United States Patent

[11] 3,596,361

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[54] **PARALLEL AND PERSPECTIVE DRAWING DEVICE WITH ANGULAR SETTING MEANS**
23 Claims, 22 Drawing Figs.

[52] **U.S. Cl.** **33/77**
[51] **Int. Cl.** **B43l 13/14**
[50] **Field of Search** 33/77

[56] **References Cited**

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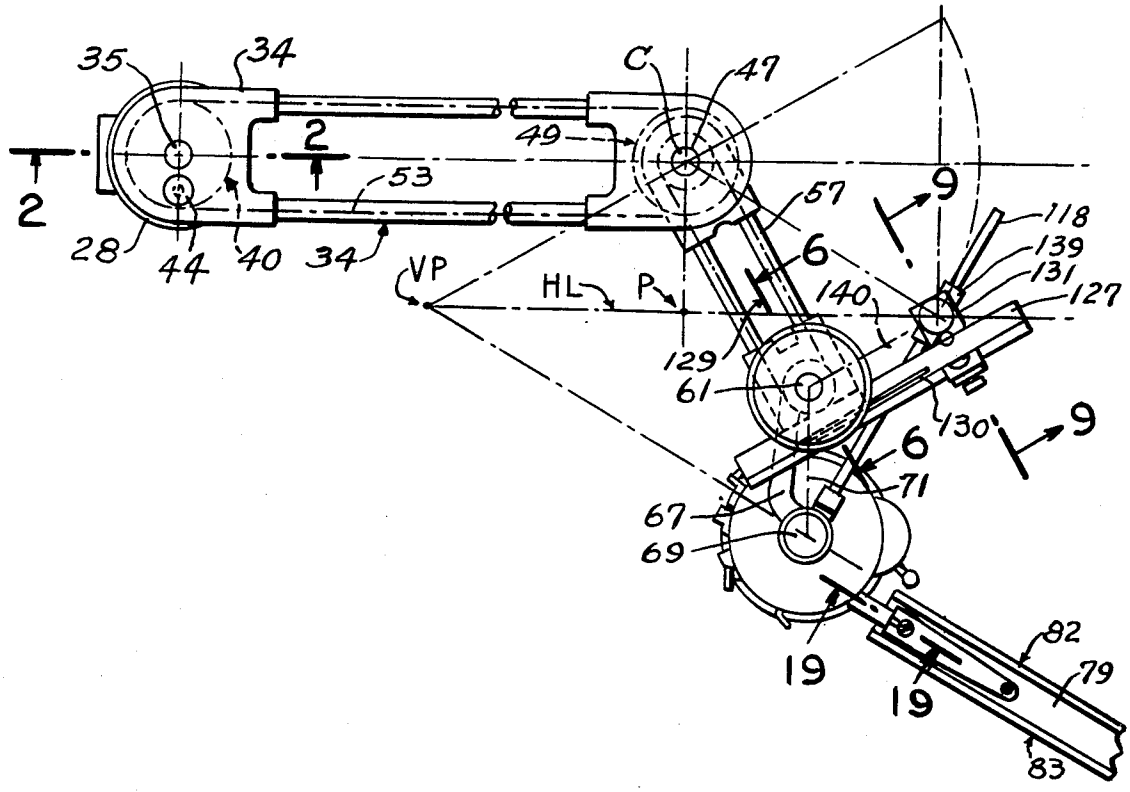
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Primary Examiner—Harry N. Haroian
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ABSTRACT: A drawing device is described which is convertable to and from a perspective drawing device and a parallel drawing device by which a move positive and convenient means is provided for drawing angularly directed parallel lines. In addition this setting may be made without changing the perspective setting. Also an improved construction is provided for the control pivot means by which the position of the vanishing point for perspective drawing is selected.



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SHEET 1 OF 7

Fig. 1

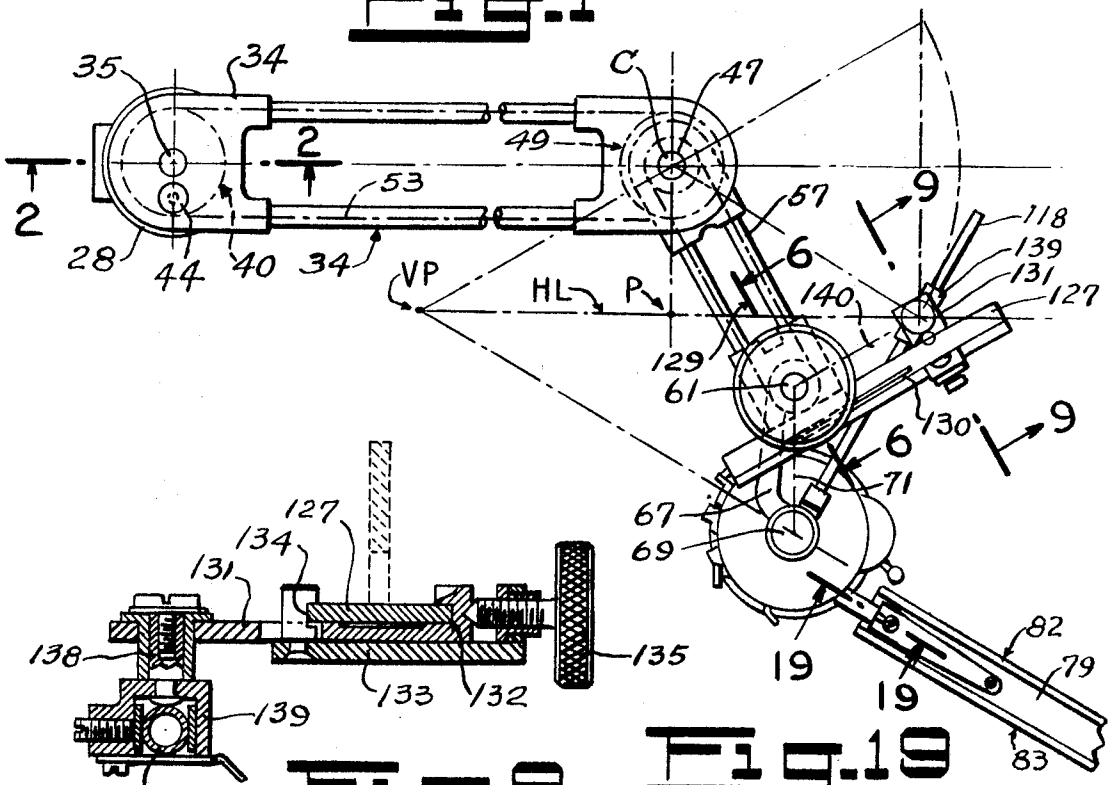
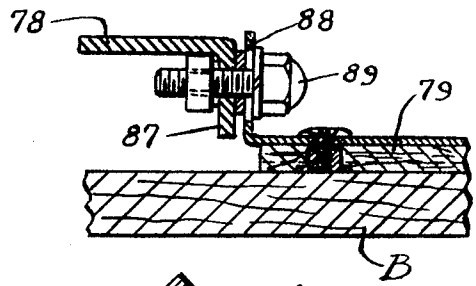


