

Aug. 2, 1955

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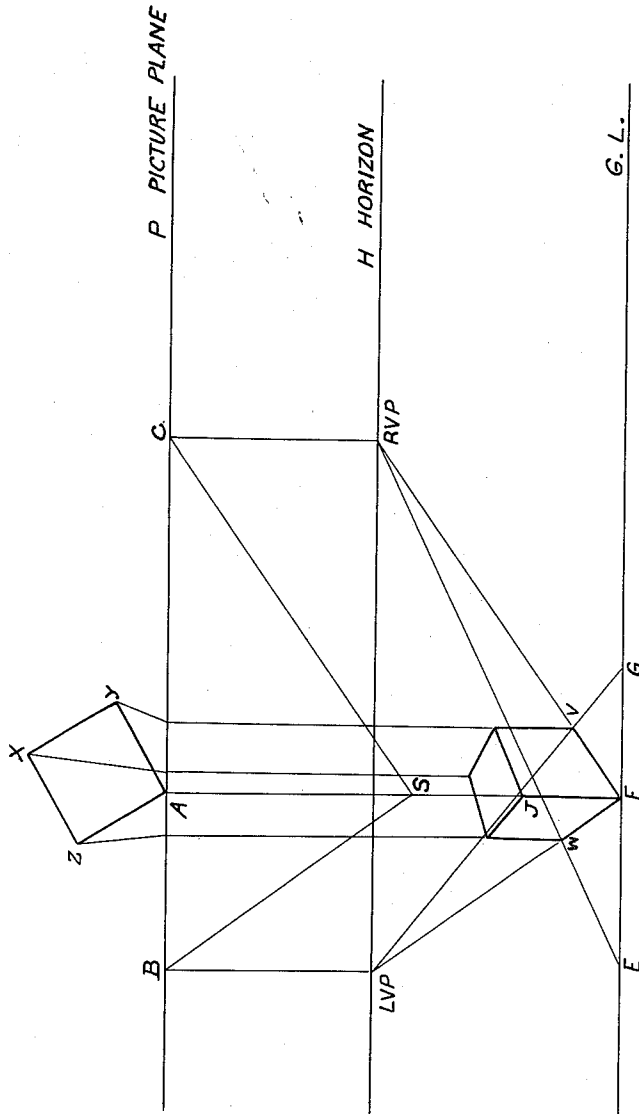
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PERSPECTIVE DRAFTING MACHINE

Filed March 31, 1952

11 Sheets-Sheet 1

Fig. 1.



