April 9, 1968 M. T. WOOLEY 3,376,647

DRAFTING MACHINE

Original Filed Sept. 17, 1964 3 Sheets-Sheet 1

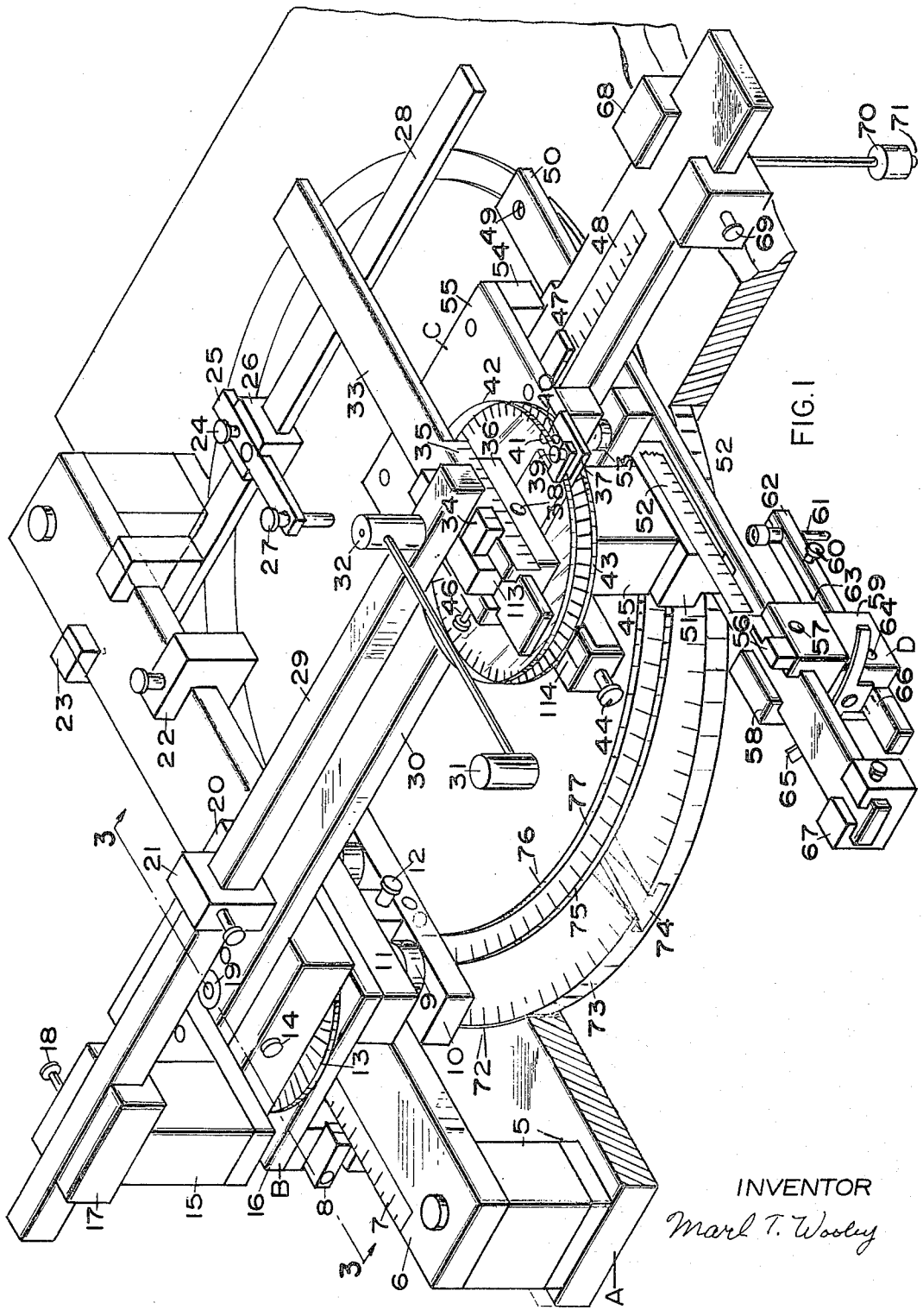


FIG. 1

INVENTOR

Mark T. Wooley

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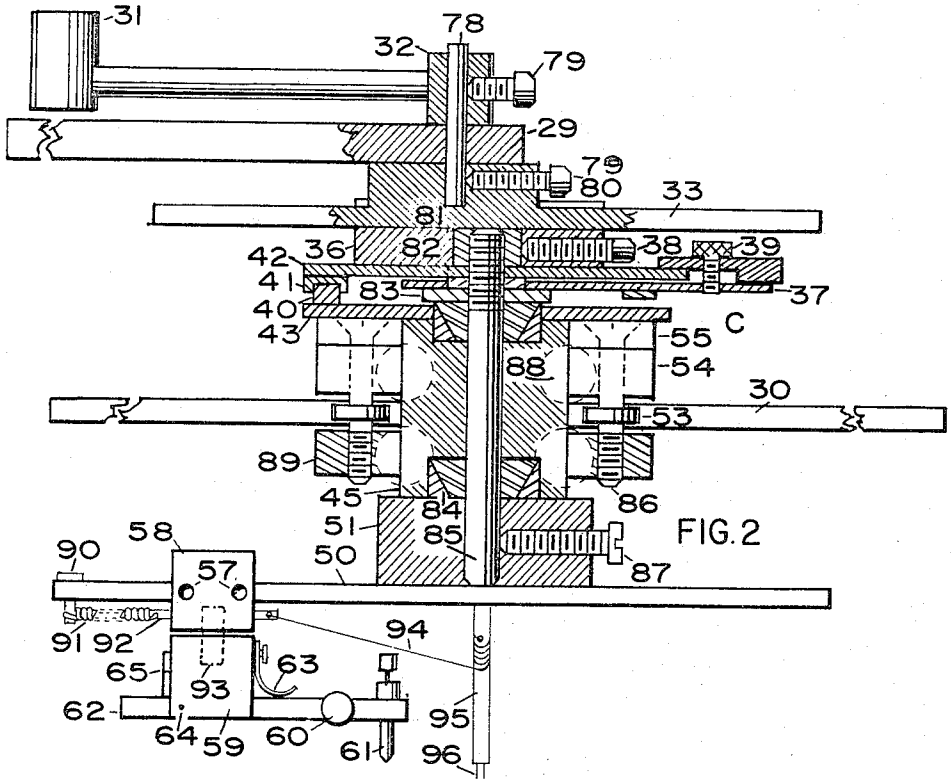


