

April 15, 1930.

L. K. BRAREN

1,754,256

ENGRAVING MACHINE

Filed Dec. 4, 1923

9 Sheets-Sheet 1

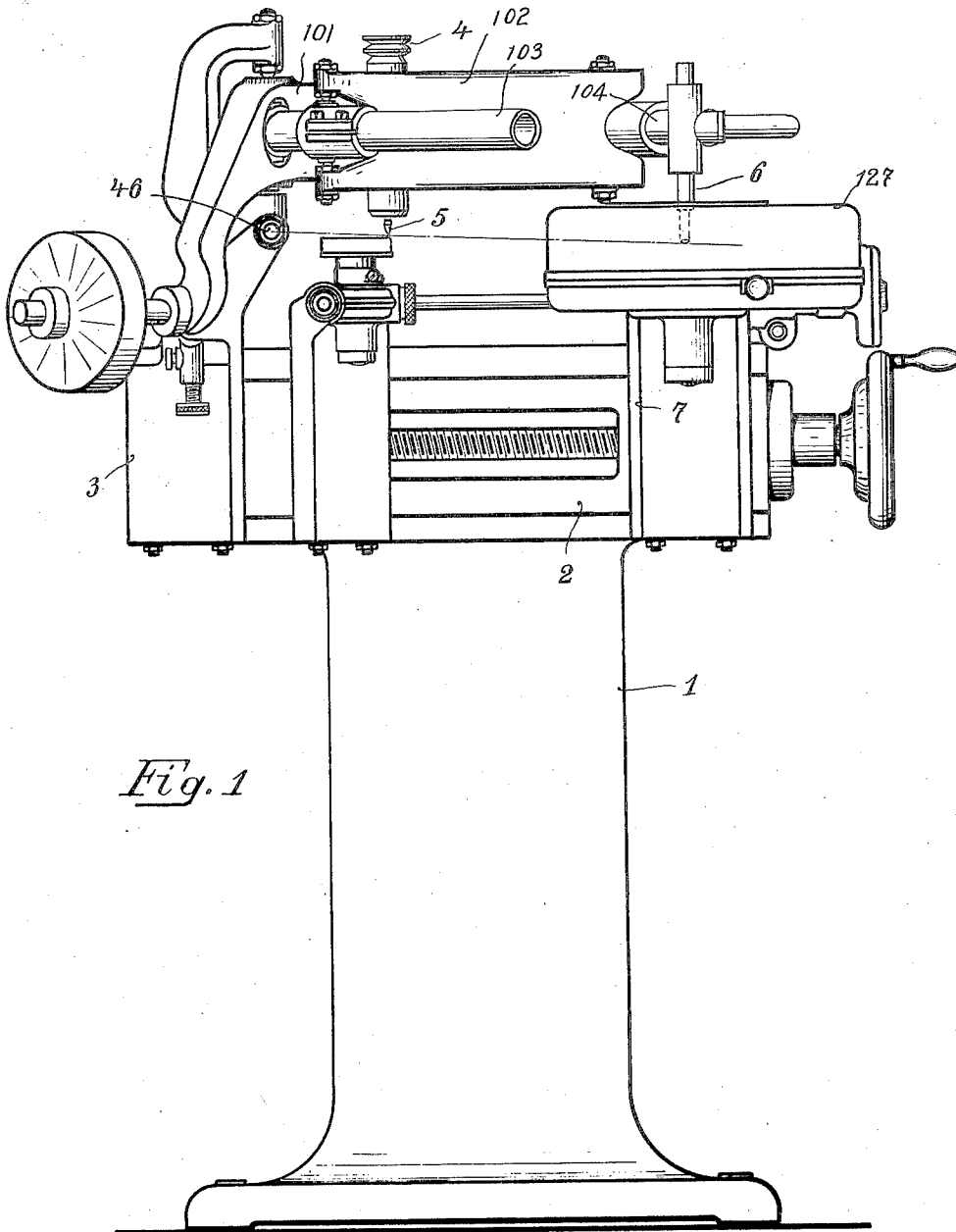


Fig. 1

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April 15, 1930.

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ENGRAVING MACHINE

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9 Sheets-Sheet 2

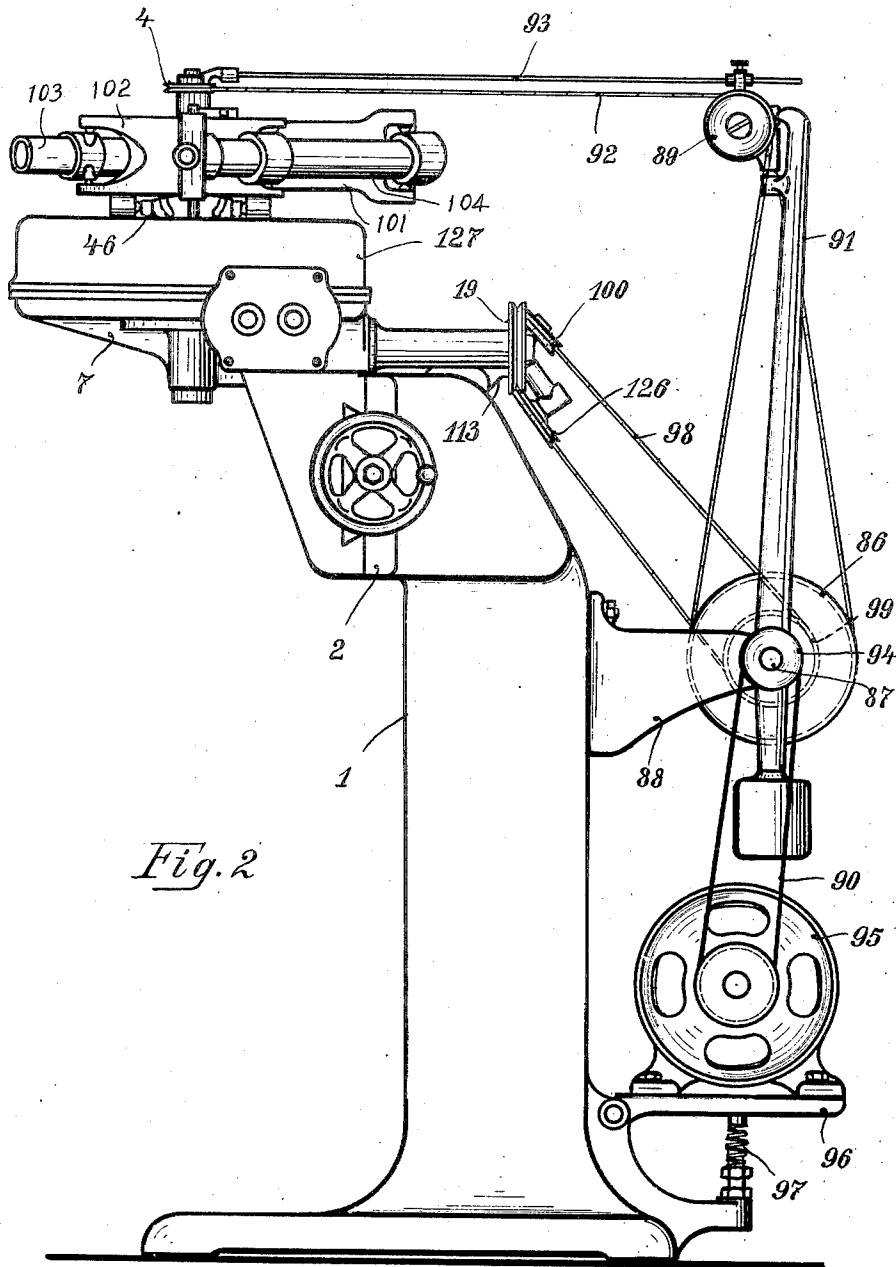


Fig. 2

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April 15, 1930.