Fig. 9

Fig. 19



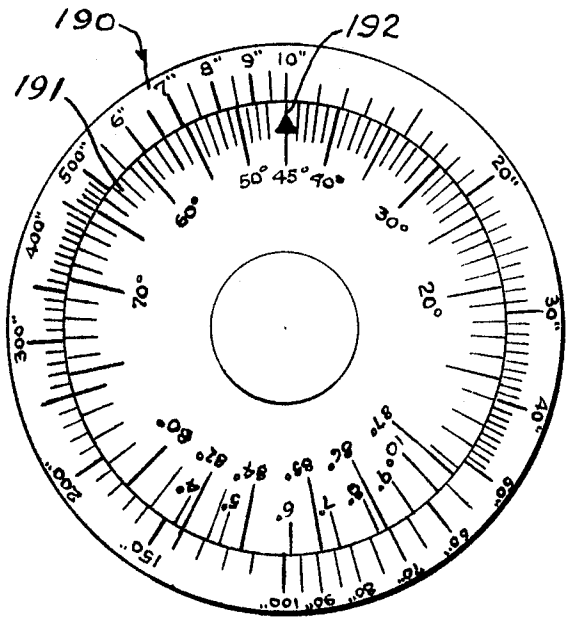


Fig. 20

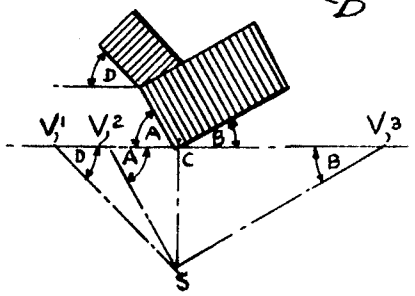


Fig. 21

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Fig. 2

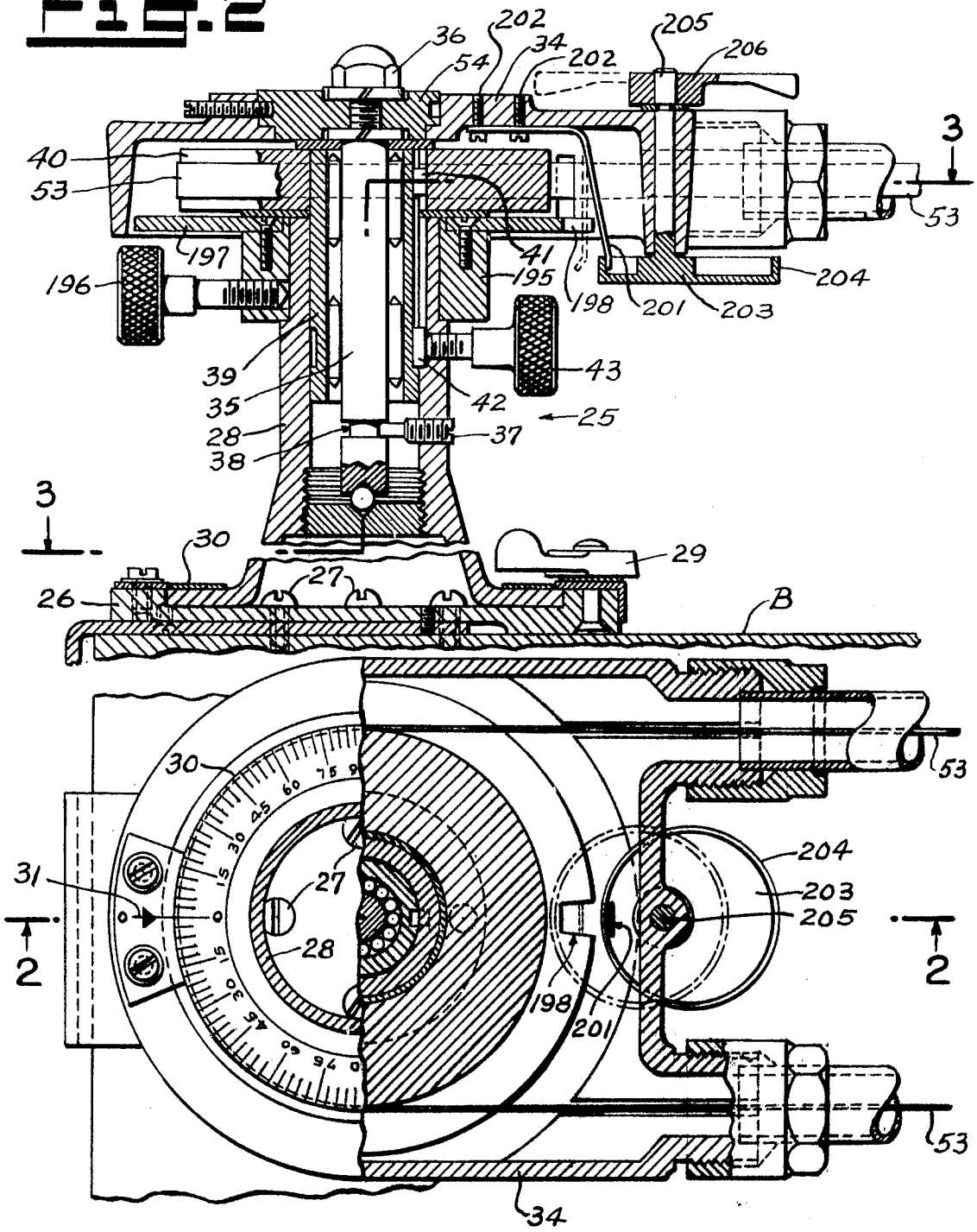


Fig. 3

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Fig. 4

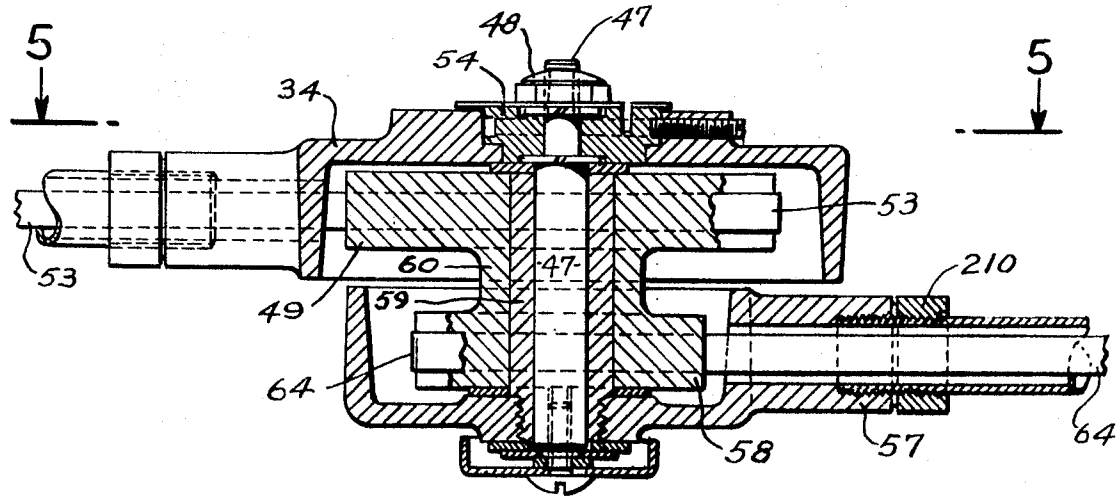
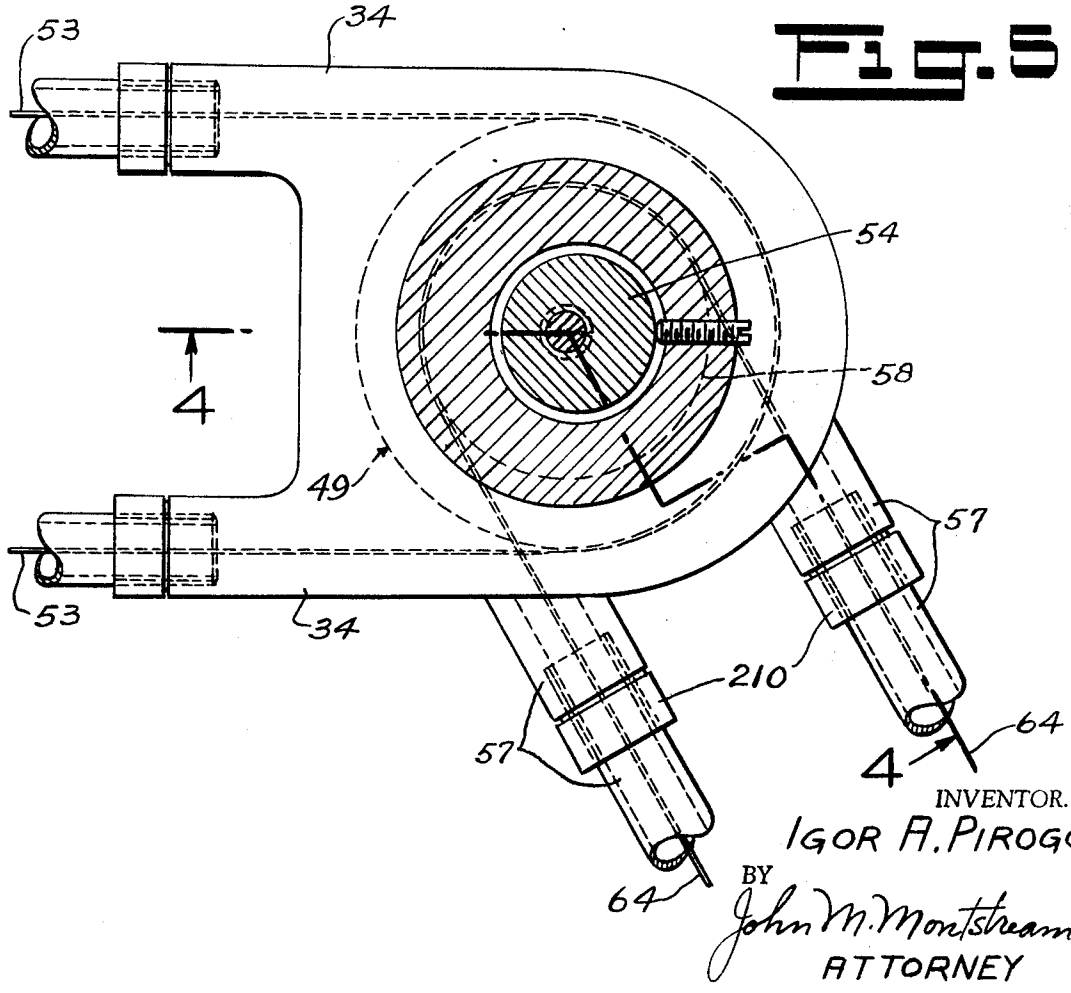