FIG. 2

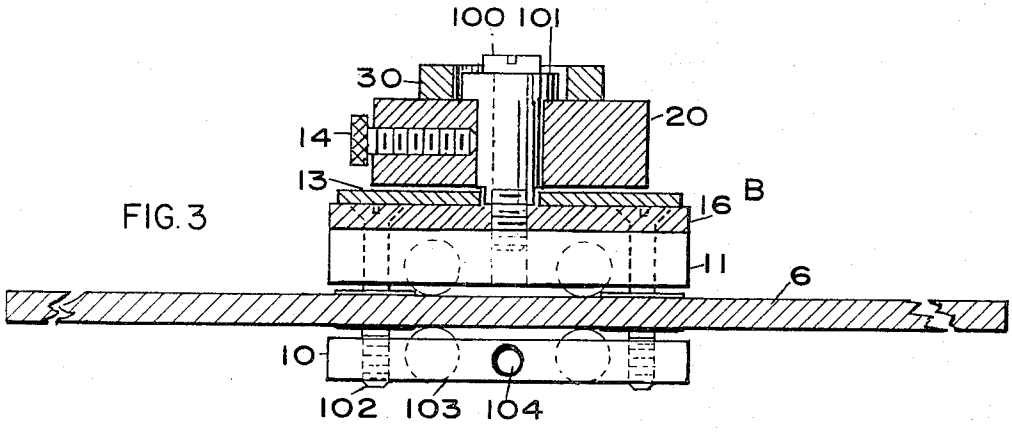


FIG. 3

INVENTOR

Mark T. Wooley

April 9, 1968 M. T. WOOLEY 3,376,647

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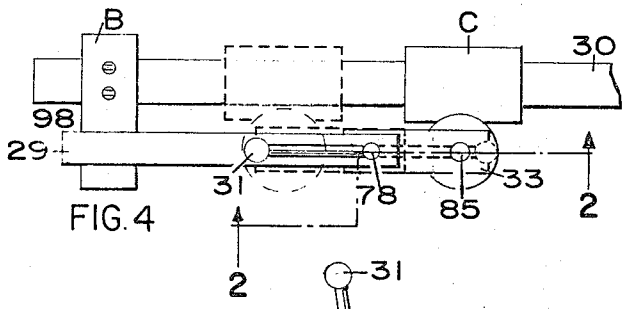