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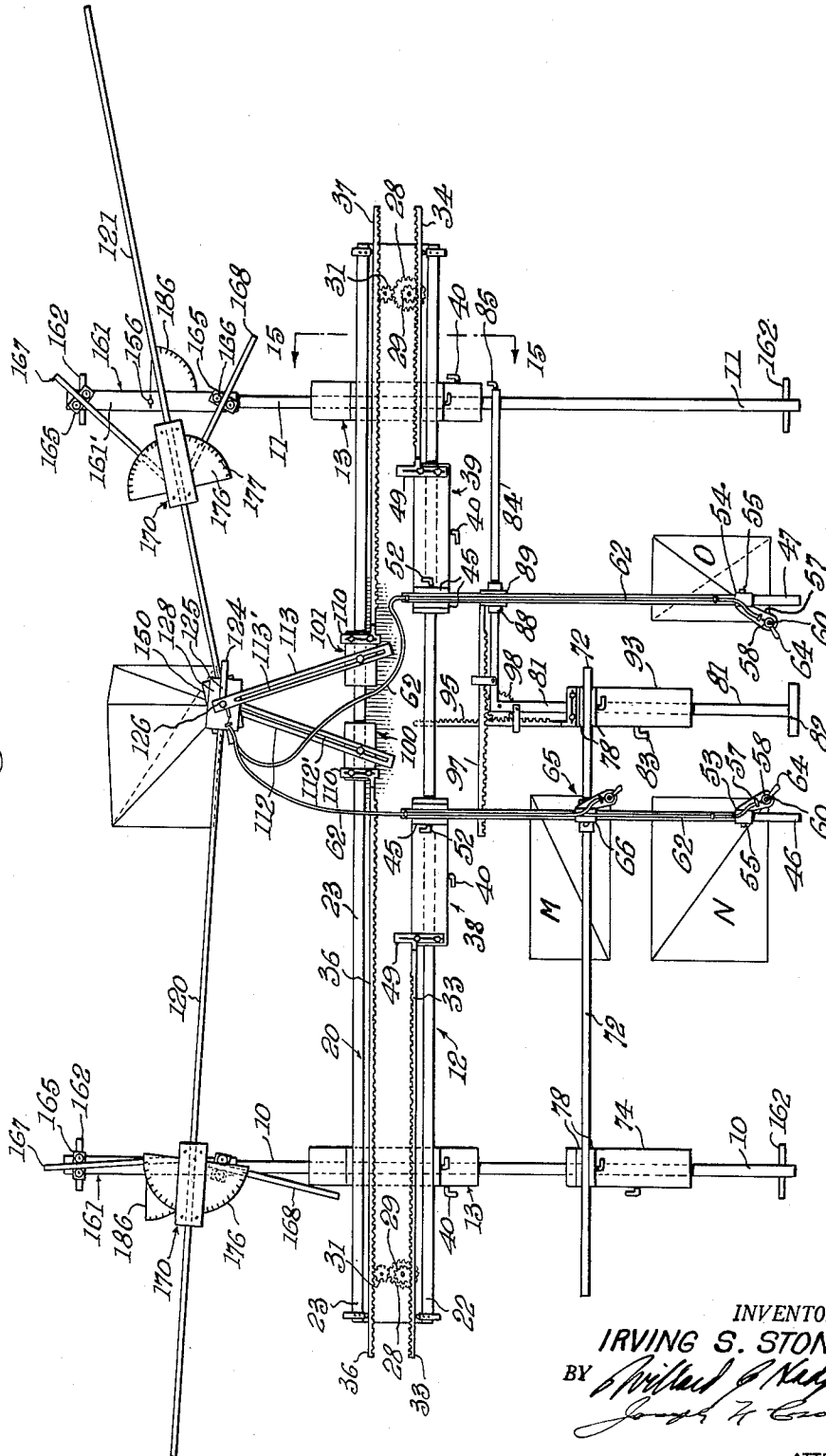
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PERSPECTIVE DRAFTING MACHINE

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11 Sheets-Sheet 2

Fig. 2.