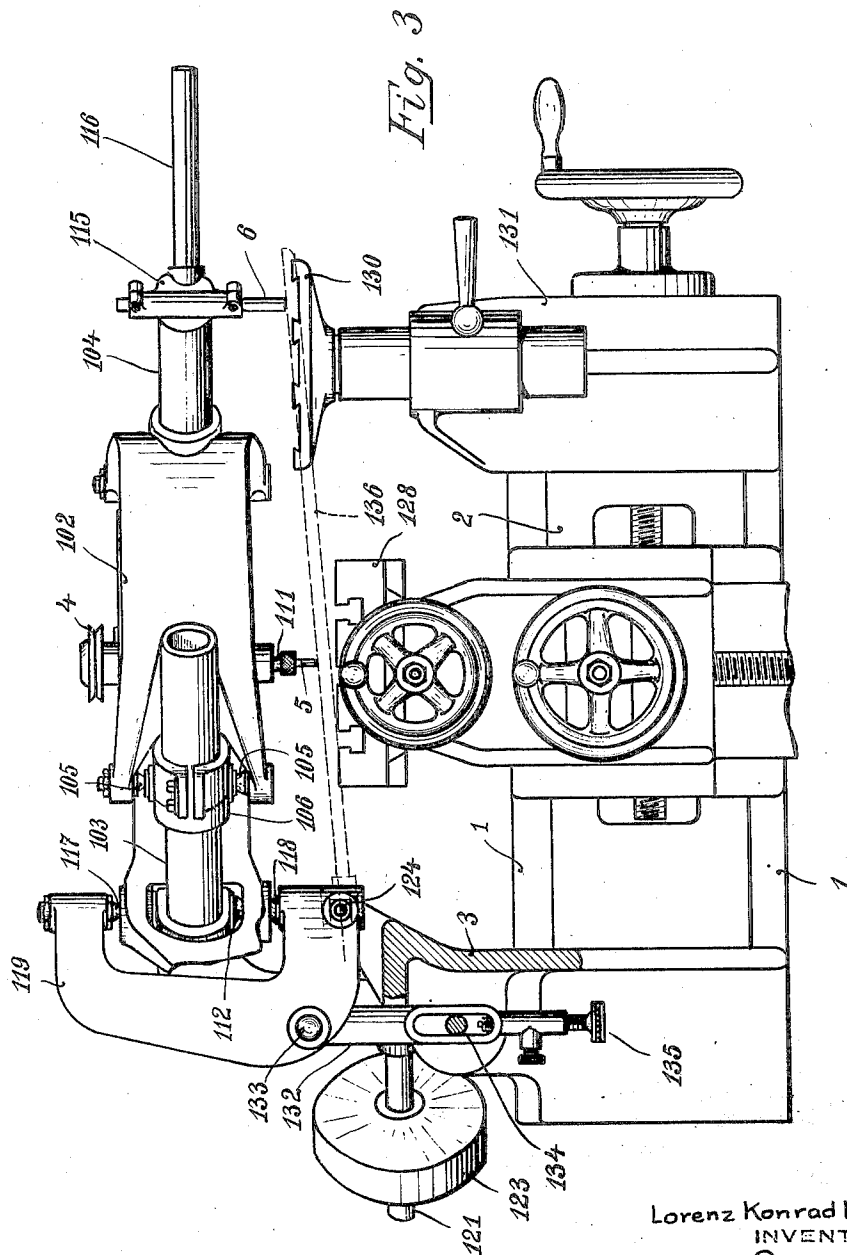
L. K. BRAREN

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ENGRAVING MACHINE

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9 Sheets-Sheet 3



Lorenz Konrad Braren
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L. K. BRAREN
ENGRAVING MACHINE