FIG. 4

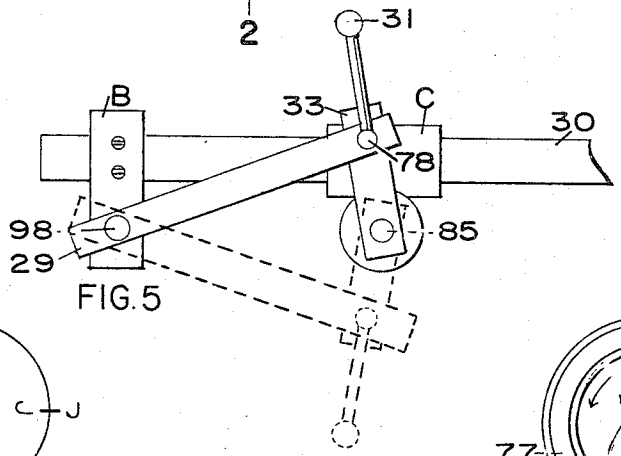


FIG. 5

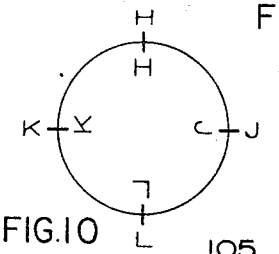


FIG. 10

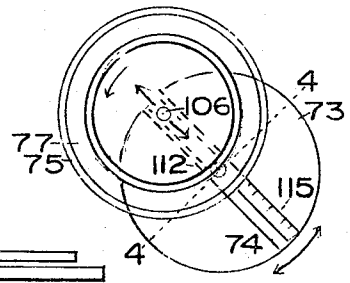


FIG. 6

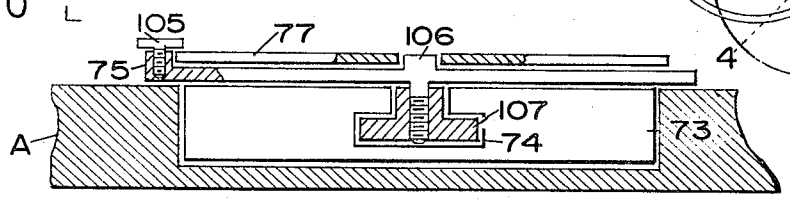


FIG. 7

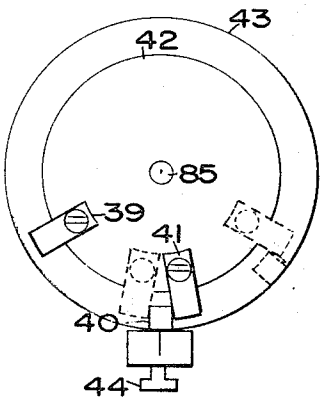


FIG. 8

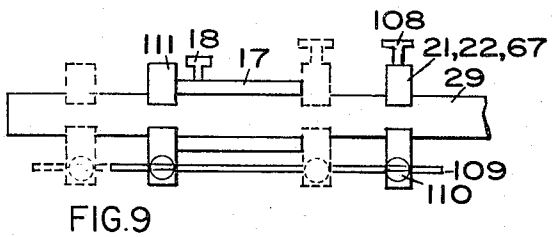


FIG. 9

INVENTOR

Mark T. Wooley

United States Patent Office

3,376,647

Patented Apr. 9, 1968

3,376,647

DRAFTING MACHINE

Marl T. Wooley, 6147½ Santa Fe Ave., Huntington Park, Calif. 90255

Continuation of application Ser. No. 397,329, Sept. 17, 1964. This application Apr. 10, 1967, Ser. No. 629,830

6 Claims. (Cl. 33—30)

ABSTRACT OF THE DISCLOSURE

An ellipsograph for guiding a tool or pen through a circular or non-circular path which includes pivotally mounted pendulum arm and horizontal arm associated at their free ends with a pair of relatively movable pivot pins operating between the free ends of said pendulum and horizontal arms with means for adjusting the relative eccentricity of the pivot pins whereby a carriage mounted on one of said pivot pins will be caused to move through a circular or non-circular path depending upon the relative positions of the pivot pins.

This application is a continuation of application Ser. No. 397,329 filed Sept. 17, 1964, now abandoned.

This invention concerns a drafting machine and more particularly an instrument of geometric nature that provides for the artist and draftsman a machine that facilitates lay-out, design, and inking details by combining both lay-out and inking work into one operation where ever possible.

The instrument of the present invention operates easily, is accurate, versatile, and has a "sense" of touch. It is hand operated and has been found useful in technical illustration, isometric, and perspective detail.

This drafting instrument will draw straight lines such as horizontal or vertical lines as well as inclined lines such as radial lines found on dials and obtuse and acute angles found in geometric figures. The machine will also draw circles with or without centers and ellipses with major and minor radii which can be changed or adjusted simply, giving untold sizes and shapes. These ellipses may also be drawn at any desired angle. In addition a dial and lettering device makes it possible to draw numerals and letters around the circumference of a dial with the letters either upright and vertical to each other or oriented away or toward the center of the dial. This same dial and lettering device is very useful in floral and composite designs.

This instrument will also draw spirals, perspective and isometric configurations through simple adjustment to its parts; and in addition, duplication processes such as cross hatching, dial calibrations, pattern repetition etc. is greatly simplified by the inclusion within the machine of devices called repeat devices.

This instrument is adapted to solve many lettering problems found in fonts of difficult nature, and it will draw with pencil and ink and it has cut clean silk-screen stencils. It is to be understood that this invention is not limited in use to employing a scribing or marking tool as its sole source of expression of its movements, but rather that it is capable of being used with other tools such as machine cutting, dentist drills, cutting torches and welding electrodes.

This machine performs the drawing work of such drafting instruments as T-square, assorted triangles, compasses and dividers, scales or rules, pencils and ruling pens, irregular curves and protractors. The function of each above named drafting instrument and others is contained within this drafting machine. The advantage of this combination of drafting functions is that it speeds up drafting and that the accurate relationship of the machine's

metal parts is not subject to change or wear and tear like the more conventional instruments which must be checked and corrected frequently. Moreover the instrument is ready for instant use; that is, direct inking without pencil layout for many of the simple drafting problems and in addition it is not necessary when drawing with ink to wait for the ink to dry because the entire machine is above the paper and only the pen touches same, thus saving considerable time.

It is, accordingly, an object of the present invention to provide an ellipsograph capable of drawing ellipses and having adjustable major and minor axes and which has a minimum of wear and tear and, hence, permits to draw figures with great accuracy.

A further object of the present invention is to provide an ellipsograph of the type disclosed for guiding a tool for marking purposes or for drawing lines which includes means to rotate the position of an ellipse to be drawn or marked so that the major and minor axes may make any desired angle with a horizontal line, for example.

A further object of the present invention is to provide an ellipsograph of the type disclosed which further includes horizontally and vertically slidable carriages for drawing horizontal or vertical lines as well as lines at an angle.

In accordance with the present invention an ellipsograph for guiding a marking tool or a pen includes essentially three pivot points. A pendulum arm is pivoted about the first pivot point and has its other free end connected to the second pivot point. Means are provided for adjusting the relative positions of the second and third pivot points. This determines the major and minor axes of an ellipse to be marked or drawn. Hence, when the pendulum arm is rotated about its three pivot points a marking tool will describe an ellipse.

In addition means are provided for rotating the position of the second pivot with respect to that of the third pivot point. This, in turn, permits to rotate the position of the major and minor axes of an ellipse with respect to a given horizontal line.

Further, it is to be understood that this invention is not to be limited by the particular drawing shown in terms of construction and arrangement but rather may employ alterations within the plane of reference of the invention.