Fig. 5



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Fig. 6

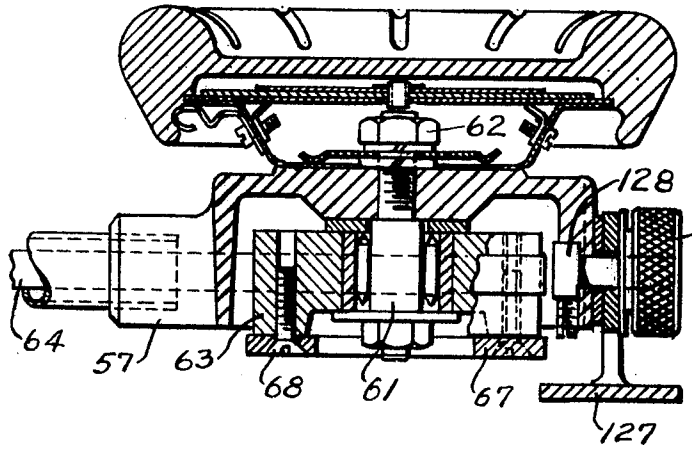


Fig. 8

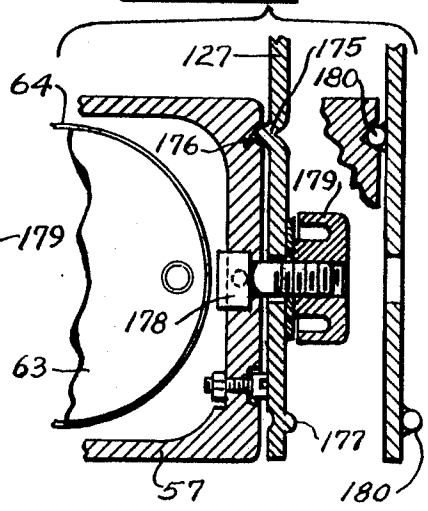


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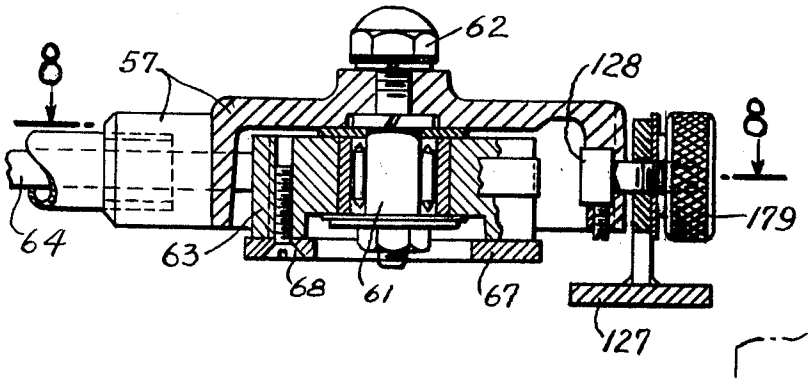


Fig. 18

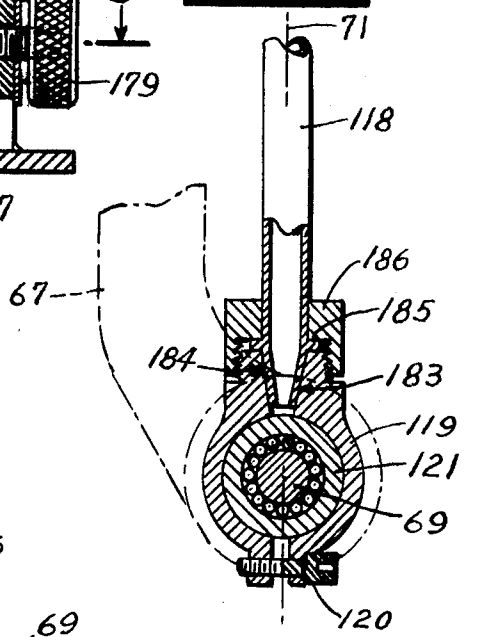


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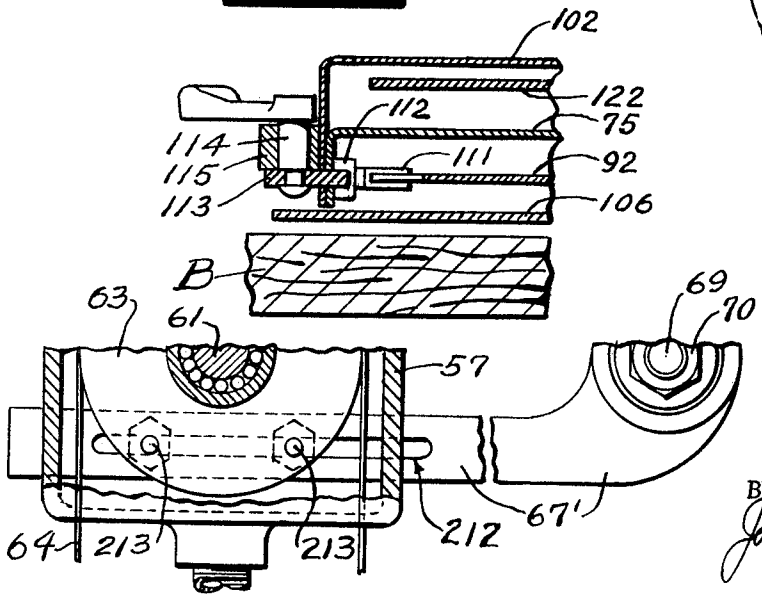


Fig. 22

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Fig. 10

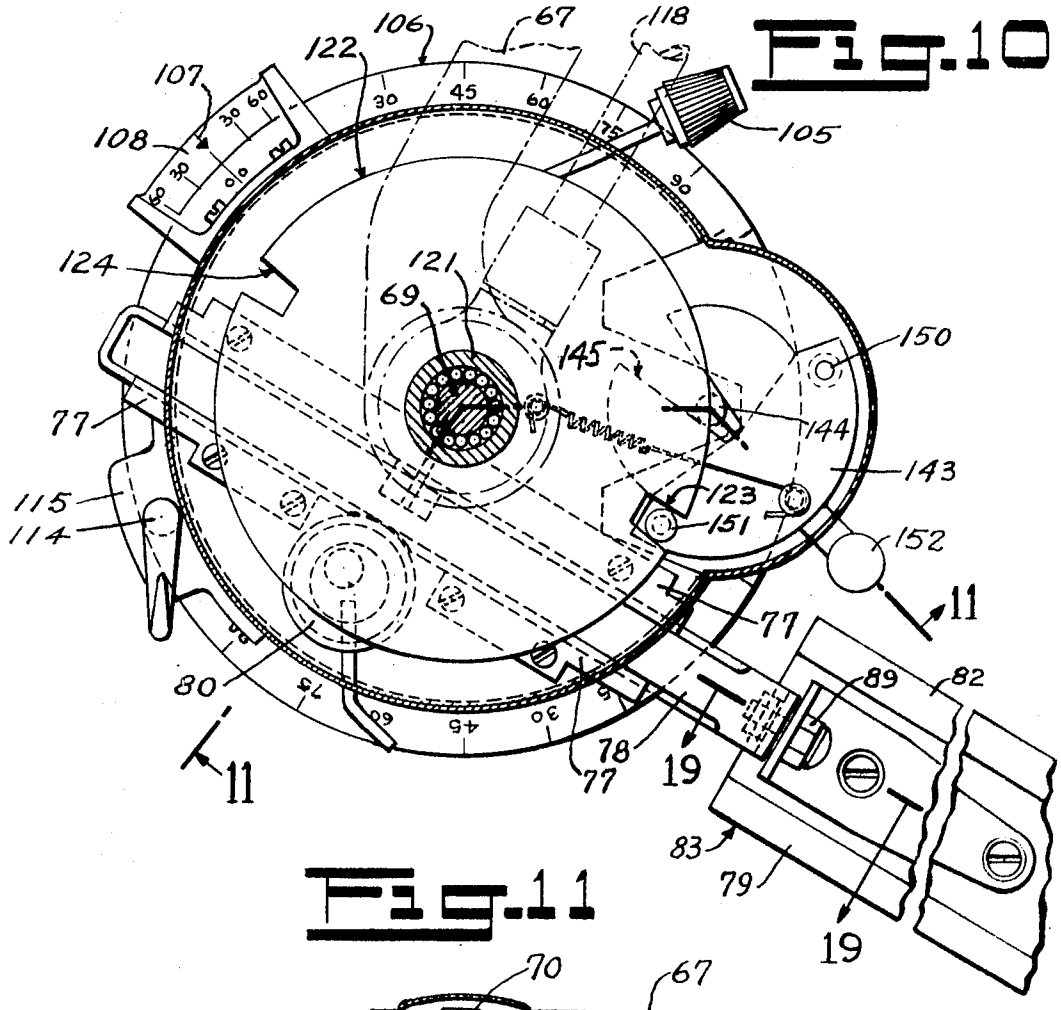
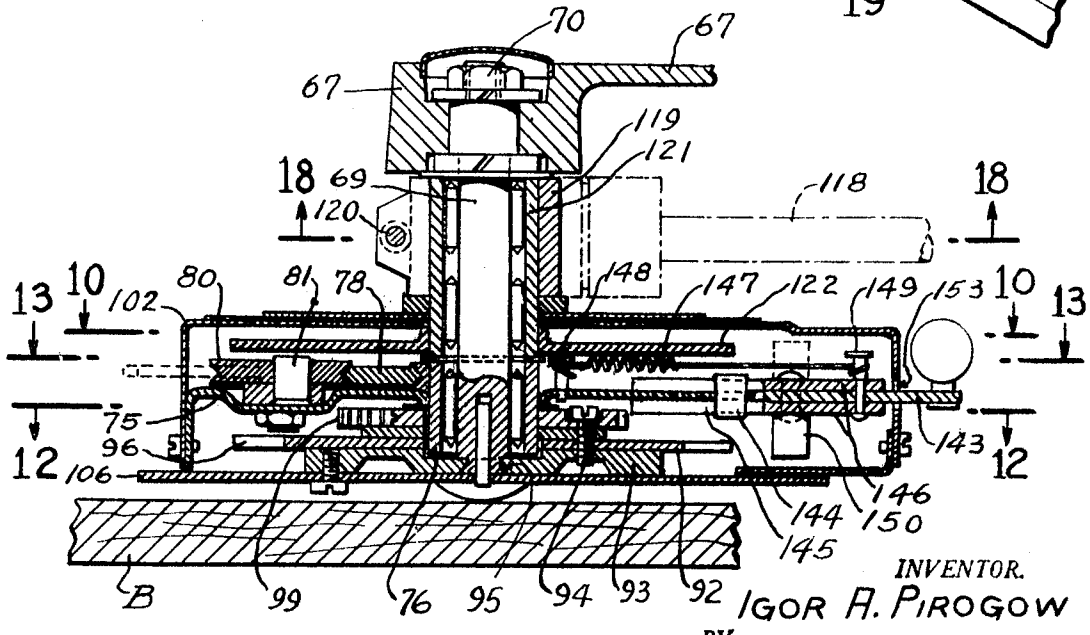