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9 Sheets-Sheet 4

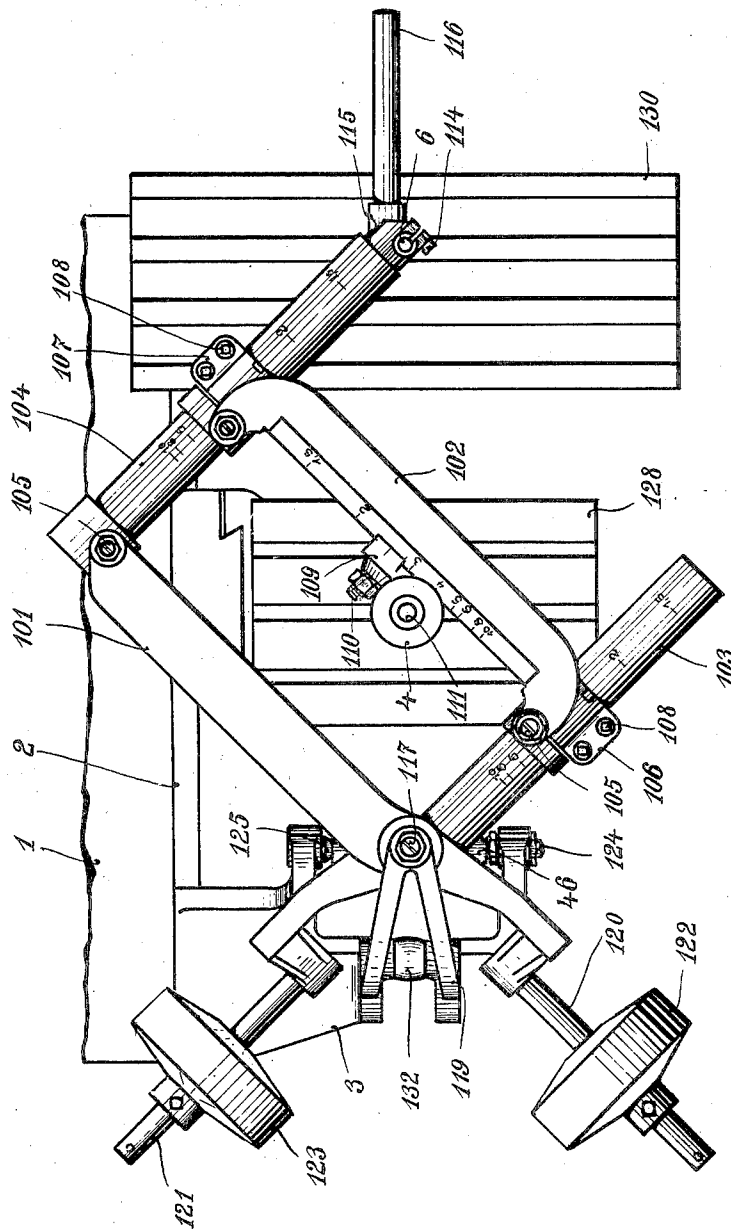


Fig. 4

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9 Sheets-Sheet 5

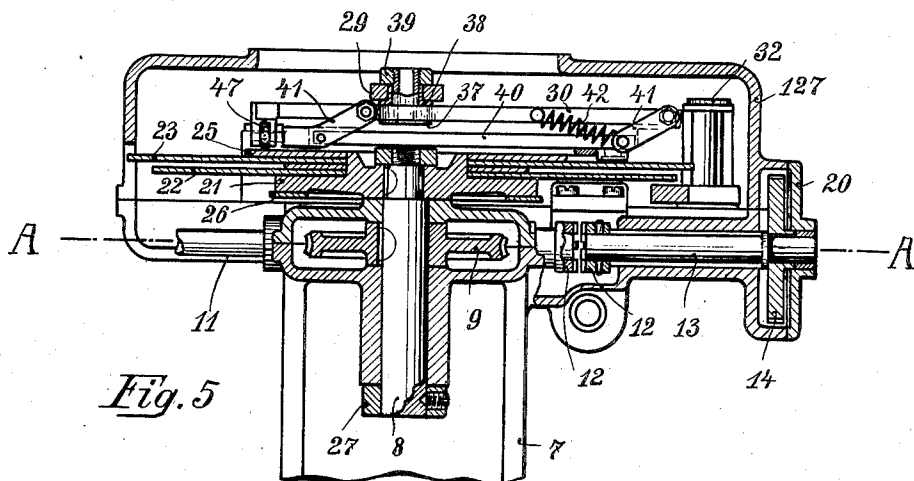


Fig. 5

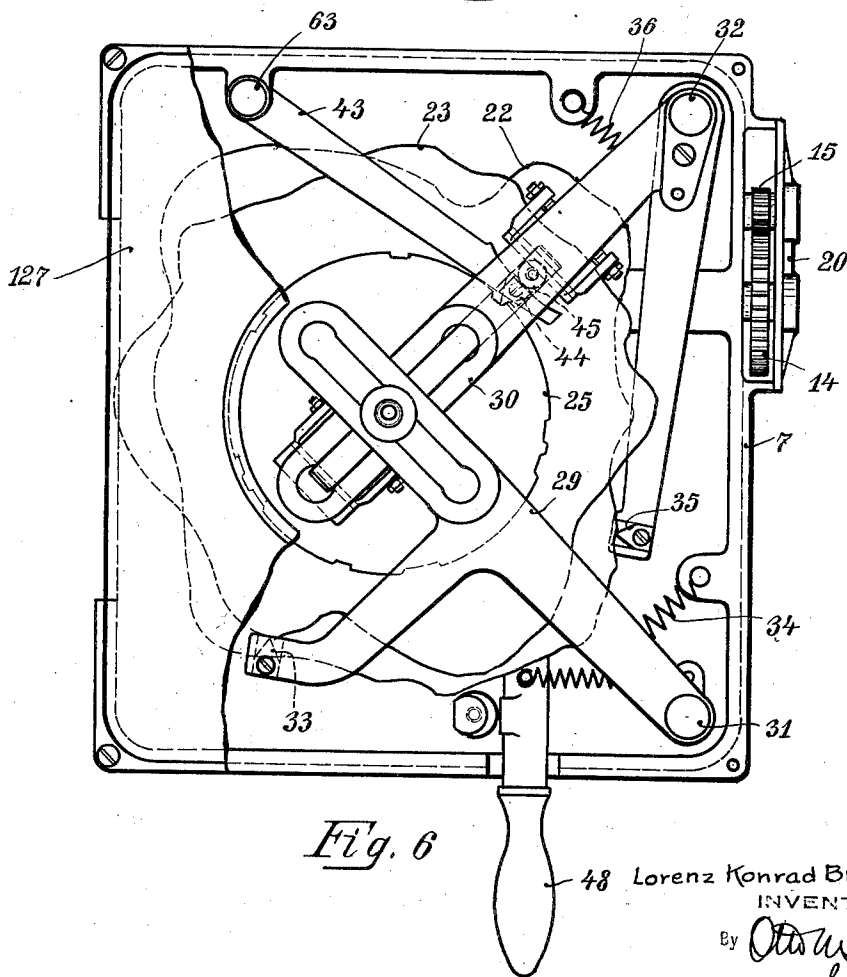


Fig. 6

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1,754,256

ENGRAVING MACHINE

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9 Sheets-Sheet 6

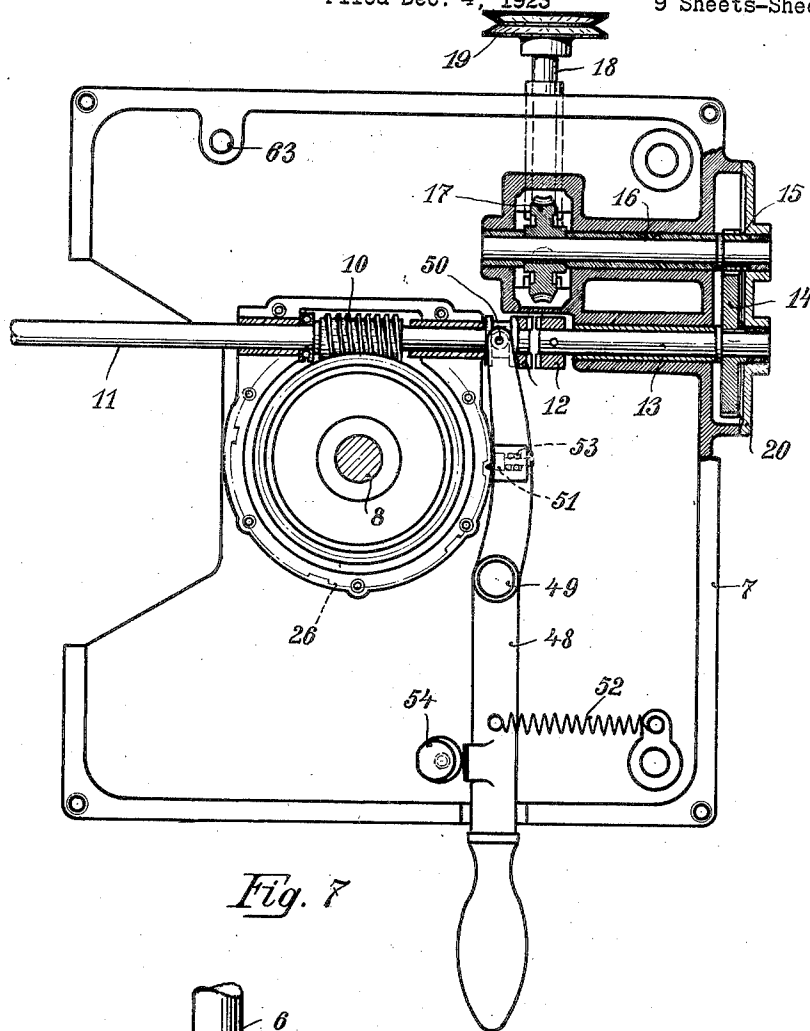


Fig. 7

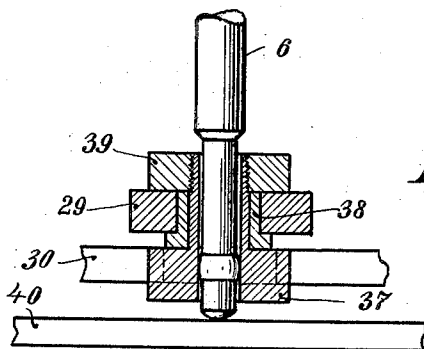


Fig. 8

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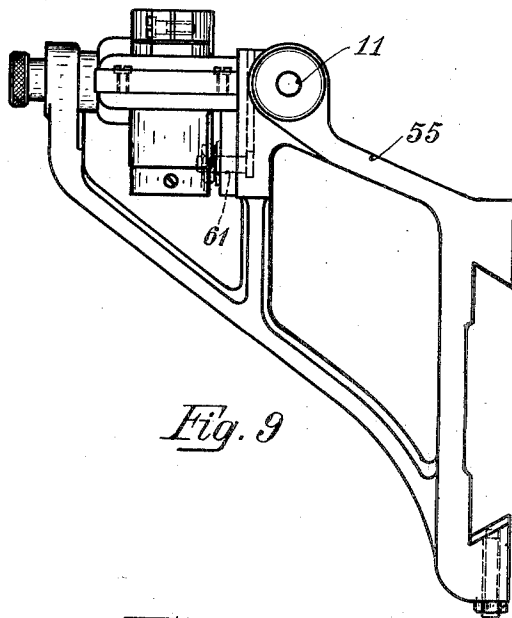