These together with other objects and advantages which will become apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawing, forming a part hereof wherein like numerals refer to like parts throughout, and in which:

FIG. 1 is an isometric view of the drafting machine;

FIG. 2 is a partial cross-sectional view taken on the line 2—2 of FIG. 1 with the elements arranged in the position shown in FIG. 4;

FIG. 3 is a cross sectional view as indicated by and along the line 3—3 of FIG. 1;

FIG. 4 is a diagrammatic top plan view showing the principles of motion involved by the top portion of the ellipse mechanism in forming an ellipse;

FIG. 5 is a diagrammatic top plan view showing the principles of motion involved by the top portion of the ellipse mechanism but with the eccentric crank at nearly angles to that shown in FIG. 4;

FIG. 6 is a diagrammatic top plan view of the dial and lettering device discs showing the principles of motion involved in their use;

FIG. 7 is a cross sectional view of the dial and lettering device along the line 4—4 of FIG. 6 when the discs 73, 75 and 77 are concentric about the center 112;

FIG. 8 is a diagrammatic top plan view of the rotary repeat device;

FIG. 9 is a diagrammatic top plan view of the linear repeat device; and

FIG. 10 is a dial design which indicates the letter orientation about a dial and same is used in explanation of the dial and lettering device.

Referring particularly to the drawings, a base member A containing or holding: a fixed cross arm **6** fixed to the base member A on riser blocks **5** having on its top surface and on the far edge a rule **7** fixed to same. Cross arm **6** supports cross carriage B which supports horizontal arm **30** which in turn supports horizontal carriage C. Co-action of these arms and carriages with tool carriage and tool provides the means for execution of vertical and horizontal lines.

A perspective device is slidably attached to cross arm **6** by slider **23** on whose bottom surface is fixed a perspective arm **28**. Slider block **26** moves over the surface of arm **28** and is fixed where desired by thumb lock **24**. A short rectangular arm **25** at right angles to the perspective arm is fixed to slider block **26** and acts to hold and engage and let rotate the radial crank **50** by engaging said crank and arm with a vanishing point pin **27** which passes through a hole in end of arm **25** and through hole **49** in crank **50**. The co-action of the perspective device with the crank **50** is such that if the two are engaged by vanishing point pin **27** than the crank **50** is pivotally moveable at said point of engagement and execution of converging lines is possible.

A dial and lettering device consisting of a protractor disc **73** which turns in a circular cavity cut into base A and a scribe mark for reading same protractor disc being scribe line **72** located on edge of cavity. A T shaped cavity **74** runs from the center of disc **73** to its edge and in this T cavity **74** slides a T shaped block **107** which is attached by a bolt **106** screwed into a tapped hole through its face to its base. The bolt **106** is fixed to disc **75**. The disc **75** acts as a lock device, a bearing surface for disc **77**, and as a protractor. Turning disc **75** counterclockwise turns bolt **106** and thus fixes block **107** in its T slot. Disc **75** may be set at a specified radius because block **107** can slide in channel **74**. The amount of this linear displacement from center is read from rule **115** using edge of disc **75** as reading edge. Disc **77** turns freely about bolt head **106** and is fixed by lock **105** attached to edge of disc **75**. Its edge has a mark **76** for reading protractor disc **75**. The co-action of disc **77** and disc **73** and interrelated disc **75** provides the way wherein disc **77** may be moved and placed and secured in a position eccentrically or concentrically related to the point of rotation **112** of disc **73**. This eccentric and concentric relationship of the points of rotation **106** and **112** of the two discs **73** and **77** provides the means wherein letters may be placed upright and vertical around the circumference of a dial FIG. 10 when the two discs **73** and **77** are eccentrically related to each other and again provides the means wherein letters may be oriented toward or away from circle center and along the axis of the various radii FIG. 10 when the two discs **73** and **77** are concentrically related to each other. In the operation of this dial and lettering device for upright and vertical characters the work tool is located at the center **112** of disc **73** and the work is attached to disc **77**. The tool may move in a horizontal direction but not at right angles to same. In the execution of upright and vertical characters this center point **112** of disc **73** is the circumference location of said characters as provided for by the radial movement of disc **75** and related disc **77**. The letters are made upright and vertical by rotating each disc **73** and **77** a like amount of distance but in opposite directions as predetermined. In the execution of letters oriented toward or away from dial center as those shown inside of circle FIG. 10, disc **77** is concentrically placed on center of disc **73** and the work tool is located on the radius desired and the characters are executed facing toward or away from circle center as desired. Floral composites are executed this way also.

A cross carriage consisting of: a horizontal arm **30** fixed on block **20** which through it's center has hole **19** drilled to fit bearing **101** snugly. Bearing **101** in turn is fixed to plate **16** with bolt **100**. An indented shoulder is cut into bearing **101** at its bottom so that protractor disc **13** is held fixed when bolt **100** is tight. A protruding shoulder on top of bearing **101** prevents up and down motion of block **20**. Thus block **20** and horizontal arm **30** which are fixed to each other may be rotated 120° when thumb lock **14** is released. Support bars **10** and **11** of which there are two to a side are secured to plate **16** with bolts **102** of which there are four. Bolts **102** also secure and fix bearing wheels **9** of which there are four between support bars **10** and **11**. Four bearing wheels are also affixed inside of support bars **10** and **11**, two riding on top of cross arm **6** and two beneath. These last two bearing wheels being on the far side of cross arm **6** and the other two bearing wheels being on the near side of cross arm **6** FIG. 1. A bolt passes through bolt hole **104** and provides the means wherein bars **10** may be drawn together to secure a snug fit of bearing wheels **9** and **103** on cross arm **6**.