Fig. 11



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Fig. 12

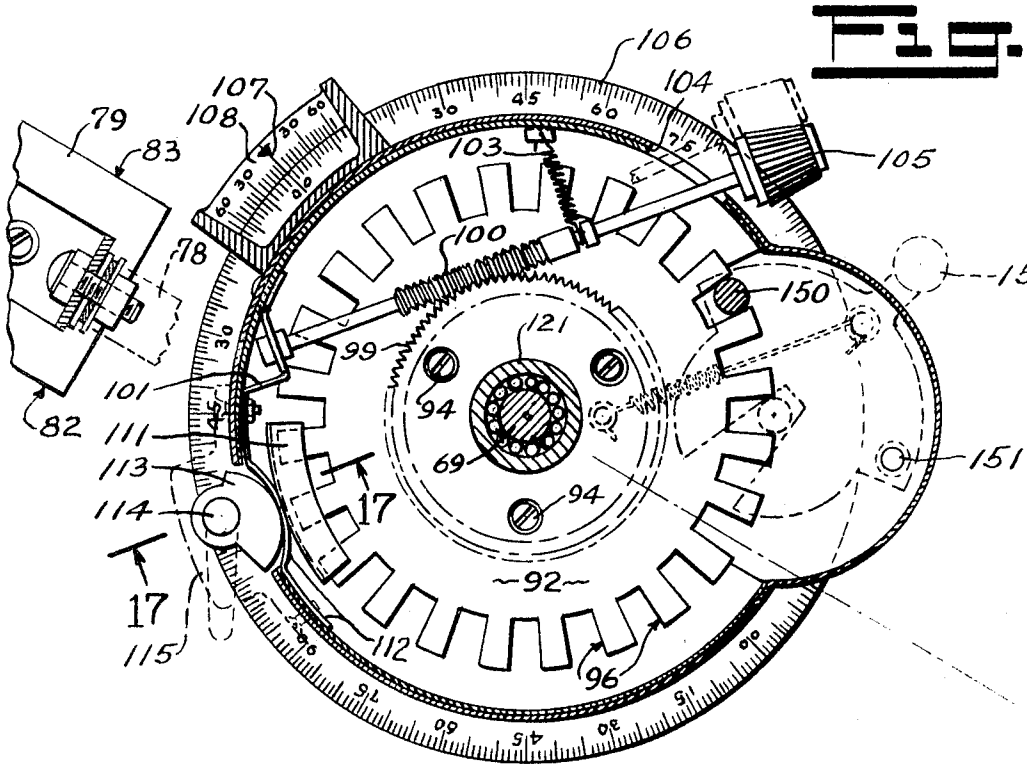
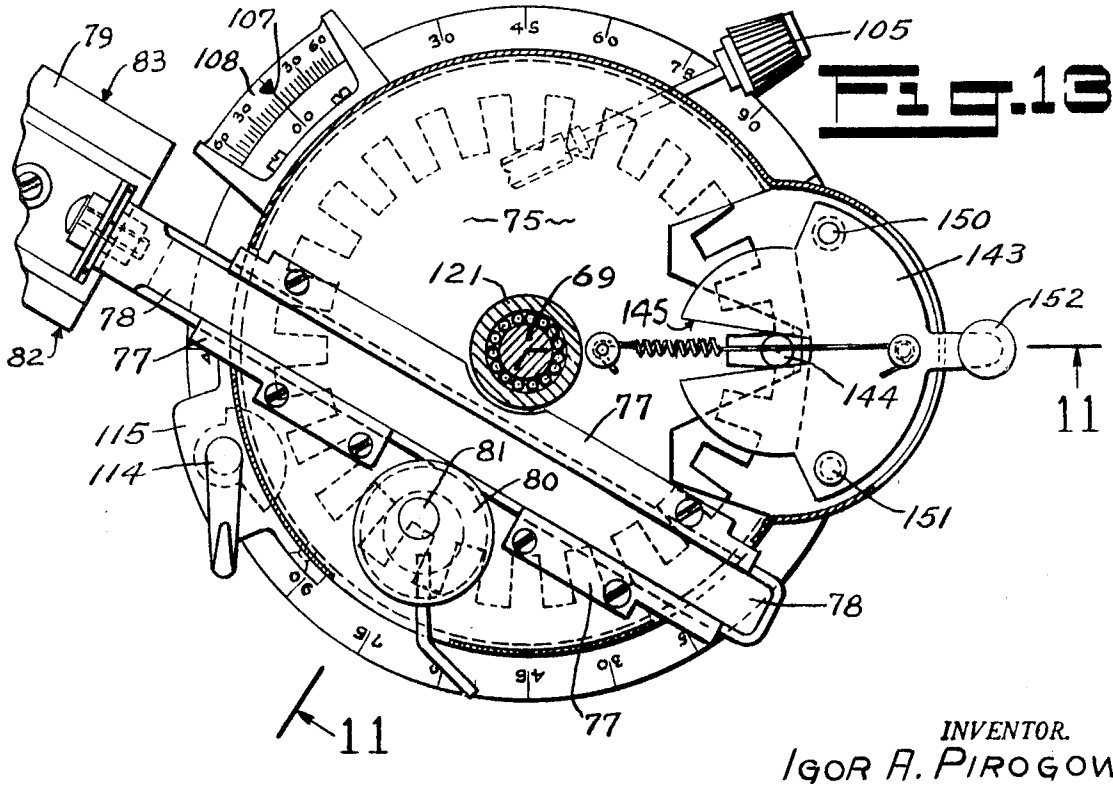


Fig. 13



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Fig. 14

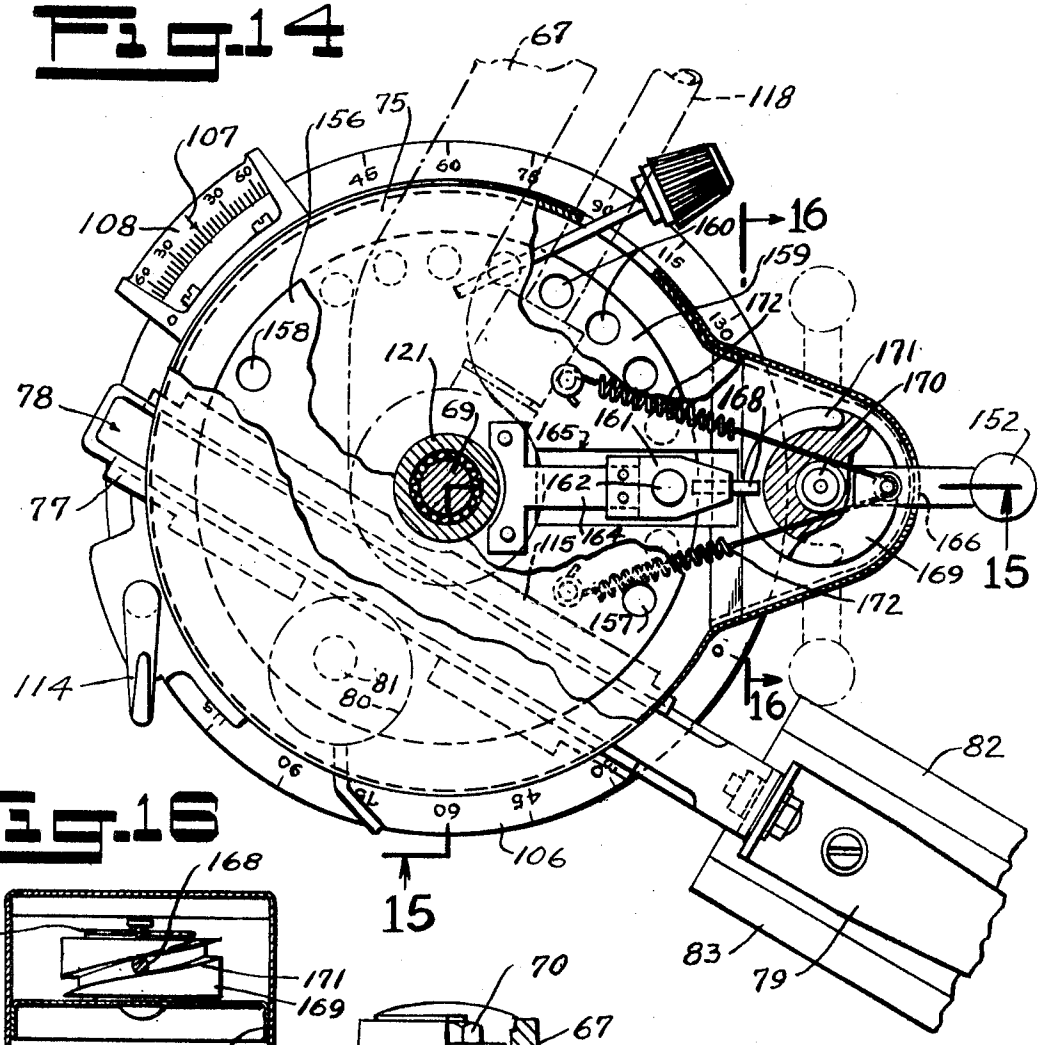


Fig. 16

Fig. 15

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PARALLEL AND PERSPECTIVE DRAWING DEVICE WITH ANGULAR SETTING MEANS

The invention relates to a drawing device for perspective and parallel drawing with improvements over the devices of my patents 2,854,750; and 3,300,863 and 3,318,003. The invention also relates to a drawing device which is convertible more easily to and from a drawing device for perspective or parallel lines. The improvements lie in several additional structures and functions which are not achieved by the devices of the prior patents.