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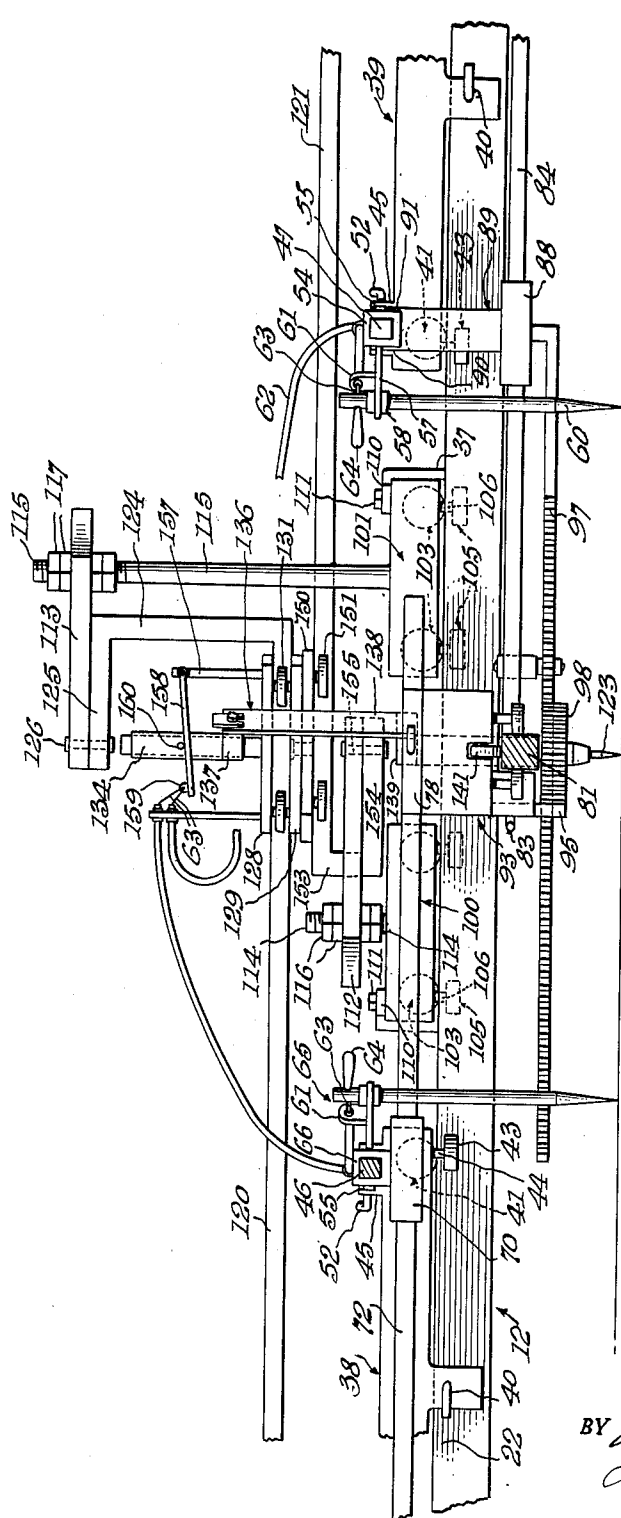
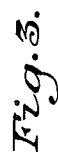
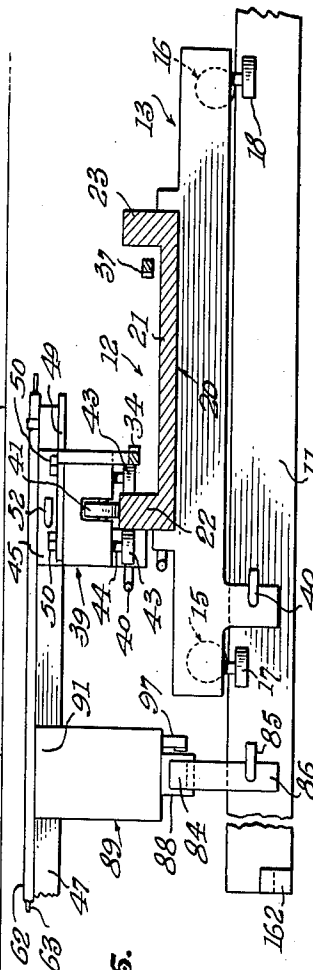


Fig. 15.