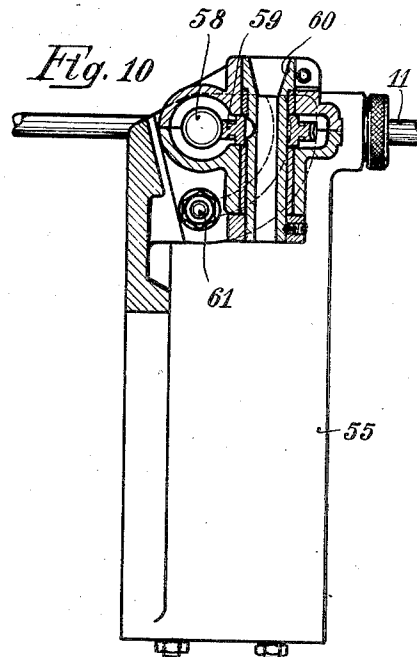
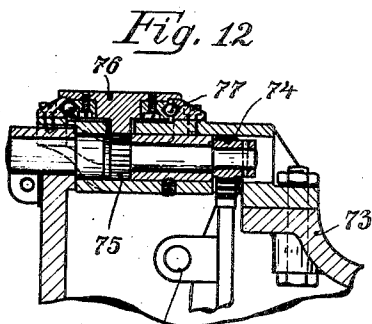
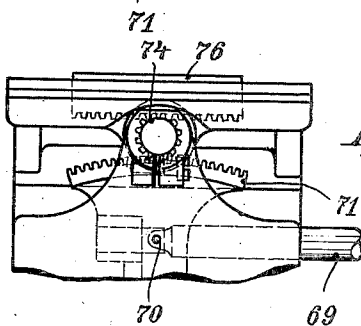
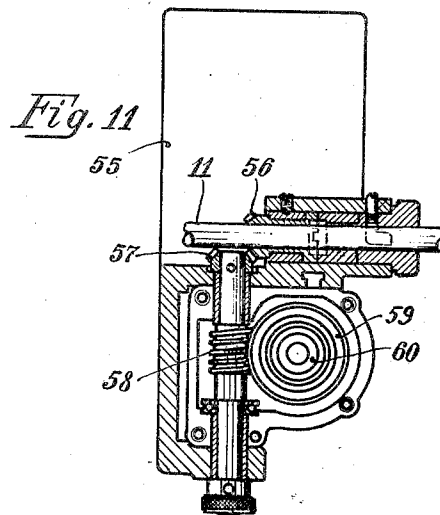
April 15, 1930.

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ENGRAVING MACHINE

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1,754,256

9 Sheets-Sheet 7



Lorenz Konrad Braren
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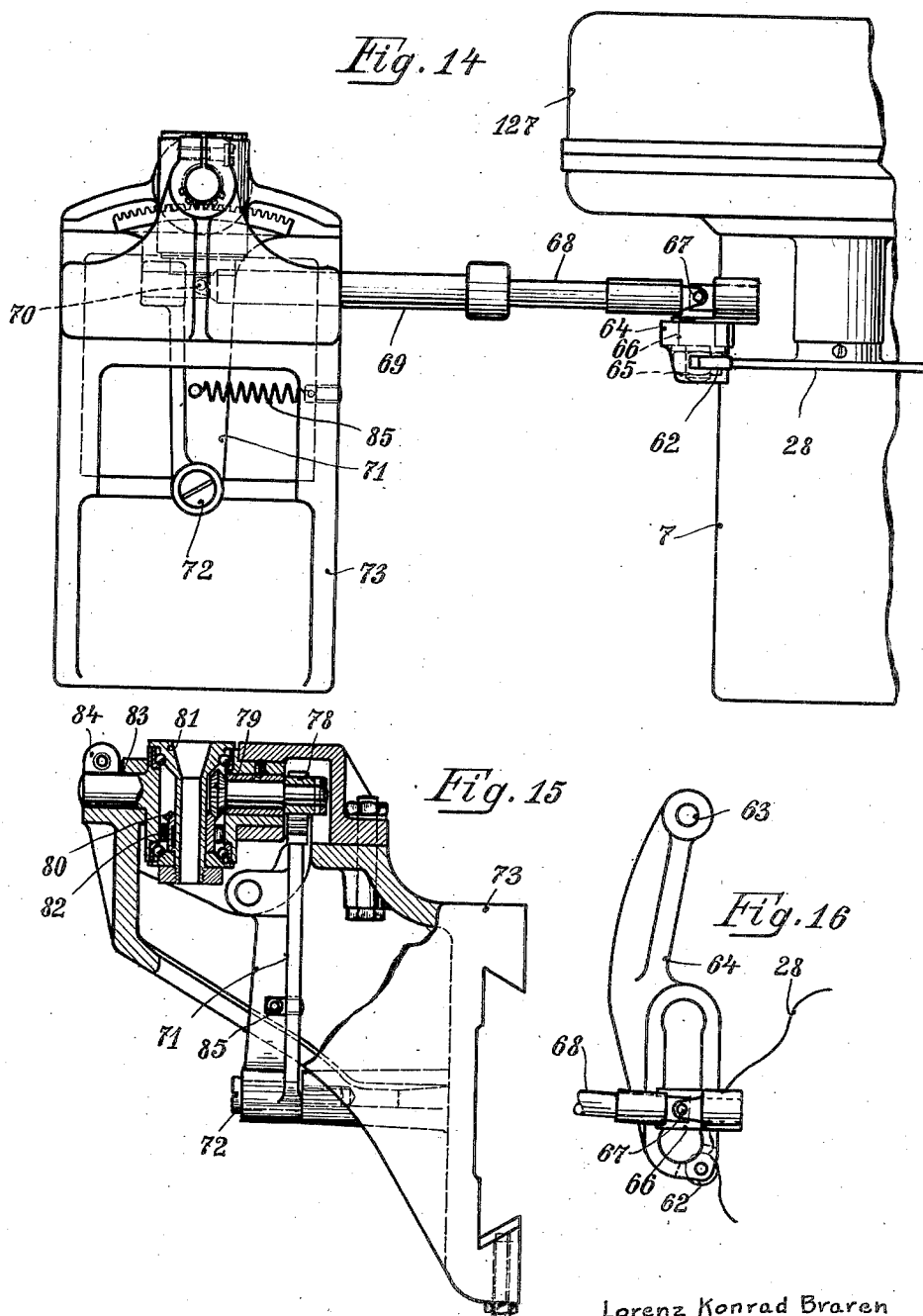
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L. K. BRAREN
ENGRAVING MACHINE

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9 Sheets-Sheet 8



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April 15, 1930.