It is an object of the invention to construct a perspective and parallel drawing device which is more convenient in operation.

Another object is as above but with more effective means for the control pivot means by which the location of the vanishing point is determined.

A still further object is to construct a drawing device as above so that it can be easily converted to and from a setting for parallel lines and also without disturbing the perspective setting.

Another object is to construct the device with a plurality of angularly spaced indexing means, one of which is selected for parallel drawing at one of a plurality of angular position.

Another object is as in the preceding paragraph but in addition can be used to select a precise angle.

A still further object is to construct a parallel drawing device having indexing means for selecting one of a plurality of positions.

Other objects of the invention will be more apparent from the following description when taken in connection with the accompanying drawings illustrating preferred embodiments thereof in which;

FIG. 1 is a plan view of the drawing device on a reduced scale;

FIG. 2 is a sectional view of the first pivot means taken on line 2–2 of FIG. 1;

FIG. 3 is a sectional view taken on line 3–3 of FIG. 2;

FIG. 4 is a sectional view taken on line 4–4 of FIG. 5;

FIG. 5 is a sectional view taken on line 5–5 of FIG. 4;

FIG. 6 is a sectional view taken on line 6–6 of FIG. 1;

FIG. 7 is a sectional view showing a modification of FIG. 6;

FIG. 8 is a sectional view taken on line 8–8 of FIG. 7 and a modification thereof;

FIG. 9 is a sectional view taken on line 9–9 of FIG. 1;

FIG. 10 is a sectional view taken on line 10–10 of FIG. 11;

FIG. 11 is a sectional view taken on line 11–11 of FIG. 13;

FIG. 12 is a sectional view taken on line 12–12 of FIG. 11;

FIG. 13 is a sectional view taken on line 13–13 of FIG. 11;

FIG. 14 is a partial sectional view taken on a modification of the construction of FIGS. 12 and 13;

FIG. 15 is a partial section taken on line 15–15 of FIG. 14;

FIG. 16 is a section taken on line 16–16 of FIG. 14;

FIG. 17 is a partial section taken on line 17–17 of FIG. 12;

FIG. 18 is a partial section taken on line 18–18 of FIG. 11;

FIG. 19 is a partial section taken on line 19–19 of FIG. 10;

FIG. 20 is a plan view of a vanishing point slide rule;

FIG. 21 is a plan view of a structure for illustrating the use of the drawing device and the slide rule; and

FIG. 22 is a partial view of an adjustable third arm.

The drawing device is shown with three arms for parallel drawing or for perspective and parallel drawing. A base 25 FIGS. 1 and 2, is secured to the drawing board B. Preferably the base is adjustable angularly, therefore the base includes a base plate 26 which is secured to the drawing board B by screws 27 and a pedestal 28 is adjustable angularly thereon and locked in adjusted position by clamping means 29. The angular adjustment is aided by a protractor 30 carried by one of the parts including the baseplate and pedestal and a pointer 31 on the other part. The pedestal may be tall enough so that the other arms may pass under the same for a greater area of use of the drawing board.

A first arm 34 is pivotally mounted on the pedestal such as by means of a first vertical pivot 35 to which one end of the arm is secured by a nut 36. The first pivot preferably is retained within the pedestal by a screw 37, the end of which is received in a groove 38 in the pivot. This first pivot is received in a sleeve 39 carrying bearings for the first pivot. This sleeve carries a first pulley 40 secured thereto such as by a key 41 and the sleeve is adjustably secured to the pedestal by a pressure plate 42 and clamp screw 43. The form of the arm is not important and is shown as having a housing at each end connected by tubes. The first arm has means to lock the same in fixed position for perspective drawing as will be described hereinafter but is free for parallel drawing. In addition, this means is a preset means so that conversion to and from perspective and parallel drawing may be made conveniently and without need to exercise care in making the conversion.

The first arm, FIG. 4, carries a second vertical pivot 47 at the other end thereof which is secured to the arm by a nut 48. A second pulley 49 is rotatably mounted on a sleeve 59 rotatably mounted on the pivot 47. A band 53, usually metal, passes around the first and second pulleys so that the two pulleys remain in the same fixed angular position irrespective of any angular movement or adjustment which is made with respect to the pedestal and hence with respect to the first pulley. Any connection between pulleys such as gears, is suitable. The band 53 may be kept taut between the pulleys by means, such as the eccentrics 54 shown.

The drawing device has a second arm 57, FIGS. 1, 4, and 5 which arm is secured to a sleeve 59 which is rotatably mounted on the pivot 47. This sleeve and hence this arm is rotatably mounted on the second vertical pivot 47. A third pulley 58 is secured to or shown as integral with the second pulley 49 so that they are rotatable together with the sleeve 59 or in effect on the second pivot. The second arm carries a third vertical pivot 61, FIGS. 1, 6 and 7 secured to the other end thereof by a nut 62. A fourth pulley 63 is rotatably mounted on this third pivot on a suitable bearing. A connection, shown as a metal band 64, connects the third and fourth pulleys for rotation together. Arm connecting means is provided in the pulleys 40,49 and their connecting band 53 and in the pulleys 58,63 and their connecting band 64. There are other forms of arm connecting means such as a gear train. As a consequence, this fourth pulley assumes or remains in the same angular position with respect to the first pulley and the base irrespective of any pivoting of the second arm on the second pivot means and irrespective of any pivoting or adjustment of the first arm on the first pivot means.

A third arm 67 is secured by screws 68 to the fourth pulley, FIGS. 1, 6 or 7 so that it assumes the same angular position with respect to the base as the first pulley for any movement of the arms. At the other end of the third arm is a fourth vertical pivot 69, FIGS. 10 and 11 which is secured to this arm by a nut 70. This arm has an arm axis 71 extending between the center axes of the third pivot and fourth pivot.

As a consequence of the pulleys and their connecting steel bands, the axis of the third arm always remains in the same angular position with respect to the base irrespective of the pivotal movement of the second arm of the drawing device and irrespective of the pivotal movement or angular adjustment of the first arm on the base. For most perspective drawing the third arm will be vertical and it remains vertical for any movement of the first and second arms.

A ruling edge mounting means, FIGS. 11,13, is pivotally mounted on the fourth pivot which means comprises a mounting plate 75 secured to a bushing or sleeve 76 which is pivotally mounted on the pivot means on a suitable bearing. The mounting plate carries spaced guides 77 forming a guideway in which the stem 78 of a ruling edge member is slidably received. The ruling edge member includes a ruling edge portion 79 secured to the stem. Clamping means is provided in an eccentric clamp 80 which is pivotally mounted on a pin 81 carried by the mounting plate. The clamp clamps the stem of the ruling edge member in the guideway. The ruling

edge member is shown in the guideway extending to the right which is for mounting the drawing device on the left-hand side of the drawing board. The guideway extends across the plate with openings at each end so that the stem of the ruling edge member may be removed from the guideway, from the position of FIG. 10, and inserted from the opposite side so that it will extend to the left, FIGS. 12, and 13, if it is desired to mount the drawing device on the right-hand side of the drawing board. The ruling edge portion has a ruling edge 82 at one edge which is in alignment with the center axis of the fourth pivot 69. For a drawing device which is suited for mounting on the left or right-hand side of the drawing board, the ruling edge 83 on the other side of the ruling edge portion is equally spaced from the center thereof so that when the ruling edge member is inserted in the guideway to project towards the left for a right-hand mounted drawing device, this ruling edge will be in alignment with the center axis of the fourth pivot 69.

It is desirable that the ruling edge member be mounted for vertical and pivotal adjustment to assure that the same rests, and rests flatly, on the drawing board. This may be accomplished by connecting the ruling edge portion with a flange 87 on the stem through a ruling edge member bracket, FIG. 19, secured to the ruling edge portion. The vertical flange of the bracket has a slot 88. A bolt 89 passes through the slot and the stem flange to secure the ruling edge portion in adjusted position on the stem.

