with said rack, means rotating said support, whereby said rotary tool head will be turned in a fixed circle and will receive independent rotary movement while moving in said circle, and means for raising and lowering said support.

9. A geometrical machine embodying therein a vertically adjustable shaft, a support for the work below said shaft, a tool head rotatably mounted in said support, means adapted through the rotation of said support to rotate said tool head, and an adjustment nut carried by a screw threaded portion of said shaft whereby said support and said tool head may be adjusted toward and from said work support.

10. A geometrical machine embodying therein a support for the work, a rotary support, a fixed rack arranged concentrically with, and about the axis of rotation of, said support, a rotary tool head carried by said support comprising a plurality of tool holders carried thereby, arranged at different distances radially of the axis of rotation of said head, a shaft, and a gear thereon in mesh with said rack, and means rotating said support, whereby said rotary tool head will be turned in a fixed circle, and will receive independent rotary movement while moving in said circle.

11. A geometrical machine embodying therein a support for the work, a rotary support, a shaft rotatably mounted in said support, the axis of said shaft being eccentric of the axis of said support, a disk eccentrically mounted upon said shaft, a plurality of tool holders arranged circumferentially about said disk, and means for imparting simultaneous rotary movement of said support and said shaft about their respective axes.

12. A geometrical machine embodying therein a rotary tool head, a rotary support therefor, and means whereby a single complete rotation of said support will cause a relatively disproportionate degree of rotative movement of said head.

13. A geometrical machine embodying therein a rotary shaft, a support carried thereby, a tool head rotatably mounted upon said support eccentrically of said shaft, a tool holder carried by said support upon a radius other than that of said rotary tool head, and means whereby a single complete rotation of said support will cause a relatively disproportionate degree of rotative movement of said head.

14. A geometrical machine embodying therein a tool head, adapted to produce a design, a sequence of work holders, and means for successively bringing said work holders in coöperative relation to said tool head, whereby different portions of the design may be produced upon the work contained in different holders.

15. A geometrical machine embodying therein a tool head, adapted to produce a design, a sequence of work holders, means for successively bringing said work holders in coöperative relation to said tool head, whereby different portions of the design may be produced upon the work contained in different holders, and indicating means for determining the operative position of said tool head at any time.

16. A geometrical machine embodying therein a tool head adapted to produce a design, a bed mounted operatively in relation thereto, a plurality of work holders mounted upon said bed, and means whereby said work bed may be rotated to bring said work holders successively in the operative relation to said tool head, whereby different portions of the design may be produced upon the work contained in different holders.

17. A geometrical machine embodying therein a tool head adapted to produce a design, a bed mounted operatively in relation thereto, a plurality of work holders adjustably mounted upon said bed, a gage whereby each said work holder may be accurately and similarly positioned upon said bed, and means whereby said work bed may be rotated to bring said work holders successively in the operative relation to said tool head, whereby different portions of the design may be produced upon the work contained in different holders.

18. A geometrical machine embodying therein a tool head adapted to produce a design, a bed, a central, equilateral guide thereon, a guide parallel to and spaced away from each side of said central guide, a work holder seated between said guides, and means whereby said bed may be rotated to bring said work holders successively in the operative relation to said tool head, whereby different portions of the design may be produced upon the work contained in different holders.

19. A geometrical machine embodying therein a tool head adapted to produce a design, a bed, a central, equilateral guide thereon, a guide parallel to and spaced away from each side of said central guide, a work holder seated between said guides, means whereby said bed may be rotated to bring said work holders successively in the opera-

tive relation to said tool head, whereby different portions of the design may be produced upon the work contained in different holders, and means for locking said bed in position.

In witness whereof, I have hereunto affixed my signature, in the presence of two subscribing witnesses, this 12th day of May, 1913.

JAMES H. REINHARDT.

Witnesses:
EUGENE UBERING,
CLARICE FRANCK.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."