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ENGRAVING MACHINE

1,754,256

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9 Sheets-Sheet 9

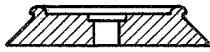


Fig. 17

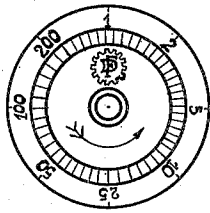


Fig. 18

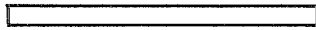


Fig. 21

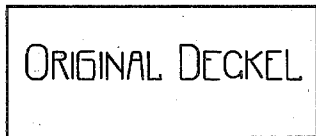


Fig. 22

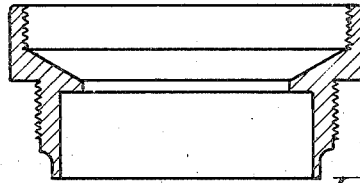


Fig. 19

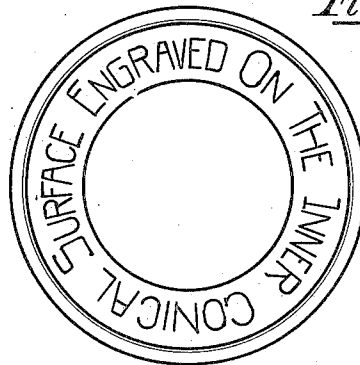


Fig. 20



Fig. 23

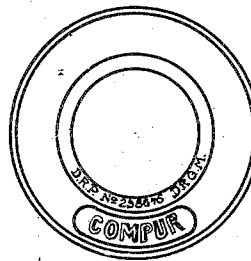


Fig. 24

ENGRAVED ON THE OUTSIDE OF A CYLINDER.

Fig. 25

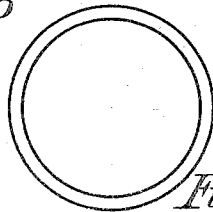


Fig. 26

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UNITED STATES PATENT OFFICE

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ENGRAVING MACHINE

Application filed December 4, 1923, Serial No. 678,485, and in Germany December 28, 1922.

The principal object of my invention is to provide a method, whereby the intricate movement of the tool of an engraving machine necessary for producing a design, a combination of letters and figures or the like is dissolved into component movements substantially at right angles to each other, whereby these movements are fixed on suitable cams and whereby finally the composite movement is reproduced with the help of these cams thus permitting the automatic production of engravings of this kind.

Another important object is to provide an improved type of engraving machine that may be operated with very little effort in three dimensions. A machine of this kind capable to reproduce not only designs on a plane surface but also plastic bodies in true proportion, may also be used to advantage without the automatic features.

There are furthermore provided different work holders and means for moving these work holders to engrave on flat, cylindrical or conical surfaces.

The above and various other improvements will be hereinafter fully described and claimed. In order that this my invention may be more readily understood reference is made to the accompanying sheets of drawings which show how the invention may be carried into practical effect.

Fig. 1 is a front view of the complete machine; Fig. 2 is a side view to Fig. 1; Fig. 3 is an enlarged front view of the upper part of the machine without the automatic mechanism; Fig. 4 is a top view of Figure 3; Fig. 5 is a sectional front view of the automatic mechanism; Fig. 6 is a top view to Fig. 5 with the coverplate partly removed; Fig. 7 is a sectional top view according to the line A—A in Fig. 5; Fig. 8 shows the guiding stylus and its actuating parts in an enlarged scale; Fig. 9 shows a work holder for rotating the part to be worked upon; Fig. 10 is a sectional view at right angles to Fig. 9; Fig. 11 is a sectional view at right angles to the Figures 9 and 10; Fig. 12 shows a work holder in section for giving the part to be worked upon a reciprocating movement; Fig. 13 is a side view to Fig. 12; Fig. 14 shows a work holder for giving

the part to be worked upon an oscillating movement; Fig. 15 is a sectional view at right angles to Fig. 14; Fig. 16 is a top view of the lever transmitting the movement from the cam to work holder; Figs. 17–26 show parts of different shapes that may be engraved automatically with the various work holders shown.

On the face of a frame 1 there is provided a guide 2 by which the bracket 3 carrying the pantographic system and the various work and template holders are supported. The pantographic parallelogram comprising four arms 101, 102, 103 and 104 of which the first two are tubular castings carrying pintle screws 105, while the arms 103 and 104 are made of seamless steel tubing on which sliders 106 and 107 may be clamped by screws 108 in different positions according to the ratio of reduction desired, marking lines on these arms facilitating the adjustment. A bracket 109, providing a bearing for a spindle 111 with a tool 5 fastened in it, is clamped by a T bolt to the face of the arm 102 on which similar marking lines for the adjustment of the spindle sideways have been cut. The spindle 111 is driven by a pulley 4, which is actuated by a belt 92 from a pulley 86 fastened to a shaft 87. The shaft 87 is journaled in a bracket 88, which is fastened to the back of the frame 1 of the machine. Two identical idler pulleys 89 of which only one appears on the drawing, Fig. 2, are carried by an arm 91 pivoted on the shaft 87 and guide the driving belt 92, a connecting rod 93 keeping the idlers 89 at the proper distance. Another pulley 94, fastened to the other end of shaft 87 is driven by a belt 90 from a motor 95 which is mounted on a swinging bracket 96, part of the weight of this bracket being supported by a spring 97 thus tensioning properly the belt 90.

A guiding stylus 6 is located in a bore of a holder 115, which is fastened in the tube 104. Clamping screws 114 permit axial adjustment of the stylus 6. A handle 116 controls the pantograph when guiding the machine by hand.

A shaft 112 is fastened in the pantograph arm 101 and is held to turn easily between two pintle screws 117 and 118 of which the

first is arranged adjustably. The tube 103 turns freely on the shaft 112. In order to balance the one-sided weight of the pantograph system the arms 101 and 103 have been extended to the opposite side of the shaft 112 and there are provided rods 120 and 121 with adjustable counterweights 122 and 123. The pintle screws 117 and 118 are seated in the carrier 119 which is rotatably mounted at right angles to the shaft 112 on a shaft 46 on two pintle screws 124 and 125, located in the bracket 3. When operating the machine by hand a work table 128 is adjustable in all three directions in well known manner and a template table 130 is adjustable up and down in a holder 131, as shown in Fig. 3. A link 132 is pivoted at one end on a bolt 133 in the carrier 119. At the other end there is an elongated slot through which a bolt 134 fastened in the support 3 passes. An adjusting screw 135 limits the depth to which the tool 5 may enter into the material.