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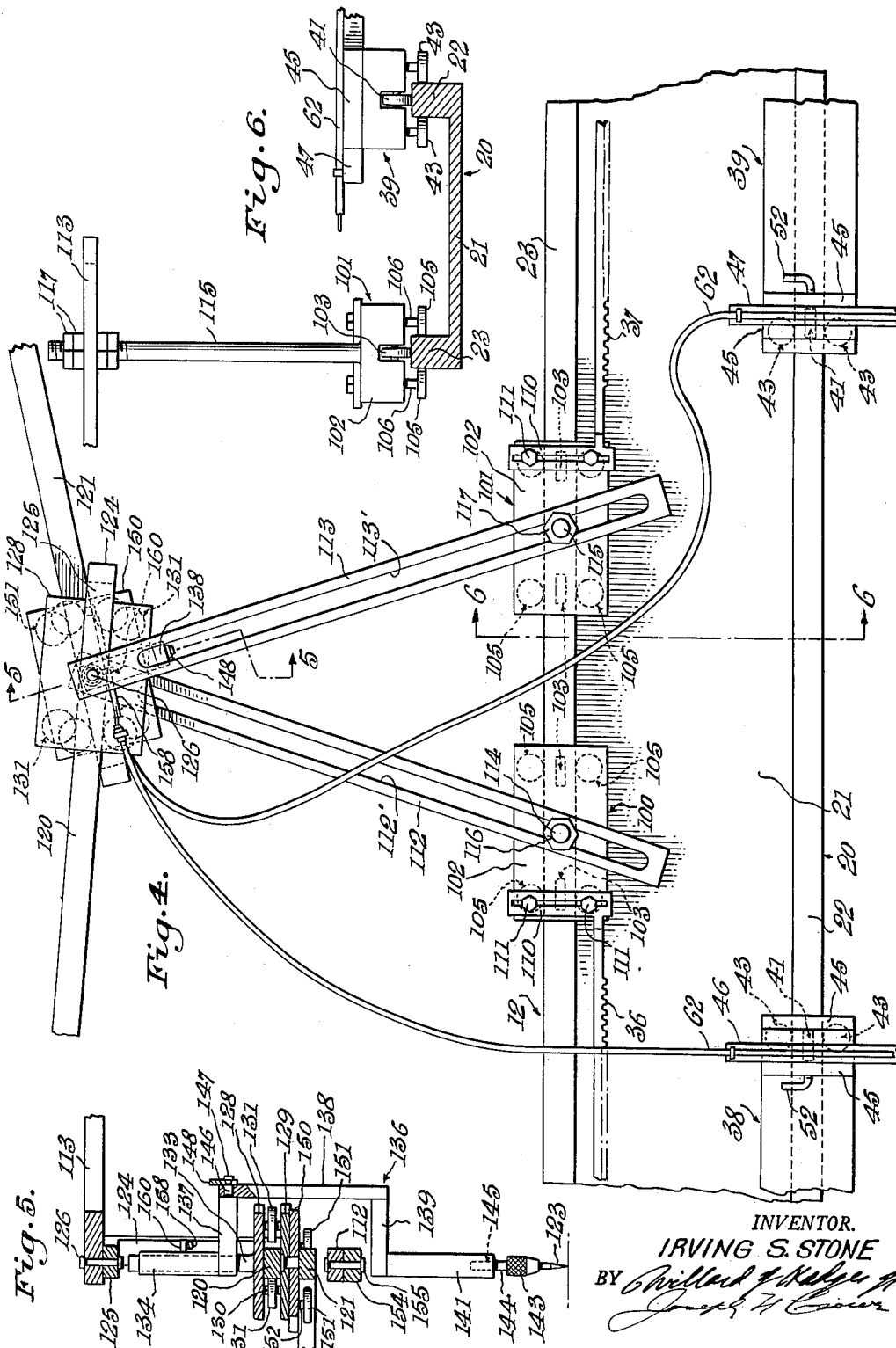
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PERSPECTIVE DRAFTING MACHINE

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PERSPECTIVE DRAFTING MACHINE

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Fig. 12.