Thumb lock **12** is used to prevent motion of carriage B. A rule reading block **8** has a scribe mark on its near end and is used to read rule **7** FIG. 1.

On the unsecured end of horizontal arm **30** is located a slider **68** that is secured with thumb lock **69**. Attached to slider **68** is a shaft that projects to a short cylinder **70** which has a ball bearing **71** in its lower surface. This slidable support device serves the purpose of keeping horizontal arm **30** level and true to block **20** and base A and at the same time permits movement of horizontal arm **30** because of ball bearing **31**. A rule **48** is fixed on center and on the top surface of horizontal arm **30**. A rule reading block **47** with a scribe mark on its near edge is used to read rule **48**.

The pendulum arm **29** has a stop slider **21** shown in FIG. 1 but this stop slider **21** is only a portion of a total device shown in FIG. 9 whose purpose is to provide a device capable of repeating some particular linear dimension over and over again. This device is called a linear repeat device.

The linear repeat device consists of two stop sliders **21** (**22** or **67**) and **111**, a shaft **109** ties stop slider **21** and **111** together by projecting or passing through the hole drilled in the side walls of each slider. These holes being equal and opposite each other. Two set screws **110** hold the stop sliders at the particular dimension selected. One stop slider **21** sits at the near end of block **17** and the other slider **111** (stop slider) sits at the far end of block **17**. With thumb lock **18** fixing pendulum arm **29** from being pushed or pulled in its retaining channel of block **17** as shown in FIG. 9, the total repeat device **111**, **109**, **21**, (**108** being loose or open) is pulled from the dotted line position to the solid line position and thumb lock **108** is turned to secure and fix stop slider **21**. Thumb lock **18** is then loosened and pendulum arm **29** is pushed until wall of slider **21** engages or touches near end of block **17**. Thumb lock **18** is again tightened and the entire process is repeated.

Speaking generally and group wise with intent to clarify terminology and relationship of groups of parts to each other: the ellipse mechanism consists of the horizontal arm **30** which supports a linearly moveable horizontal carriage C which consists of a bearing housing and a vertically attached rotatable crank shaft **85** which supports on its top end a radially slidable eccentric crank **33** which is pivotally connected by a pin bearing **78** to a pendulum arm **29** which is again pivotally attached by a pivot block **17** and an anchor post **15** to the horizontal arm **30** and this combination of parts and their relationship to each other provides an adjustable method to control linear movement of the horizontal carriage C as the crank shaft **85** rotates and also and simultaneously provides the major radius of an ellipse. The crank shaft **85** supports on its bottom

end the fixed radial crank 50 which in turn supports a radially and linearly moveable and adjustable tool carriage D and tool and their relationship of these parts to each other and to those attached to the top of crank shaft 85 provides the radius of a circle or the minor radius of an ellipse and an adjustable method of relating the effective radial position of the work tool 61 to the rotatable crank shaft 85 and also and simultaneously to the effective radial position of the pin bearing 78 which together form the effective radii of the axes of an ellipse or the radius of a circle through the interactions of the rotary motion of the work tool 61 with the linear motion (or lack of same) of the horizontal carriage C.

Speaking specifically and part wise with intent to establish relationship of parts to each other; an ellipse mechanism consisting of: a bearing housing consisting of a housing plate 55 and support bars 54 and 89 of which there are two to a side and which are secured to plate 55 with bolts 86 of which there are four. Bolts 86 also secure and fix wheel bearings 53 of which there are four between blocks 54 and 89. Eight wheel bearings 88 are also fastened inside of blocks 54 and 89, two riding on top of horizontal arm 30 and two beneath or four to a side. Thus there are 6 wheel bearings for each side of the bearing housing, two top, two bottom, and two side bearings. These bearings are fitted snugly about the horizontal arm 30. This fit being further enhanced by a threaded bolt which pulls the two support bars 89 even closer together. The bearing housing provides linear motion parallel to the horizontal arm 30 and perpendicular to anchor post 15. The linear motion of this housing is normally perpendicular to that provided by the cross carriage B though not necessarily so because the horizontal arm 30 may be rotated through an arc of 120° so that the horizontal carriage C would travel at an inclined angle to the cross arm. Part 47 is a rule reading block for scale 48.

A support block 45 is fixed to the near side of bearing housing C. It supports the rotary portion of the horizontal carriage C at right angles to the surface of the work or paper. A hole is drilled the entire length of support block 45 so that crank shaft 85 may turn freely in same. On each end of support block 45 a circular cavity is cut to hold and receive the "races" of thrust bearing 84.

Crank shaft 85 links the curvilinear motion of the components above support block 45 to the components below support block 45. A bolt 87 prevents motion of block 51 on the lower end of crank shaft 85, and set screw 38 prevents motion of the eccentric arm block 36 on the top end of crank shaft 85. A round bearing nut 81 the outer surface of which is a bearing surface for the eccentric arm block 36, also secures and prevents the plastic disc 42 from any motion except that imparted from knob 31. A spacing washer 82 provides for the free rotation of repeat arm 37 around its outer edge and at the same time helps to prevent motion of plastic disc 42 by bearing against its bottom surface. A spacing and retaining nut 83 provides the necessary tension against the thrust bearings 84 and at the same time aids in the support of spacing washers 82 and bearing nut 81.

An L shaped anchor post 15 is rigidly fixed to far end of horizontal arm 30. On center of the top surface of anchor post 15 is a tapped hole to retain bolt 97 which extends through center of ball bearing wheel 98 to attach it to anchor post 15. The outer rm of this ball bearing wheel 98 is pressed fit to the bottom and center of pivot block 17 and thus pivot block 17 may rotate or pivot freely when bolt 97 secures ball bearing wheel 98 to top surface of anchor post 15.