For parallel drawing the first arm is free to pivot and the ruling edge member is fixed to the fourth pivot 69. It is desirable, however, that the ruling edge member be adjustable to various angular positions so that parallel lines may be drawn at any angle or at least at a limited number of angles. An indexing member, 92 FIGS. 11,12, is attached to the pivot by means of a plate 93 and screws 94. This plate is secured to the pivot 69, such as by swagging over the tip end 95 of the pivot which projects through a hole in the plate. The indexing member has a plurality of indexing means, that shown being inwardly extending slots 96 around the periphery of the member. The slots are shown as radial although the angularity would vary depending upon the distance of the pins 150 and 151 from pivot 144 and other factors. For a parallel drawing device to be attached solely at the left-hand edge of a drawing board, the indexing means need extend solely around 180° of the member. For a drawing device to be attached on the left and right-hand side of the drawing board, the indexing means will extend around 360° of the member. The indexing means are shown spaced 15° apart or 12 for each 180° of the periphery. The ruling edge mounting means and hence the ruling edge member is selectively adjustable for interconnection with any one of the indexing means by mechanism which will be described hereinafter.

The indexing notches on the disc are shown as spaced 15° apart. This range of adjustment may be adequate in most cases but there are times when a more particular angular position of the ruling edge means is desired. Angular adjusting means is, therefore, provided by which the ruling edge mounting means can be adjusted with respect to the fourth pivot so that any angle may be selected. This angular adjusting means includes a worm gear 99, FIGS. 11,12, secured to plate 93 and indexing member 92 by the screws 94. A worm 100 is rotatably mounted on the casing in any fashion for engagement and disengagement with the worm gear. The means illustrated for securing this engagement and disengagement comprises a bracket 101 carried by a casing 102 and which is secured to the ruling edge mounting means 75 by screws and this bracket provides a loose fit for the end of the worm so that the worm may turn and pivot away from the worm gear. A spring 103 propels the worm normally outwardly away from engagement with the worm gear. The worm projects through a slot 104 in the casing and the outer end of the worm carries a knob 105 for rotating the same. A protractor 106 is carried by the bottom plate and a pointer 107 is carried by the casing so that it may be adjusted as desired. Preferably a verner scale 108 is carried by the casing for a 5 minute portion of 1° in either direction to give a more precise adjustment for the angle of the ruling edge means.

Clamping means is provided when the angular adjusting means is used to secure the casing and hence the ruling edge means in adjusted position. This clamping means is shown as a clamping shoe 111, FIG. 12, which engages the periphery of the indexing member and bridges the indexing slots 96. The shoe is suitably secured to an arcuate spring 112 carried by the casing and a cam lever 113 is pivotally mounted on a pin 114 in a bracket 115 on the casing. Turning of the cam lever presses the clamping shoe against the periphery of the indexing member and releasably secures the same to the casing and hence clamps the ruling edge mounting means with the fourth pivot.

When the drawing device is used for perspective drawing the angular position of the ruling edge member changes for any position to which it is moved on the board so that the ruling edge is always in alignment with the vanishing point selected on the horizon line. The means for perspective drawing includes a control rod 118 FIGS. 1, 11 and 18 having a hub 119 which is clamped by a screw 120 to a control rod pivot means 121 shown as a sleeve. The sleeve is pivotally mounted on the fourth pivot 69 on a suitable bearing and carries a disc 122. This control rod pivot means is selectively connectable with the ruling edge mounting means 75 by interlocking means of a notch 123, FIG. 10, in the disc. If the drawing device is to be adapted for mounting on the right-hand side of the drawing board a second notch 124 is provided spaced 180° from notch 123. The ruling edge member changes its angle under the control of the control rod pivot means and a control pivot means now to be described.

The second arm 57, FIGS. 1, 6 and 7, has a control pivot frame 127 secured thereto, such as by a bolt 128, and the frame is accurately at right angles to the axis 129 of the second arm. The control pivot frame preferably carries a perspective scale 130 having scale markings thereon to locate the vanishing point. Control pivot means is carried by the control pivot frame and includes a control pivot bracket 131 preferably suitably mounted for adjustment thereon for adjusting the location of the vanishing point *vp*. This bracket, FIG. 9, provides a fixed slot 132 to engage one longitudinal edge of the control pivot frame. A clamping plate 133 carries a groove 134 to engage the other edge of this frame. The control pivot bracket is held in adjusted position by a lock screw 135 on the clamping plate which contacts the control pivot bracket to clamp the same to the longitudinal edges of the control pivot frame. For a drawing device having a fixed vanishing point, the control bracket would be fixed in one position on the control pivot frame.

The control pivot means also includes a control pivot 138 which is pivotally mounted on the bracket 131. The control pivot has a control rod slide 139 which slide conveniently is a slot. The axis of this control rod slide is in alignment with the axis of the control pivot 138 and the control pivot axis is on a line 140 FIG. 1 perpendicular to the longitudinal axis 129 of the second arm which line also passes through the axis of the third pivot 61. The control rod 118 is received in the slide and hence its longitudinal axis at this point is in alignment with the control pivot axis in all positions. The adjustable bracket constitutes adjustable means for the control pivot means by which the location of the vanishing point *vp* is set. This bracket is easily removed from the control pivot frame without necessitating moving it to the end of the frame which is advantageous if a stop or stops are used on the frame member and it is desired not to disturb the setting of the stop.

For perspective drawing, the first arm 34 is fixed in position, by the arm clamp screw 44 which conveniently engages the pulley which is keyed to the pedestal through key 41, sleeve 39 and tightened clamp 42,43. By changing the angular position of the first arm which raises and lowers or adjusts the vertical position of the second pivot 47, the vertical position of the ruling edge member 79 and the horizontal line HL, on the board may be adjusted. With the first arm fixed in desired an-

gular position and the second arm horizontal, the ruling edge is on a horizontal line HL. By adjusting the position of the control bracket means above the infinity mark on the scale, which is in alignment with the second arm axis **129**, the vanishing point *vp* may be fixed anywhere desired on the left on this horizon line by using the upper part of the scale. To set the *vp* at the desired distance to the right, the scale below the infinity mark is used. Because this lower scale is relatively short, the distance of the *vp* cannot be set relatively close to the fourth pivot **69**. Because of the band or connecting means, the third arm will be in vertical position for the usual perspective drawing having a horizontal horizon line irrespective of the fixed angular position of the first arm and irrespective of the angular position of the second arm in drawing or use. An angular horizon line can be set up in several ways such as by holding the first arm horizontal, turning the second arm to the angle desired and then turning the pedestal to the angle of the second arm so that the third arm is vertical to the second arm in this position, and then clamp the lock screw **44** to engage the pulley **40**. In this position, the ruling edge is on an angular horizon line. The ruling edge is in all angular positions of the second arm for this setting will be in alignment with the set *vp* on this angular horizon line.

In order to locate the vanishing point *vp* on a horizontal or angular horizon line, the control pivot bracket clamping screw **135** is turned to release the control pivot bracket **131** on the control pivot frame **127** and this bracket is shifted to the desired setting. The clamping screw is tightened to secure the bracket in adjusted position. The location of the vanishing point is then at the intersection of the horizon line extending from the ruling edge in that position in which the third arm is at right angles to the second arm and a line through the axis of the control pivot and the axis of the second pivot. The *vp* would be on the intersection of a line of the ruling edge in any other position. In perspective drawing, the axis of the control pivot means moves on an arc of a circle having its center on the axis of the second pivot **47**.

With the control pivot bracket adjusted to the infinity mark on the scale, the device with a perspective setting, or with a fixed first arm, will draw parallel lines, that is, the ruling edge will be horizontal in all fixed positions of the first arm and all pivotal positions of the second arm as well as in any fixed position of the first arm and any angular position of the second arm as described in connection with an angular horizon line. The third arm will also be vertical with respect to horizontal lines in all angular positions of the second arm.

The length of the first and second arms and the third arm between pivot axes may be any dimension selected but for practical reasons they should not be of excessive length compared to the drawing board on which they will be used. The indicia on the perspective scale would be generally different for different lengths of the second and third arms.

Conversion means is provided, FIGS. **10** to **13**, to selectively convert the drawing device from a perspective drawing device to a parallel drawing device which means is mounted on the ruling edge mounting means. This means includes the indexing member or disc **92** and the control rod disc **122**. The mounting means for the ruling edge member is located between the two discs. The conversion means for connecting the ruling edge mounting means with one of the discs includes a conversion member **143** having pivot means of any suitable kind which pivotally mounts the same on the mounting means such as a pivot **144** carried by the mounting means being received in a slot **145** in the conversion member. This conversion member, as shown, includes a pair of spaced straddle plates **146** which straddle the upper and lower surfaces of the mounting plate. Spring means **147** has one end attached to a pin **148** carried by the mounting plate, and the other end is connected to a pin **149** carried by the conversion member which pulls the same radially inwardly in all positions. The conversion member has a downwardly projecting connecting pin **150** to engage in one of the indexing notches **96** in the indexing disc **92** and an upwardly projecting pin **151** to engage in one of the notches **123** or **124** of the perspective connecting disc **122**. The conversion member pivot engaging in its slot provides a pivot for the connecting member so that the latter may be pivoted counterclockwise by its handle **152** to the position shown in FIG. **12** so that the connecting pin **150** engages a notch **96** in the indexing disc. In this position the ruling edge mounting plate is operatively connected with the indexing disc.