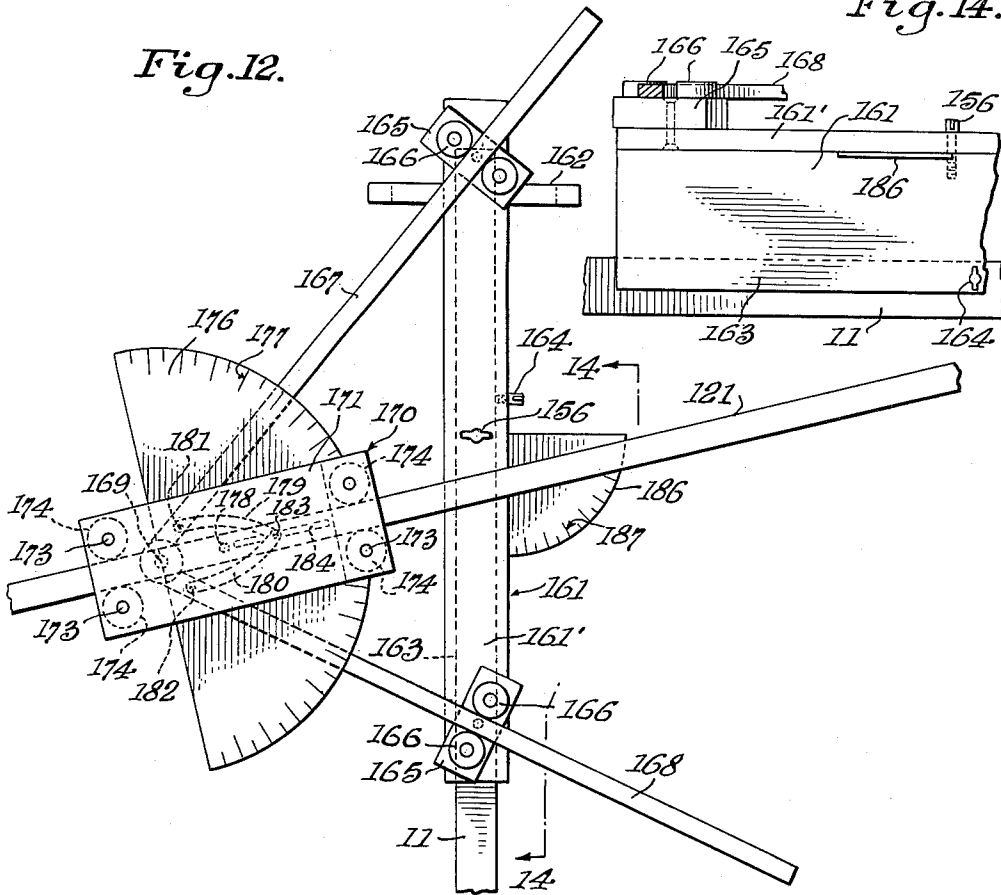


Fig. 14.

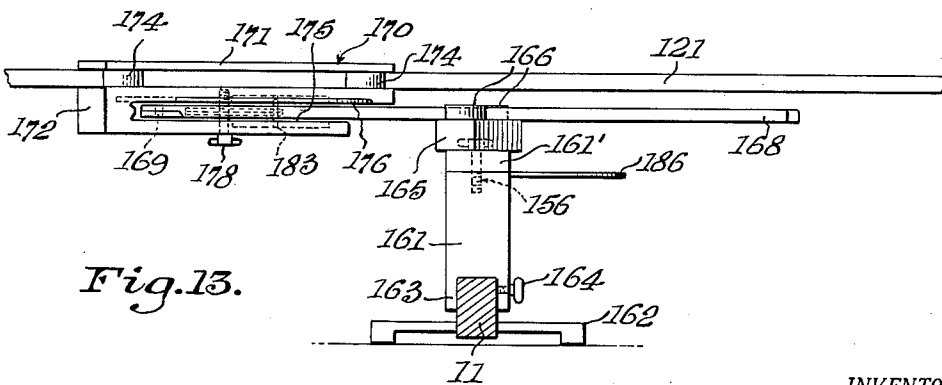
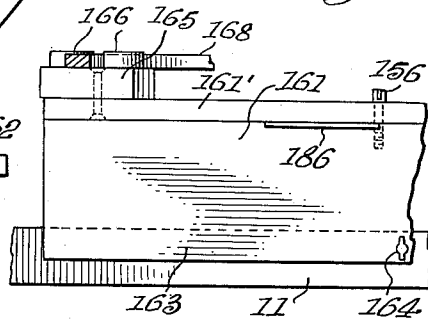


Fig. 13.