Pivot block 17 has a channel milled on center and lengthwise on its top surface to fit and hold pendulum arm 29. A thumb lock 18 retains pendulum arm 29 in this slot or channel. Pivot block 17 serves the purpose of allowing pendulum arm 29 to pivot or rotate and also to slide or move in a linear direction. This linear motion of pendulum arm 29 is necessary in drawing horizontal lines, repeat and duplication steps, centering or placement of circles and ellipses etc.

A pendulum arm 29 the far end of which is held and retained in a channel cut into top surface of pivot block 17 and the near end is held by pin bearing 78 which extends through bearing hole drilled from top to bottom surface of pendulum arm 29 to an eccentric crank 33 located on its bottom surface.

Pin bearing 78 extends through a hole in pendulum arm 29 into a hole drilled on center and into top surface of pin bearing block 113 and is rigidly fixed in the hole by retaining set screw 80. Pendulum arm 29 is rotatably held on pin bearing 78 by retaining cylinder 32 located on top surface of pendulum arm 29.

A shaft at right angles to pin bearing 78 connects retaining cylinder 32 to knob 31 and thus forms a handle or a rigid extension of eccentric crank 33 for rotating crank shaft 85 and its related parts. Thus the handle 31 and eccentric crank 33 are tied rigidly together by pin bearing 78.

Pin bearing block 113 is fixed on top and center of eccentric crank 33 and serves to hold pin bearing 78, set screw 80, and rule reading block 34.

An eccentric crank block 36 has a T channel milled on its center and top surface through which eccentric crank 33 slides. A thumb lock 46 serves to secure and fix eccentric crank 33 in T slot of eccentric crank block 36. A hole drilled on center and from top to bottom of eccentric crank block 36 serves to center same on bearing nut 81. Set screw 38 secures and fixes eccentric crank block 36 to bearing nut 81. The bearing hole in bottom of eccentric crank block 36 and a bearing nut 81 and a set screw 38 allows eccentric crank block 36 to be rotated around crank shaft 85. A rule 35 is fixed to near surface of eccentric crank block 36. Eccentric crank block 36 allows eccentric crank 33 to slide in its T channel and thus provides a displacement of position of pin bearing 78 in relation to the position of crank shaft 85 and pivot block 17. Eccentric crank block 36 also serves the purpose (through being able to rotate around crank shaft 85) of alteration of the spacial orientation of the ellipse. Rotation of eccentric crank block 36 changes the relation of eccentric crank 33 to radial crank 50 and likewise alters the relation of tool 61 to the direction of motion of horizontal carriage C.

The center points of crank shaft 85 and pivot block 17 are parallel to the sides of horizontal arm 30.

A tool carriage D consisting of radial crank 50 on whose top surface is fixed a radial crank support block 51. Crank shaft 85 extends into a hole drilled from top to bottom and on center of radial crank support block 51 and bolt 87 holds same fixed to each other. A rule 52 is fixed to face of radial crank support block 51 and rule reading block 56 is attached to top surface and near face of tool slider 58. Two ball bearings in holes 57 under spring tension and contained by set screws are used to take up any slack or slop of tool slider 58. Tool bar support block 59 is secured to bottom of tool slider 58 by pin bearing 93. A hole on center of bottom surface of tool slider 58 and a hole on center of top surface of tool bar support block 59 receives this pin bearing 93 which permits raising or lowering tool bar support block 59 to properly align inking pen or other tools. The tool slider 58 and tool bar support block 59 are both fixed to pin bearing 93 by the use of set screws. A rectangular slot is milled into the bottom of tool bar support block 59 of such size that tool bar 62 fits the slot's sides snugly but may be raised and lowered sufficient distance to allow all tools to reach the work surface below them. A pin bearing 64 retains and holds bars 62 in its slot. A hole drilled from top to bottom of tool bar 62 and at its far end receives and holds tool 61. A slit cut in tool bar 62 from top to bottom intersects pen hole on center and extends back a distance from hole to allow thumb lock 60 to tighten respective sides of tool block against tool 61.

A lever 65 is used to raise and lower tool bar 62. The square edged lower corners of lever 65 engages the shallow slots 66 when pen 61 is raised from work surface. The shallow slots are not engaged by these corners when pen 61 is lowered and in work position. A spring 63 gives the necessary tension to pen 61 when in work position.

The function of the tool device is such that it allows the pen 61 or other tool to be placed on a specific radius in relation to center of crankshaft 85 through the act of moving tool slider 58 along radial crank 50 reading chosen radius from rule 52 with rule reading block 56. The tool or pen may then be lowered to the work surface by moving lever 65 to a horizontal position as shown in FIG. 1.

Installation and alignment of the tool 61 and tool bar 62 to the work surface is simplified by co-action between tool bar support block 59 and tool slider 58 which are linked together by pin bearing 93 thus making it possible to raise, lower, or turn tool bar support block 59 and thus also tool bar 62.

The position of the three bearing points (pin bearing 78, crank shaft 85, and pivot block 17) to each other determines whether the pendulum arm 29 will move when knob 31 is turned: if pin bearing 78 is set on center of crankshaft 85, pendulum arm 29 can't move because there is no displacement of position of pin bearing 78 in relation to crank shaft 85 and pivot block 17; but if pin bearing 78 is set off center of crank shaft 85, pendulum arm 29 will move as shown in FIGSs. 4 and 5. If knob 31 be turned through a complete circle, pendulum arm 29 will swing like a pendulum because its far end is held rotatably fixed in the slot of pivot block 17 by thumb lock 18 and its near end is subject to the displacement provided for by pin bearing 78 as its rotates around crank shaft 85. The width of this pendulum swing is subject to the distance between pin bearing 78 and crank shaft 85.