The conversion member may be swung by its handle in a clockwise direction, FIG. **10** to bring its connecting pin **151** into the notch **123** of the perspective disc **122** to operatively connect the ruling edge mounting plate with this disc and thereby convert the device to a perspective drawing device. The spring provides a toggle construction so that when the connecting member is moved in a clockwise direction the spring means maintains the pivot **144** in its slot **145** and the connecting pin **151** in its selected notch **123**. Likewise when the conversion member is pivoted in a counterclockwise direction the spring means is moved to the opposite side of the pivot **144** to retain the pivot in its slot and the connecting pin in its selected notch. When the conversion member is in central position where it may rest in a lock notch **153** in the housing the conversion member is in neutral position. The plurality of indexing notches in the indexing member or disc enables the ruling edge member to be positioned in any angular position in 15° increments and parallel lines are drawn at the set angle. The notches **96**, **123** and **124** and the slot **145** are tapered so that the connection of the conversion means with the respective disc will be tight or without any looseness. An alternative construction of conversion means for selectively converting the drawing device to and from a perspective and parallel drawing device is illustrated in FIGS. **14** to **16**. In this construction the perspective disc **156** is provided with two holes **157** and **158**, for right or left-hand mounting on the drawing board spaced 180° apart. The indexing member or disc **159** has a series of spaced holes **160** around the periphery thereof **24** being shown for right and left-hand mounting and providing adjustment of 15° each. The worm gear means is also provided for more precise angular adjustment. The conversion member **161** has an upwardly projecting connecting pin **162** on one side thereof for connection with the perspective disc and a downwardly projecting connecting pin **163** on the other side thereof for engaging in a hole **160** in the indexing member or disc. This conversion member is mounted on a pair of spaced flexible members **164** secured to the mounting plate for the ruling edge member so that the vertical movement of the conversion member is a parallel movement. The ruling edge mounting plate **75** has a recess **165** in which the conversion member is movable.

Operating means is provided for shifting the conversion member **161** vertically upwardly to bring the connecting pin **162** into engagement in a hole **157** in the perspective disc **156** and downwardly for engagement of the connecting pin **163** in a hole **160** in the indexing disc. This operating means includes a shift pin **168**, FIG. **16**, carried by the conversion member. The operating means also includes a rotatable element **169** pivotally mounted on a pivot **170** carried by the ruling edge mounting plate or member **75**. This operating means has a cam slot **171** in the periphery thereof which receives the end of the shift pin. Rotation of the operating means clockwise will propel the shift pin to the high point of the cam slot and engage connecting pin **162** in the hole **157** in the perspective disc **156**. Rotation of the operating means in a counterclockwise direction will propel the shift pin to the bottom of the cam slot to engage the lower connecting pin **163** in an indexing hole **160** in the indexing disc. The operating means may be locked in central or neutral position by a notch **166** in the housing. Spring means **172** retains the operating means in its moved position.

If the device is to be mounted on the right side of the drawing board without any other change, the control pivot frame **127** would project downwardly. It is necessary therefore, to turn the control pivot frame around on the second arm and

remount the same projecting in the opposite direction so that it will now project upwardly for this mounting. This is achieved by the construction shown in FIG. 8 in which the control pivot frame carries an aligning rib 175 which is received in a vertical V groove 176 in the end of the second arm 57. On the opposite side of the control pivot frame is a similar aligning rib 177 and spaced an equal distance from the centrally located bolt 128. By unscrewing a nut 179 from the bolt which attaches the control pivot frame to the end of the second arm, the frame may be removed and turned around so that the opposite ridge 177 is received in the V groove whereupon the nut is threaded onto the bolt to reclamp the frame in position now projecting in the opposite direction but upwardly with respect to the right-hand mounting. FIG. 8 shows another method of providing the aligning ribs by means of rods 180 welded or soldered to opposite faces of the control pivot frame.

Again, in mounting the device on the right-hand side of the drawing board without any other change, the third arm would be projecting upwardly. In order to project it downwardly, the ruling edge member is removed, the clamping screw 43 for the first arm 34 is loosened and the pedestal clamp 43 is tight and clamping means 29 is also loosened. The pedestal is then rotated through 180° which rotates the first, second and third pulleys through 180° and the pedestal clamp 29 is then tightened. The third arm which is secured to the third pulley will have rotated 180° and will now project downwardly. The control pivot bracket is also removed and remounted to extend from the other edge of the control frame so that the axis of the control pivot 138 will be in line with the center of the third pivot 61 and at right angles to the longitudinal axis 129 of the second arm. The control rod is inserted in the control rod slide 139 which rotates it through 180° and the perspective control disc 122 rotates therewith to bring the other notch 124 therein in position to be engaged by the connecting means. The indexing member or disc 92 turns through 180° with rotation of the third arm and the indexing notches 96 in the other 180° half or circumference of the indexing member are the notches used for angular positioning of the ruling edge member. The ruling edge member is inserted from the opposite side of its mounting means so that it projects to the left. This completes the conversion of the drawing device from a left-hand mounting to a right-hand mounting on the drawing board.

In order to assure with greater certainty that the control rod 118 is in alignment with the vertical axis of the fourth pivot 69, it may be conveniently constructed with a tapered end 183, FIG. 18. This tapered end fits into a tapered socket 184 in the control rod hub 119 which socket is aligned with the pivot axis. The rod carries a shoulder shown as a circular flange 185 which is engaged by a capnut 186 threaded onto the hub and this nut drives the tapered end of the control rod into tight contact with the tapered socket.

In order to assist in the location of the vanishing point at a desired distance from the object to be drawn, a vanishing point slide rule may be used, FIG. 20. This slide rule is shown in circular form for compactness and includes a primary disc 190 having logarithmic inch markings from 6 to 500 around its peripheral edge. A secondary disc 191 is rotatably mounted with respect to the primary disc and carries a logarithmic scale of cotangents (or tangents) of angles around its peripheral edge from 3° to 87° with some overlapping. At the 45° mark and at the peripheral edge is an arrow 192.

This slide rule is used by placing the arrow at the desired number of inches distance of the observation point from the picture plane or structure to be drawn then reading the *vp* distance at the angle thereof. For example, if the arrow is placed on 30 inches as the distance of the eye from the picture plane and the structure to be drawn and the angle, at which the face of the object is viewed, is 45°, the distance of the vanishing point can be read off and in this case it would be 30 inches. If, on the other hand, the object is to be viewed at an angle A of 60°, FIG. 21, the location of the vanishing point V2 from point C can be read off on the inch scale namely 17½ inches. The angle in the opposite direction would be 30° and therefore the vanishing point V3 can be read off at the 30° reading which shows a distance of this *vp* from point C as being 52 inches. In like manner, the position of the vanishing point may be determined by adjusting the pointer to any other distance of the viewing point S from the structure to be drawn, and reading off the distance on the inch scale at the angle of the face of the structure to be drawn.

If the structure being drawn should have a wing extending at a different angle and let it be assumed that this angle D is 45° as illustrated, the vanishing point for the L structure can be read off on the inch scale as 30 inches for the vanishing point V-1.

The drawing device described provides a plurality of angular adjustments of the ruling edge member for parallel drawing at various selected fixed angles. This is one contribution to the drawing device. It also provides adjustment for the vanishing point for perspective drawing. A simpler construction of the device may provide solely one vanishing point at a fixed point on any horizon line. The device has maximum utility when it is provided with both of these adjustments. The device is used for perspective drawing by the first arm being fixed in position and pivoting the second arm on the second pivot means. The ruling edge will be in alignment with the vanishing point in all positions of the ruling edge member for the setting.

The pulley diameters for the steel band connection are made directly proportional to the length of its respective arm and thereby equalizing any tendency of the bands from slipping on its respective pulleys.

It is desirable that any selected position of the first arm may be returned to this position with assurance and with out resetting as such after the device has been converted to perspective drawing. This is accomplished by the preset means illustrated in FIG. 2, which means includes a collar 195 which is rotatably mounted on the base means 28 and is secured in adjusted position by a lock screw 196. The collar is provided with a locating disc 197 which is secured to the collar and forms a part thereof. This disc has locating means, such as a notch or slot 198 in the periphery thereof.

The first arm 34 carries a detent which engages in the locating slot which detent may take many forms that shown being a spring 201 secured to the arm by screws 202. Detent means of suitable form is provided to remove the detent from and insert the same into the notch 198. The means shown is a cam 203 having an eccentric ridge 204 carried thereby and the eccentric ridge engaging the free end of the spring 201. The cam disc is pivotally mounted on a stem 205 having a handle 206 for rotating the cam disc. In the position shown the detent has been removed from the slot 198 and is held removed by the eccentric ridge 204. By turning the cam disc to the dot-dash position shown in FIG. 3, the spring flexes inwardly and upon rotating the first arm to bring the locating slot 198 into alignment with the detent whereupon it engages in the slot and retains the first arm in this preset position. With this presetting means the device may be converted to a parallel drawing device in which the first arm is free to rotate and restore the same to its initial perspective drawing position with the first arm fixed in that position.

There are variations of this structure available for example the spring detent could be carried on the collar and the notch or slot in the arm. And in this form the detent could be fixed to the pedestal and the notch disc could be selectively adjusted on the arm. The detent then may be carried by the pedestal or the first arm and the resetting notch would be carried by the other part, and it is immaterial whether the detent or the slot is selectively adjustable.