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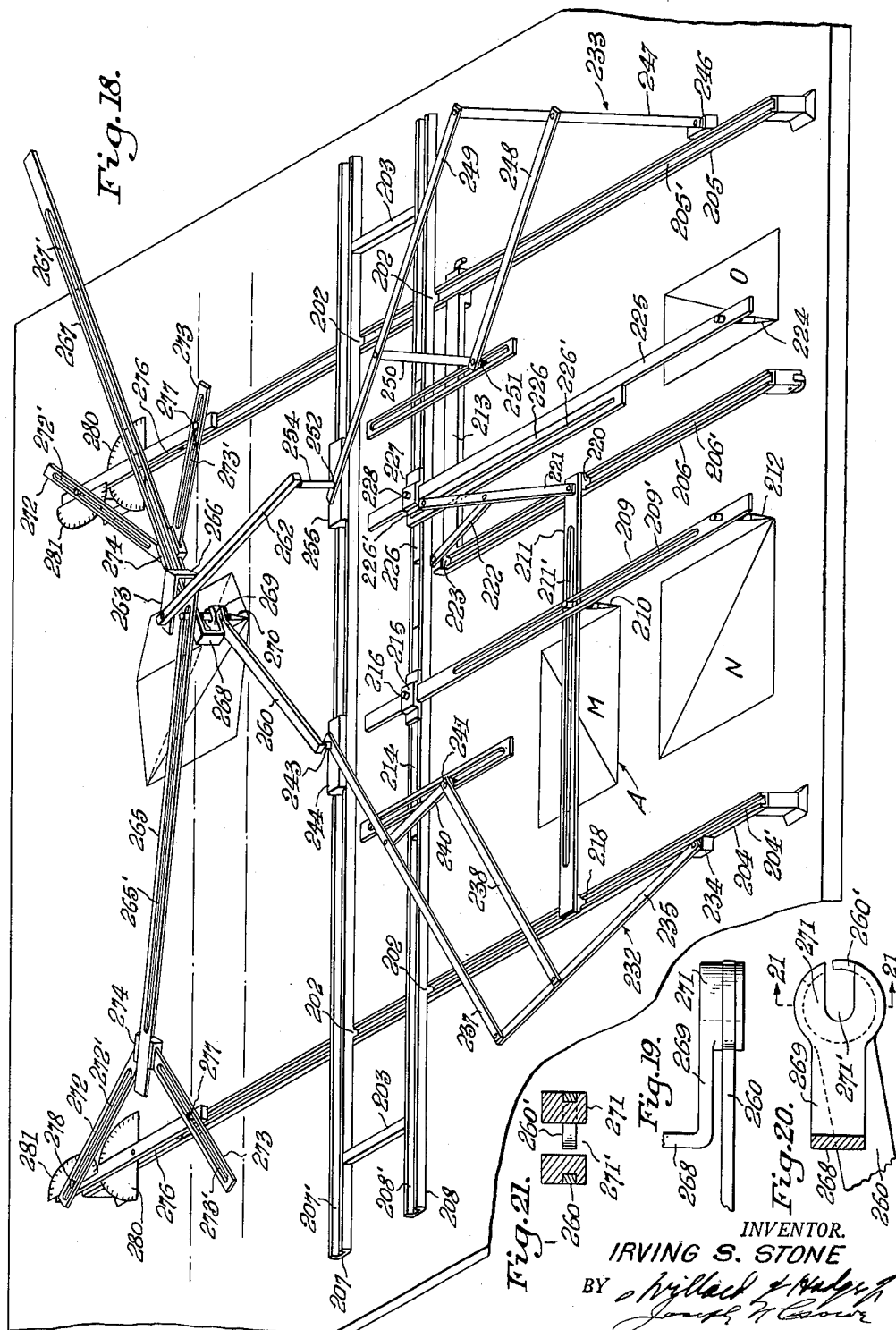
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PERSPECTIVE DRAFTING MACHINE

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2,714,253

PERSPECTIVE DRAFTING MACHINE

Irving S. Stone, Buffalo, N. Y.

Application March 31, 1952, Serial No. 279,678

15 Claims. (Cl. 33—18)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without payment to me of any royalty thereon.

This invention relates to mechanical movements and, more particularly, to a machine for automatically producing a perspective of an object from plane views thereof, such as conventional plan, front and side elevations and the like.