For plastic reproductions it is essential that the axis 124—125, the face of the cutter 5 and the face of the guiding stylus be exactly in-line. To facilitate the setting of the cutter and the stylus there is provided a lever 136 as a gauge. This lever fits with a fork-like end over the shaft 46 and has the upper face finished to extend in a plane passing through the center line of the shaft 46.

To produce a line engraving, a design, a letter, figure or the like it is necessary to move the engraving tool in a more or less complicated manner in a plane, while gradations in depth or breaks in the continuity of the line require a corresponding lifting of the tool. Any movement in a plane may be dissolved into component movements at right angles to each other and can in this form be transferred to cams. In the same manner the movement for controlling the depth of the engraving may be fixed on a third cam. When these cams are combined in a suitable mechanism and rotated, they will automatically reproduce the movement desired.

For this purpose the template holder 131 is replaced by a two part housing 7, 127 fitting over the guide 2 and containing the mechanism for guiding the guiding stylus or pantograph moving element 6. A cam shaft 8, journaled in a bearing of the housing 7, is rotated by a worm gear 9 fastened to the shaft. A worm 10 in mesh with the worm gear 9 is fastened on a shaft 11, which shaft is connected by a coupling 12 to a shaft 13. The latter is driven through a pair of change gears 14 and 15 from a shaft 16, which is rotated through a worm gear drive 17 from a shaft 18 and a pulley 19 fastened thereon. This pulley 19 is driven through a belt 98 from a pulley 99 integral with the pulley 86. Idlers 100 and 126 on a bracket 113 guide the belt 98 properly.

The change gears 14 and 15 may be readily

exchanged after taking off a cover 20. In this manner the cam shaft 8 is caused to rotate slowly at an even rate while the speed of rotation may be varied through the change gears 14 and 15. On the upper end of the cam shaft 8 there is fastened a cylindrical body 21 for carrying the cams 22 and 23 which control the movement of the guiding stylus in the plane of the work, and for the cam 25 controlling the vertical movement of the engraving tool 5. A cam plate 26 for controlling the opening and closing of the clutch 12 is fastened to the lower side of the cam carrier 21. Any axial movement of the shaft 8 is prevented by a collar 27. For certain classes of work the work carrier also must be controlled by a cam. In this case the collar 27 is replaced by a cam 28 (Fig. 14).

In order to transfer and combine the component movements from the cams 22 and 23 to the guiding stylus 6, two levers 29 and 30 are pivoted on bolts 31 and 32 respectively in such a way that they act approximately at right angles to each other. A nose 33 fastened to the lever 29 is held by the pull of a spring 34 against the cam 23, while a nose 35 fastened on an arm of the lever 30 is held against the cam 22 by a spring 36. A radial slot is provided in the lever 30 in which a slide 37 fits, while a bushing 38, rotatably mounted on a cylindrical shoulder of the slide 37, fits slidably in a radial slot of the lever 29. Axial movement of the bushing 38 is prevented by a nut 39. The guiding stylus 6 extends through a central bore of the slide 37 and fits with a ball shaped portion against the wall of the bore. In this way only movements at right angles to the radial slots are transmitted by the levers 29 and 30 to the stylus 6. The lower end of the stylus 6 rests on a plate 40 which is held parallel to the lever 30 by two links 41. In this way the stylus 6 with the slide 37 may move back and forth in the slot of the lever 30 without being lowered or raised. A spring 42 tends to raise the plate 40 by swinging it towards the left as shown in Fig. 5. A roller 45 fastened rotatably to the plate 40 limits the movement of the plate 40 by striking against the back of the lever 43 which is pivoted on a stud 63 in the housing 7. A nose 44 fastened to the lever 43 lays up against the cam 25, transferring thus the pull of the spring 42 through the plate 40, the roller 45 and the lever 43 to the cam 25.

The back of the lever 43 is shaped on an arc with a radius struck from the center of the pivot 32, in order to prevent swinging movements of the lever 30 to change the radial distance of the roller 45 from the center 32 keeping in this manner the vertical position of the plate 40 uniform in all different positions the lever 30 may assume. When the nose 44 drops into a recess of the cam 25, the plate 40 actuated by the spring 42 is allowed to swing upwards and to lift the tracing stylus 6 and

therewith the pantographic system and the cutter 5. To prevent deflection of the lever 30 a supporting roller 47 is fastened to the end of this lever and moves on the surface of the cam plate 25.

To stop the machine automatically after completing each part, a lever 48 pivoted on a stud 49 carries on one forked end two rollers which fit in a slot of the loose half of the coupling 12. A spring 52 holds a guiding nose 51 against the cam 26 and causes, when a depression of the cam 26 is passing underneath the nose 51, the uncoupling of the shafts 13 and 11, bringing thus the cam shaft 8 to a standstill. In order to be able to stop the machine also when running, that is when the nose 51 is sliding on the high concentric portion of the cam 26, the nose 51 is arranged slidably with a stiff spring 53 supporting it. By a strong pressure on the handle of the lever 48 towards the right this spring may be compressed and the coupling becomes disengaged. To hold the lever 48 in this position an eccentric roller 54 has been arranged to be turned against a projection of the lever 48.

Different work holders must be used to suit the shape of the parts to be engraved and the form of the engraving. To engrave the flat center portion of a part as shown in Figures 17 and 18 with comparatively limited dimensions, it is best to use a stationary work holder and to shape the cams 22 and 23 to take care of the movement necessary. To engrave however a part as shown in Figures 19 and 20 with a ring-shaped surface where the lettering is approximately evenly spaced on the circumference a work holder turning at the same speed as the cam shaft might be employed. The work holder has to be made adjustable to various angles because circular engravings, for instance in the optical and photographic industries, are frequently located on conical surfaces (Figs. 19 and 20) or on the circumference of tubular objects (Figs. 25 and 26). To make engravings of quite some length on flat surfaces as shown in Figures 21 and 22 a work holder with reciprocating movement is most suitable. In this case the lettering may either be fairly evenly spaced or there may be distinct steps. In the first case the work holder can be advanced evenly while in the second case the same must be moved to suit the engraving to be made with corresponding steps and even portions. Finally parts have to be considered like those shown in the Figures 23 and 24 with the engraving arranged on an arc not extending all the way around the circle. The work holder of course has to be arranged universal to permit of the necessary movements on flat, conical or cylindrical objects.

A work holder for turning at the same speed as the cam shaft is shown in the Figures 9, 10 and 11 where 55 represents the bracket located on the guide 2, adjustable ac-

ording to the setting of the pantograph. In a bearing of the bracket 55 there is rotatably mounted a miter gear 56, a collar with a set screw preventing axial movement. The miter gear 56 is rotated by an extended portion of the worm shaft 11 which drives also the cam shaft 8. A miter gear 57 in mesh with gear 56 is fastened on a worm shaft 58 which is in engagement with a worm gear 59. The latter is fastened to a work holder 60. The ratio of the worm gear 59 to the worm 58 must be the same as the ratio of the worm gear 9 to the worm 10 in order to insure the same rotative speed of the work holder 60 and the cams 22 and 23. A special work holder, not shown, adapted to the particular parts to be engraved is fastened on the work holder 60. The complete holder is rotatable on the worm shaft 58 and is locked after setting by a bolt 61, thus permitting the use of the holder for engravings on cylindrical and conical surfaces.