Crank shaft 85 is rotatably held in support block 45 and same is rigidly fixed to horizontal carriage C and horizontal carriage C is slidably attached to horizontal arm 30, thus as pin bearing 78 is rotated around crank shaft 85 the pin bearing 78 provides the displacement of position necessary to force pendulum arm 29 to move or swing and this constantly changing position of pendulum arm 29 provides a leverage point for pin bearing 78 to force horizontal carriage C to move in a linear direction as shown in FIGS. 4 and 5. This linear motion of horizontal carriage C reacts with the rotary motion the pen or tool 61 receives from crank shaft 85 to draw or cut an ellipse on the work surface of base member A, providing pen 61 and pin bearing 78 are properly aligned for same. Thus the pendulum arm 29, pin bearing 78, and crank shaft 85 defines the limits of linear travel of horizontal carriage C as the tool 61 is rotated and in so doing also defines the major ellipse axis. The minor ellipse axis is defined by the position of tool 61 in relation to the crank shaft 85.

The spacial orientation of the ellipse (vertical or horizontal) when eccentric crank 33 is parallel to radial crank 50 is dependent on whether the tool 61 opposes or complements the direction of motion of horizontal carriage C as determined by position of pen 61 in relation to crank shaft 85 and pin bearing 78: if the pen be placed so that it follows the direction of linear travel of horizontal carriage C, then a horizontal ellipse is formed and if it be placed so that it opposes the direction of linear travel at right angles or 90° to same, then a vertical ellipse is formed.

In setting and adjusting the machine for a horizontal ellipse (eccentric crank 33 being parallel to radial crank 50), the major and minor radii of the ellipse are placed on opposite sides and in relation to crank shaft center with the adjustable eccentric crank 33 representing the major axis of the ellipse and the moveable tool carriage and tool 61 representing the minor axis of the ellipse. In the vertical ellipse setup the major and minor radii are on the same side and in relation to the crank shaft center with the moveable tool carriage and tool 61 representing the minor axis and being always farther from crank shaft center than the adjustable eccentric crank 33 and pin bearing 78 representing the major axis of the ellipse. In drawing a horizontal ellipse with this machine the center of the ellipse is crank shaft center whereas the center of a vertical ellipse (eccentric crank 33 being parallel to crank 50) is a point directly below the center of pin bearing 78 wherever it is located.

In drawing a vertical ellipse with a major axis of 2.00" and a minor axis of 1.5", compute the difference between the major and minor axis (in this case .50") and divide this last sum in half (in this case .25") and place eccentric crank 33 on this numerical value for major radius, reading same from rule 35 by use of rule reading block 34. This numerical value may be read from the left or the right of the center point of rule 35. Next compute the minor radius by dividing the minor axis in half (in this case .75") and then adding this value to the value found for the major radius (in this case .25" plus .75" equals 1.00") and place pen point on this numerical value by reading rule 52 with rule reading block 56 and either to the left or right of center point as was done above. Note that the actual value for the minor radius is .75" and that it is added to the major radius .25" because .25" is the ellipse center of the vertical ellipse and the pen point must be always to the right or left of this vertical ellipse center depending on whether the pin bearing 78 is to right or left of crank shaft center. If pin bearing 78 is to the left of crank shaft center then pen point 61 would be yet farther left of this point etc.

In drawing a horizontal ellipse with a major axis of 2.00" and a minor axis of 1.50" compute the difference between the major and minor axis (in this case .50") and divide this last sum in half (in this case .25") and place eccentric crank on this numerical value for major radius by reading same from rule 35 by use of rule reading block 34 and reading from left or right of center point of rule 35. Next compute the minor radius by dividing the minor axis in half (in this case .75") and place pen point on this numerical value by reading rule 52 with rule reading block 56 and place pen on side opposite crank shaft center to that where pin bearing 78 was placed.

Slanting ellipses may be drawn with this machine by releasing eccentric crank block lock 38 and rotating same a specific number of degrees as read from protractor disc 43 and then relocking the same and proceeding in like manner as above. Slanting ellipses result because the pen point is so placed and the rotary motion so occurs that they oppose the direction of linear travel of horizontal carriage in a manner as shown by the ellipses that are drawn.

Slanting ellipses may also be drawn with the eccentric crank block 36 left in its normal position (its length parallel to horizontal arm 30 and also parallel with radial crank 50) and horizontal arm 30 rotated to some angular degree desired and then locked in place. Use same procedure for execution of these ellipses as was used for construction of ellipses wherein the length of eccentric crank block 36 was parallel to horizontal arm 30.

A horizontal line two times the eccentric crank radius setting may be drawn when the pen 61 is on crank shaft center and eccentric crank 33 is set off-center of crank shaft center.

A vertical line two times the radial dimension setting of the eccentric crank 33 and pen point 61 is drawn when both eccentric crank 33 and pen point 61 are on same dimension and same side of crank shaft center.

A circle is executed when eccentric crank 33 is set on crank shaft center and pen point 61 is set off center of crank shaft center.

Another method of constructing a vertical ellipse consists of rotating eccentric crank 33 so that it is at right angles to radial crank 50. Locate pen point 61 and construct vertical ellipse using same procedure as that used

when the length of eccentric crank block **36** is parallel to horizontal arm **30**.