The theory of mechanical drafting is well known and therefore this description will not include any analysis of the theory except insofar as it may be necessary to a description of the mechanical elements employed and their operation.

Accordingly, it is an object of the present invention to provide a machine adapted to produce a perspective of an object from the tracings of the plan and elevation views thereof. A further object of the invention is the provision of a machine adapted to mechanically correlate the proportions of length, width, and height necessary to produce a perspective of an object from plan and elevation views thereof.

Another object of the invention is to provide a machine adapted through relatively simple mechanical movements to produce from plan and elevation views of an object a three dimensional representation thereof.

A further object of the invention is the provision of a relatively simple machine for producing a perspective from plan and elevation views which is simple and easy to operate in order that an operator may easily employ the machine and without the necessity of understanding the theory underlying its operation.

A still further object of the invention is the provision of a machine various portions of which may be employed in the production of conventional isometric, oblique, enlargement, surface intersection, and one-point perspective drafting.

These and other objects of the invention will become apparent from the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a diagrammatic view illustrating a well-known method of graphical construction of a perspective view;

Fig. 2 is a plan view of an embodiment of my invention;

Fig. 3 is a fragmentary front elevation of the device of Fig. 2;

Fig. 4 is an enlarged scale detail plan view of the drawing arm assembly of Fig. 2;

Fig. 5 is a section on the line 5—5 of Fig. 4 illustrating the details of the pencil-controlling mechanism;

Fig. 6 is a section on the line 6—6 of Fig. 4;

Fig. 7 is an enlarged scale plan view of the details of the right half of the main track;

Fig. 8 is a front elevation of the structure of Fig. 7;

Fig. 9 is a section on the line 9—9 of Fig. 7;

Fig. 10 is a plan view illustrating the details of the pinion and rack assembly;

Fig. 11 is a section on the line 11—11 of Fig. 10;

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Fig. 12 is an enlarged plan view of the right controllead;

Fig. 13 is an elevation of the structure of Fig. 12 with the track appearing in section;

Fig. 14 is a section on the line 14—14 of Fig. 12;

Fig. 15 is a section on the line 15—15 of Fig. 2;

Fig. 16 is a plan view of a modified form of the tracing mechanism of Fig. 2;

Fig. 17 is a section on the line 17—17 of Fig. 16;

Fig. 18 is a perspective of a modified form of my invention;

Fig. 19 is a fragmentary elevation to an enlarged scale illustrating the details of the holding means for the perspective drawing pencil of Fig. 18;

Fig. 20 is a plan view of the device of Fig. 19;

Fig. 21 is a section on the line 21—21 of Fig. 20;

Fig. 22 is a plan view of a further modification, particularly adapted for making one point perspectives;

Figs. 23, 24, 25, and 26 are sections on lines 23—23, 24—24, 25—25, and 26—26 of Fig. 22;

Fig. 27 is a plan view of a further modification, particularly adapted for producing an oblique view;

Fig. 28 is a section on the line 28—28 of Fig. 27;

Fig. 29 is a fragmentary plan view of a modified drawing arm construction for use with tracing and motion transmitting mechanism as shown in the lower portion of Fig. 2, for producing isometric views; and

Fig. 30 is a section on the line 30—30 of Fig. 29.

Referring to the drawings and particularly Fig. 1, a plan view of the cube AZXY is shown with the corner A resting in the picture plane P, the sides AY and AZ of the cube being positioned at the desired angles to the picture plane, 30° and 60°, respectively, being commonly selected for these angles. For the purposes of illustration the position of the observer is at S, slightly below the horizon H, the ground line GL being positioned on the sheet below the horizon H to prevent interference between the perspective to be drawn and the other views insofar as possible.

Ordinarily, an elevation of two adjacent sides of the object would be required to provide information to construct its perspective, but for simplification a cube has been selected whose height corresponds to its width and hence the perpendicular AF from the picture plane to the ground line has the segment JF marked off corresponding to the edge of the cube in the picture plane. By conventional construction we obtain the left vanishing point LVP and the right vanishing point RVP and construct the cube on the ground line as shown.