Means are provided to tighten the endless band 64 for the second arm extending between pulleys 58 and 63. The eccentric used for belt tightening on the first arm not suitable for this arm since this form of adjustment changes the position of the longitudinal center line of the arm and would change the effective infinity point on the scale. The band may be

tightened or loosened by lengthening and shortening the second arm **57**. There are many ways to accomplish this and that illustrated uses right and left-hand threads on the ends of the arm tubes which connect the end frames forming the second arm and the tubes are locked in adjusted position by locknuts **210**. Changing the length of the second arm without more would affect the accuracy of the scale **130**. This inaccuracy can be removed by shortening or lengthening the third arm **67** proportionately so that the product of the length of the second arm and of the length of the third arm remains the same for all adjustments. For example, if the two arms are of the same length between centers, that is basically without adjustment, and the second arm is lengthened, then the third arm should be shortened by essentially an equal amount, or precisely such that the product of the arm lengths is always the same, in order to make the scale accurate for the increase in the length of the second arm. If the two arms are not the same length between centers then the change in the length of the second arm would require a proportional change in the length of the third arm so that the product of these two arm lengths remain the same for all adjustments.

The length of the third arm **67** (FIG. **22**) may be adjusted in several ways that illustrated including a longitudinal slot **212** in the arm with bolts **213** passing therethrough and securing the arm to the pulley **63**. A single bolt may be used but an aligning means, such as a slot or shoulder in the pulley to receive the arm, must be provided. The adjustment of the length of the third arm may be made with a ruler or there could be suitable markings carried by the third arm or its pulley and a pointer carried by the other part.

This invention is presented to fill a need for improvements in a Parallel and Perspective Drawing Device with Angular and Parallel Adjustment. It is understood that various modifications in structure, as well as changes in mode of operation, assembly, and manner of use, may and often do occur to those skilled in the art, especially after benefiting from the teachings of an invention. This disclosure illustrates the preferred means of embodying the invention in useful form.

What I claim is:

1. A parallel drawing device comprising base means having a first pivot means, a first arm having ends and pivotally mounted at one end thereof on the first pivot means, a second arm having ends and an arm axis, a second pivot means pivotally mounting one end of the second arm to the other end of the first arm, a third arm having ends, a third pivot means mounting one end of the third arm to the other end of the second arm, a fourth pivot means secured to the other end of the third arm and having a vertical axis, a arm-connecting means connecting the base means with the third arm to retain the relative angular position of this arm with respect to the base means in all positions of the first and second arm, a ruling edge member having at least one ruling edge, mounting means for the ruling edge member pivotally mounting the ruling edge member on the fourth pivot means, the ruling edge being in alignment with the axis of the fourth pivot means, an indexing member secured to the fourth pivot means and having a plurality of indexing means angularly spaced uniformly over at least 180° thereof, and a connecting member carried by the ruling edge mounting means having a neutral position and a position connecting the ruling edge mounting means with one of the indexing means on the indexing member.

2. A parallel drawing device as in claim **1** for right-hand and left-hand mounting of the device on the drawing board in which the indexing means extends over 360° of the indexing member, and means to adjust one of the parts including the base and the arm connecting means through 180°.

3. A parallel drawing device as in claim **1** including a protractor secured to the fourth pivot means, means carried by the ruling edge mounting means to adjust the angular position of the ruling edge mounting means with respect to the protractor with the connecting member in neutral position, and means to clamp the ruling edge mounting means in adjusted position.

4. A perspective and parallel drawing device as in claim **1** including a control rod, control rod pivot means pivotally mounting said rod on the fourth pivot means, a perspective frame secured to the other end of the second arm and extending at right angles to its arm axis, control pivot means mounted on the perspective frame including a control pivot slidably receiving the control rod and having its center at right angles to the center axis of the third pivot means, conversion means to convert the device to and from a perspective drawing device and a parallel drawing device including said connecting member being operable to a third position to selectively connect the ruling edge mounting means with the control rod pivot means.

5. A perspective and parallel drawing device as in claim **4** including a perspective scale carried by the perspective frame, and adjusting means carried by the control pivot means to adjust the same along the perspective scale and retaining the center of the control pivot means at right angles to the center axis of the third pivot means in all adjusted positions.

6. A perspective and parallel drawing device as in claim **5** in which the conversion means has a pivot to pivotally mount the same on the ruling edge mounting means, interlocking means on the conversion means such that pivoting of the latter in one direction interlocks the same with an indexing means and pivoting in the opposite direction interlocks the conversion means with the control rod pivot means.

7. A perspective and parallel drawing device as in claim **6** in which the indexing means are notches, the interlock connection on the control rod pivot means has at least one notch, and the conversion means has an interlock pin on one side of its pivot for interlocking with a notch of the indexing means and has an interlock pin on the other side of its pivot to interlock with a notch on the control rod pivot means.

8. A perspective and parallel drawing device as in claim **7** in which the indexing notches are tapered outwardly for a tight engagement of the connecting pin therein.

9. A perspective and parallel drawing device as in claim **8** in which the conversion means has a radially tapered notch to tightly receive the conversion means pivot on the ruling edge mounting means, and spring means connected with the conversion means to press the same radially inwardly.

10. A perspective and parallel drawing device as in claim **7** in which the conversion means has a radially tapered notch to tightly receive the conversion means pivot on the ruling edge mounting means, and spring means connected with the conversion means to press the same radially inwardly.

11. A perspective and parallel drawing device as in claim **6** in which the indexing means are holes, the interlocking connection on the control rod pivot means is at least one hole, the conversion means being mounted on the straight edge mounting means for vertical upward and downward movement from a neutral position, and having an upwardly projecting pin and a downwardly projecting pin, and conversion operating means connected with the conversion means to selectively move the same vertically into interlocking connection with an indexing means and with the control rod pivot means.

12. A perspective and parallel drawing device as in claim **11** in which the conversion operating means includes a conversion means operating member pivotally mounted on the ruling edge mounting means and having a cam on the periphery thereof engaging the conversion member to move the same vertically upon pivotal movement of the conversion means operating member.

13. A perspective and parallel drawing device as in claim **4** including a worm gear secured to the indexing disc, a worm for engagement with the worm gear, worm mounting means carried by the ruling edge mounting means mounting the worm for engagement with and disengagement from the worm gear and a protractor scale carried by the fourth pivot means.

14. A perspective and parallel drawing device as in claim **6** including a worm gear secured to the indexing disc, a worm for engagement with the worm gear, worm mounting means carried by the ruling edge mounting means mounting the

worm for engagement and disengagement from the worm gear, and a protractor scale carried by the fourth pivot means.

15. A perspective and parallel drawing device as in claim 13 including a verner scale carried by the casing and positioned in cooperative relation with the protractor scale.

16. A perspective and parallel drawing device as in claim 5 in which the ruling edge mounting means receives the ruling edge member to selectively project from opposite sides thereof, the indexing means being provided through 360° of the indexing member and the control rod pivot means having two interlocking means spaced 180° apart.

17. A perspective and parallel drawing device as in claim 16 in which the ruling edge mounting means is a guideway open at both ends thereof, the end of the ruling edge member having a stem received in the guideway from either end thereof, and the opposite ruling edge being in line with the axis of the fourth pivot when the ruling edge member projects in a left-hand direction.

18. A perspective and parallel drawing device as in claim 1 in which the arm connecting means includes a first pulley, a second pulley, a third pulley secured to the second pulley, and a fourth pulley, means to secure the first pulley to the base means, means rotatably mounting the second and third pulleys on the second pivot means, means pivotally mounting the fourth pulley on the third pivot means, the third arm being secured to the fourth pulley, band means connecting the first and second pulleys, band means connecting the third and fourth pulleys, and the diameters of the first and second pulleys and the diameters of the third and fourth pulley being directly proportional to the length of the first and second arms respectively between the axes of their respective pivot means.

19. A perspective and parallel drawing device as in claim 5 including a detent carried by the base means or the first arm and a locating means carried by the other part which locating means is to be engaged by the detent.

20. A perspective and parallel drawing device as in claim 19 including adjusting means for one of the parts including the detent or the locating means to adjust the same circumferentially with respect to the other part.

21. A perspective and parallel drawing device as in claim 20 including actuating means carried by the part having the detent to engage the detent to disengage the same from the locating means and to retain the detent disengaged therefrom.

22. A perspective drawing device comprising base means having a first pivot means having a vertical axis, arm means mounted on the first pivot means, including a first perspective arm having ends and an arm axis, a second pivot means pivotally mounting one end of the first perspective arm to the first pivot and having a vertical axis, a second perspective arm having ends, a third pivot means mounting one end of the second perspective arm to the other end of the first perspective arm and having a vertical axis, a fourth pivot means secured to the other end of the second perspective arm and having a vertical axis, arm connecting means connecting the base means with the second perspective arm to retain the relative angular position of this arm with respect to the base means in all positions of the said first and said second arms including at least one belt, a ruling edge member having at least one ruling edge mounting means for the ruling edge member pivotally mounting the ruling edge member on the fourth pivot means, the ruling edge being in alignment with the axis of the fourth pivot means, a control rod, control rod pivot means pivotally mounting said rod on the fourth pivot means, a perspective frame secured to the other end of the second arm and extending at right angles to its arm axis, control pivot means mounted on the perspective frame including a control pivot slidably receiving the control rod and having its center at right angles to the center axis of the third pivot means, adjusting means for the second arm to lengthen and shorten the same, and adjusting means for the third arm to shorten and lengthen the same.

23. A perspective and parallel drawing device as in claim 4 including adjusting means for the second arm to lengthen and shorten the same, and adjusting means for the third arm to shorten and lengthen the same.