For straight line engravings the arrangement shown in the figures 12 and 13 and for engravings on an arc the fixture as shown in the Figures 14 and 15 may be employed advantageously. In both cases the drive is identical using the additional cam 28. A lever 64 pivoted on a stud 63 carries a roller 62 which is held in contact with the cam 28. In a radial slot of this lever there may be fastened a sliding part 66 held by a nut 65 at varying distances from the pivot 63. Through two universal joints 67 and 70 and a telescopic connecting rod, consisting of two parts 68 and 69 adjustable to different total lengths, the movement of the slide 66 is transmitted to a gear sector 71, a spring 85 taking up the slack. The sector 71 is mounted on a pivot stud 72 on the bracket 73 which latter fits over the guide 2 and is used instead of the bracket 55.

A reciprocating movement (Figs. 12 and 13) is effected by arranging a gear 74 in mesh with the teeth of the sector 71 while another gear 75 fastened with gear 74 on the same spindle moves the work holder slide 76 back and forth through a rack fastened to the slide. To reduce friction and to prevent any play of the slide 76 the latter moves on balls 77 between suitable guiding pieces. Depending on the design of the cam 28 the slide 76 advances either at an even speed during one rotation of the cam shaft 8 or in a series of steps.

The attachment of engraving on an arc as shown in the Figures 14 and 15 employs also the bracket 73 and the gear sector 71 with its drive. Here a pinion 78 is in mesh with the sector 71 and transmits the movement to a bevel gear 79 in mesh with a bevel gear 80 which is fastened to a work holder 81. A clock spring 82 is fastened with one end to the bevel gear 80 and with the other end to the housing 83 preventing thus dead movement in the gearing. The work holder 81 is held precisely in ball bearings and is designed to

receive special holders made for different parts. The housing 83 besides receiving the work holder 81 furnishes a bearing for the shaft of the bevel gear 79 and is arranged to rotate about the axis of said shaft, so that it may be clamped in any angular position by a screw 84.

Having now fully explained my invention I do not wish to be understood as limiting myself to the exact details of construction, as obviously many modifications will occur to a person skilled in the art.

What I claim is:

1. In an engraving machine a parallelogrammatic pantograph, cutting means, guiding means, both carried by said pantograph, pivoting means on which said pantograph turns, different pivoting means at right angles to said first pivoting means, permitting the pantograph to make three dimensional movements and a removable gauge for setting the points of said cutting and guiding means in line with the center of said second pivoting means.

2. In an engraving machine, a pantograph movable in three dimensions, a rotatable engraving tool moved by said pantograph, a drive for said engraving tool, guiding means for moving said pantograph, a plurality of cams for moving said guiding means, and means interposed between said cams and said guiding means for transferring the movement.

3. In an engraving machine, a pantograph, rotatable cutting means carried by said pantograph, a drive for said cutting means, a plurality of cams controlling the movement of said pantograph means interposed between said cams and said pantograph for transferring the movement, a drive for said cams rotating at a fixed speed, and change gears interposed between said cam drive and said cams.

4. In an engraving machine, a pantograph, cutting means, guiding means, both carried by said pantograph, two levers approximately at right angles to each other, each controlling only the component movement of said guiding means at right angles to the radial line connecting the pivot of said levers and the point where said guiding means is in contact with said lever, and two cams acting each on one of said levers.

5. In an engraving machine, a pantograph, an engraving tool, a guiding stylus, both said engraving tool and guiding stylus connected to and moving with said pantograph, two cams rotating automatically for moving said guiding stylus, two levers for transmitting movements from said cams to said guiding stylus rocking back and forth, each actuated by one of said cams, radial slots provided in said levers, and two slides in said radial slots, one of said slides being mounted rotatably

for rotation on the other slide, said guiding stylus being actuated by said slides.

6. In an engraving machine, rotatable cutting means, a drive for said cutting means, a plurality of cams for controlling the movement of said cutting means, a drive for said cams, a different cam connected to and moving with said first cams, a lever controlled by said last cam, and a coupling for disengaging said drive under control of said lever.

7. In a machine of the class described, a pantograph, cutting means rotatable thereon, means for controlling the movement of said cutting means, driving means for rotating said controlling means, a rotatable work holder, means for driving said work holder and a cam control mechanism for guiding the pantograph adapted to be operated by said driving means.

8. In an engraving machine an engraving tool, a plurality of cams for controlling the movement of said engraving tool, a work holder, a drive for turning both said cams and work holder and means for turning said work holder around an axis inclined to the axis of said cams.

9. In an engraving machine, a pantograph, a tool rotatable upon said pantograph, a rotatable work holder, means for adjusting said work holder to different angular positions, driving means for said tool and work holder, guiding means for the pantograph and a plurality of cams for moving the guiding means arranged to be actuated by said driving means.

10. In an engraving machine, a pantograph adapted to swing about a horizontal and a vertical axis, a tool rotatable upon the pantograph, a rotatable work holder, means for adjusting said work holder to different angular positions, means for clamping said work holder in the various angular positions, driving means for said tool and work holder, guiding means for the pantograph and means for moving the guiding means arranged to be operated by said driving means.

11. In an engraving machine, a pantograph, a tool, means carried by the pantograph for controlling the movement of said tool, a work holder, means for rotating said work holder and said controlling means, and means for adjusting said work holder to different positions with respect to said controlling means.

12. In an engraving machine, cutting means, a plurality of cams for controlling the movement of said cutting means, a work holder and a different cam for controlling the movement of said work holder.

13. In an engraving machine, an engraving tool, a plurality of cams for controlling the movement of said engraving tool, a work holder, a different cam for controlling the movement of said work holder and a common carrier both for said cam controlling the

work holder and for the plurality of cams controlling the engraving tool.

14. In an engraving machine, a tool, a work holder, a plurality of cams for controlling both the movements of said tool and said work holder, a carrier for said cams, and a drive for rotating said carrier.

15. In an engraving machine, a pantograph, a tool, guiding means, both said tool and guiding means being connected to and moving with said pantograph, cams for controlling the movement of said guiding means, a workholder and a different cam for controlling the movement of said workholder.

16. In an engraving machine, a tool, means for moving said tool, a work holder, a cam, means for transmitting movements caused by said cam to said work holder and different means for varying proportionally the movements caused by said cam.

17. In an engraving machine, a tool, means for moving said tool automatically, a work holder, a cam, a lever actuated by said cam, a radial slot in said lever, a slide in said radial slot and connecting means transmitting the movements from said slide to said work holder.

18. In an engraving machine, a tool, means for moving said tool, a work holder, a cam, a segmental gear, moving said work holder and means for transmitting the movement of said cam to said segmental gear.

19. In an engraving machine, a tool, means for controlling the movements of said tool, a work holder, a cam, a lever actuated by said cam and means for transmitting the movement of said lever into a turning movement of said work holder.

20. In an engraving machine a tool, means for controlling the movement of said tool said controlling means turning at an even speed, a work holder, and means for turning said work holder, with interruptions.

21. In an engraving machine, cutting means, a work holder, a plurality of cams for controlling the movements both of said work holder and said tool, a drive for rotating said cams at an even speed and means for turning said work holder at an uneven speed.