A rotary repeat device consisting of a plastic disc **42** (which acts as a supporting member for rotation of repeat arm **37** around its edge and allows reading a protractor beneath it) which is fixed to crank shaft **85** and thus related to crank handle knob **31** and forces imparted to same. A protractor disc **43** is free to rotate around crank shaft **85** and is linked or related to disc **42** through its stop **40** (attached to its top surface) and this stop **40** is placed between repeat arm **37** (lower surface disc **42**) and plastic disc stop **41** (under surface of disc **42**). Thus if stop **40** is securely retained by thumb lock **39** (which fixes moveable stop arm **37** to plastic disc **42**) between stops **37** and **41** as shown in FIG. 1 and if thumb lock **44** (which locks protractor disc **43** to horizontal carriage C) be also locked, then no rotation is possible if knob **31** be pushed for rotation; if thumb lock **34** is unlocked, complete rotation of crank shaft and parts is possible. If some portion of a circle or ellipse is desired, then thumb lock **39** is unlocked and the repeat arm **37** is set at that desired degree, reading same from protractor scale and then thumb lock **39** is again locked as is also thumb lock **44**; and now it is possible for disc **42** to turn when knob **31** is pushed and the amount or degree disc **42** will turn is determined by the distance between stops **37** and **41**. Stop **40** permits and prohibits rotation beyond stops **37** and **41** as shown in FIG. 8.

A duplication of a previous crank shaft **85** rotation is provided for when thumblock **44** is unlocked and disc **43** is rotated until stop **40** engages either stop **37** or **41** (depending on direction of rotation) when again thumb lock **44** is locked and knob **31** is forced to move and the rotation is again repeated as shown in FIG. 8. A scribe mark **114** is used to read the protractor disc **43**.

This rotary repeat device provides the means of angular measurements and duplications of same and also provides a method of locking crank shaft **85** to prevent rotation f same.

A spiral device consisting of spring post **90** fixed to radial crank **50** and connected by tension spring **91** to tie post **92** which is fixed to slider block **58** on one side and on the other side and parallel to radial crank **50** a tie post **92** connected by cable **94** to a stationary shaft **95** having on its bottom end two retaining pins **96** pushed into the work surface. Top of stationary shaft **95** projects into bottom of crank shaft tube **85**.

The function of the spiral device is such that it allows the pen or tool to be used with a constantly changing radius. This becomes evident when it is observed that when knob **31** is rotated, shaft **95** remains stationary because pins **96** are imbedded in work surface and that when the tool device is rotated and is held on one end by a spring fixed to radial crank **50** and on the other end by a cable tied to stationary shaft **95**, then the cable must either wind or unwind from or on shaft **95** and in so doing move the tool device either backward or forward on radial crank. The shape of the spiral figure executed is dependent upon the diameter of shaft **95** and also depends on whether the cable winds as shown in FIG. 2 as a single layer or as an increasingly thicker layer as the thread on a sewing machine bobbin.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

I claim:

1. An ellipsograph for guiding a marking tool or pen, comprising:

(a) a pendulum arm;

(b) a pivot block including a first pivot pin, said pendulum arm having an end connected to said pivot pin;

(c) a horizontal arm secured to said pivot block;

(d) a first member disposed on said horizontal arm and spaced from said pivot block and including a second pivot pin, the other end of said pendulum arm being connected to said second pivot pin;

(e) a second member including a third pivot pin, said first member being journalled in and rotatable about said third pivot pin, wherein a horizontal carriage is movably mounted on said horizontal arm, and wherein said first and second members are secured to and movable with said horizontal carriage;

(f) a tool carriage connected to said second member for supporting a tool; and

(g) means for adjusting and locking the relative positions of said second and said third pivot pins with respect to each other whereby movement of said pendulum arm about said three pivot pins will cause said tool to describe an ellipse when said second and third pivot pins do not coincide.

2. An ellipsograph as defined in claim **1** wherein means are provided for adjustably rotating and locking at will said second member about said third pivot pin, thereby to adjust the angular positions of the axes of the ellipse described by said tool upon rotation of said pendulum arm.

3. An ellipsograph as defined in claim **2**, wherein a crank is secured to said second pivot pin to cause movement of said pendulum arm upon rotation thereof.

4. An ellipsograph as defined in claim **2**, wherein a vertical carriage movable in a vertical direction is provided, and wherein said pivot block and horizontal arm are secured to and movable with said vertical carriage.

5. An ellipsograph as defined in claim **2**, wherein a support is provided for the work to be marked below said ellipsograph, and wherein said tool carriage is so arranged that the work is marked within the area defined by said ellipsograph.

6. An ellipsograph for guiding a tool or pen, comprising:

(a) a pendulum arm;

(b) a pivot block including a first pivot pin, said pendulum arm having an end connected to said pivot pin;

(c) a horizontal arm associated with said pivot block;

(d) a first member disposed on said horizontal arm and spaced from said pivot block, there being a second pivot pin associated with said first member and said pendulum arm;

(e) a second member having a third pivot pin associated with it, said first member being swingable about the axis of said third pivot pin;

(f) a tool carriage movable with and about the axis of said third pivot pin for supporting a tool; and

(g) means for adjusting and locking the relative positions of said second and said third pivot pins with respect to each other whereby movement of said pendulum arm about the axes of said three pivot pins will cause said tool to move along a line other than circular when said second and third pivot pins do not coincide, there being means associated with said horizontal arm whereby said first and second members may move in a horizontal plane when said second and third pivots are adjusted.

No references cited.

HARRY N. HAROIAN, *Primary Examiner.*