22. In an engraving machine, a pantograph, cutting means thereon, means for operating said cutting means, guiding means for the pantograph comprising relatively movable cooperating devices having a member associated therewith and connected with the pantograph for moving the latter, said member being arranged for operation by either of the devices, cams for effecting operation of said devices and driving means for said cams.

23. In an engraving machine, a pantograph, cutting means thereon, means for operating said cutting means, guiding means for the pantograph comprising relatively movable cooperating devices having a mem-

ber associated therewith and connected with the pantograph for moving the latter, cams for effecting operation of said devices, driving means for said cams and means adapted at a predetermined position of the cams to automatically shift the pantograph in a direction to move the cutting means out of engagement with the work.

24. In an engraving machine, a pantograph, cutting means thereon, means for operating said cutting means, guiding means for the pantograph comprising relatively movable cooperating devices having a member associated therewith and connected with the pantograph for moving the latter, a separate cam for effecting operation of each of said devices, driving means for said cams and means for automatically discontinuing operation of the driving means when said cams are in a predetermined operating position.

25. In an engraving machine, a pantograph, cutting means thereon, means for operating said cutting means, guiding means for the pantograph comprising relatively movable cooperating devices having a member associated therewith and connected with the pantograph for moving the latter, cams for effecting operation of said devices, driving means for said cams, manually operable clutch release means for disconnecting said driving means at will and means operated by said driving means for automatically effecting movement of the clutch means to disconnect the driving means when said cams are in a predetermined position.

26. In an engraving machine, a pantograph, cutting means thereon, operating mechanism for the cutting means, a guiding member for the pantograph, an operating device for said guiding member, a pair of cooperating elements on which the operating device is free to move, each of said elements being movable to actuate the operating device, cams for controlling the movements of said elements and driving means for the cams.

27. In an engraving machine, a pantograph, cutting means thereon, operating mechanism for the cutting means, a guiding member for the pantograph, an operating device for said guiding member, a pair of cooperating elements on which the operating device is free to move and each of which elements is movable to actuate the operating device, cams for controlling the movements of said elements, another cam for automatically shifting the pantograph in a direction to move the cutting means out of engagement with the work and driving means for the cams.

28. In an engraving machine, a pantograph, cutting means thereon, operating mechanism for the cutting means, a guiding member for the pantograph, an operating device for said guiding member, a pair of cooperating elements on which the operating

device is free to move and each of which elements is movable to actuate the operating device, a separate cam for controlling the movements of each of said elements, driving means for the cams and another cam for automatically stopping operation of the driving means when the first mentioned cams are in a predetermined position.

29. In an engraving machine, a pantograph, cutting means thereon, a work holder movable adjacent the cutting means, operating mechanism for the cutting means, a guiding member for the pantograph, an operating device for said guiding member, a pair of pivoted elements on which said device is free to move, each of the elements being movable to actuate said device, cams for controlling the movements of said elements, driving means for the cams and the work holder and cam controlled means for automatically discontinuing cooperation of the driving means when the first mentioned cams are advanced to a predetermined position.

30. In an engraving machine, a pantograph, cutting means carried by the pantograph, driving mechanism for rotating said cutting means, guiding means for the pantograph comprising relatively movable elements connected with the pantograph and each adapted to operate the same, individual cams for actuating said elements and driving means for said cams.

31. In an engraving machine, a pantograph movable to swing about different axes, cutting means carried by the pantograph, driving mechanism for rotating said cutting means, guiding means for the pantograph comprising relatively movable devices having a member connected with the pantograph and arranged for operation by either of said devices, individual cams for actuating said devices, driving means for said cams and means for automatically moving the pantograph in a direction to shift the cutting means to inoperative position when the cams are in a predetermined position.

32. In an engraving machine, a frame, a pantograph mounted thereon to swing about different axes, a cutting tool connected with the pantograph, a work holder mounted for movement adjacent the cutting tool, guiding means for moving the pantograph about one axis, cam mechanism for moving the pantograph about the other axis, additional cam mechanism for actuating the guiding means, and driving means for said work holder and said cam mechanisms.

33. In an engraving machine, a frame, a pantograph mounted thereon to swing about different axes, a cutting tool connected with the pantograph, a stylus connected with the pantograph, guiding mechanism for moving the stylus in one direction to move the pantograph about one axis, mechanism for moving the stylus in a different direction to move

the pantograph about the other axis and means for actuating said mechanisms.

34. In an engraving machine, a pantograph, cutting means thereon, driving means for said cutting means, guiding means for the pantograph, operating means for said guiding means, driving means for the operating means and means adapted at a predetermined position of the operating means to automatically shift the pantograph in a direction to move the cutting means out of engagement with the work.

35. In an engraving machine, a frame, work holding means thereon, a pantograph mounted upon the frame and having a cutting member arranged to operate upon the work, guiding means for the pantograph, operating means for said guiding means, driving mechanism for the work holding means and the operating means including a clutch, means adapted at a predetermined position of the operating means to automatically shift the pantograph in a direction to move the cutting means out of engagement with the work and means operated by a portion of said driving mechanism adapted to automatically effect release of the clutch when said operating means is in a predetermined position.

36. In a pantograph control mechanism, a pair of cams, a pair of levers mounted to swing at one side of the cams and having operating portions engaging the cams, said levers being provided with angularly disposed slots arranged one opposite another, a slide mounted in one of said slots, a second slide mounted in the other slot and rotatable upon the first mentioned slide, said slides having registering openings therein adapted to receive a stylus on the pantograph whereby to guide the latter and means for driving the cams.

37. In a pantograph control mechanism, a pair of cams, a pair of levers mounted to swing at one side of the cams and having operating portions engaging the cams, said levers being provided with angularly disposed slots arranged one opposite another, a slide mounted in one of said slots, a second slide mounted in the other slot and rotatable upon the first mentioned slide, said slides having registering openings therein adapted to receive a stylus on the pantograph whereby to guide the latter, a member swingingly mounted upon one of the levers adapted to receive and form a support for the stylus, means for moving said member in a direction to effect axial movement of the stylus, a cam normally holding said member against movement and adapted in one position of operation to free it for movement in the direction of the stylus and driving means for said cams.

38. In a device of the class described, a frame, a pantograph mounted thereon to swing about different axes and including a stylus, guiding means engaging the stylus to

move it in different directions whereby to swing the pantograph about one axis, a device engaging the stylus and associated with said guiding means adapted under predetermined operating conditions to effect axial movement of the stylus whereby to move the pantograph about another axis, and operating means for said device and said guiding means.

39. In apparatus of the class described, pantograph mechanism having an element for moving the same, a reproducing element controlled by said pantograph mechanism, a plurality of driven cams, and mechanism connected with said moving element and actuated by said cams for combining the motions produced by said cams and transmitting said combined motion to said moving element and pantograph mechanism.

40. In apparatus of the class described, pantograph mechanism having an element for moving the same, a reproducing element controlled by said pantograph mechanism, a plurality of driven cams, mechanism connected with said moving element and actuated by two of said cams for combining the motions produced thereby and transmitting the same to said moving element and pantograph mechanism, and a device actuated by certain of said cams and connected with said moving element for shifting the latter to move said reproducing element out of engagement with the work.

In testimony whereof I hereunto affix my signature.

LORENZ KONRAD BRAREN.