The present perspective drafting machine embodies a relationship existent between the length, width, and height of the object in the plan and elevation views and in the perspective. In Fig. 1, the line SB indicates a ray from the observation point S parallel to side AZ of the cube having its intercept or piercing point with the picture plane at B, and SC is a similarly located line parallel to the side AY of the cube. The lower left and right corners W and V are obtained by conventional means, and lines from the right and left vanishing points RVP and LVP, respectively, representing rays from such right and left vanishing points, are extended to E and G on the ground line.

Referring to the machine itself, and particularly Figs. 2 through 12, the device includes parallel left and right-hand supporting rails or tracks 10 and 11. Slidably mounted on the tracks is a frame assembly 12. The frame is supported by carriage members 13 on each of the tracks, each carriage member comprising a substantially rectangular block having front and rear bottom rollers 15 and 16 and front and rear pairs of side rollers 17 and 18. The rollers 15 and 16 support the blocks on the track

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and the side rollers 17 and 18 maintain the alignment of the block therewith.

The frame assembly comprises a channel member 20 having a relatively broad web 21 and flanges 22 and 23, which flanges are on the forward and rearward edges of the channel member 20, respectively, and which extend from the sides of the web. Supported adjacent each end of the member 20 on the web is a plate 25 having pins 26 and 27 extending upwardly therefrom. The pin 26 rotatably carries concentric gear members 28 and 29, the gear 29 being substantially smaller than the gear 28. Relative movement between the gear members 28 and 29 is prevented by pin 30 attached to the upper surface of the lower gear member 28 and extending through a snugly fitting aperture in the upper gear member 29, the pin and the aperture being spaced the same radial distance from the axes of their respective gear members. It is apparent, therefore, that upper gear members of various sizes may be easily substituted when desired, in order to vary the ratio between the various gear members. Pin 27 carries a gear 31 in mesh with and substantially smaller than the gear 28. Left and right racks 33 and 34 are positioned adjacent to flange 22 of the member 20 and mesh with the pinion gears 29, and left and right racks 36 and 37 adjacent the flange 23 are meshed with the pinion gears 31.

The inside extremities of the racks 33 and 34 are connected to left and right transverse slider bar members 38 and 39, each of the members 38 and 39 being slidably mounted on the flange 22 of the channel member 20, similar to the mounting of the carriage members 13 on the tracks 10 and 11. Fasteners 40 threaded into the slider bar members 38 and 39 and the carriage members 13 are adapted to engage the supporting channel member or rail to hold the members in position thereon. The members 38 and 39 are substantially rectangular and have rollers 41 mounted at each end and lateral rollers 43 at either side of the rollers 41, the rollers 43 being suspended by shafts 44 from the underside of the members 38 and 39. At the extremity of the members 38 and 39 near the central portion of the machine is a pair of spaced upstanding flanges 45 for the reception of left and right guide bars 46 and 47. At the other end of the members 38 and 39 slotted offset brackets 49, which may be integral or attached to the racks 33 and 34, are secured to the upper surface of the members 38 and 39 by the fasteners 50 extending through the slots.

The members 46 and 47 comprise elongated rods or rails and are movably secured at one extremity between the flanges 45 mounted on the members 38 and 39 by a fastener 52. Adjacent their other end the guide bars have adjustable sleeves 53 and 54 on the left and right guide bars 46 and 47 respectively which are secured thereto by fastener 55. A flange 57 extends laterally from each of the sleeves and has a sleeved aperture 58 through which a tracing pointer 60 extends. Mounted on each of the flanges 57 is a bracket 61 to which is attached a sheath 62 for a wire 63, the wire being connected to the upper portion of the pointer 60 above the flange 57. A lever 64 is also attached to the upper portion of each pointer in order to assist the operator in its manipulation.

A third pointer mechanism 65 is mounted by sleeve 66 on the guide bar 46 between the member 38 and sleeve 53. The sleeve 66 has a slider member 70 attached to its lower portion which is adapted to ride on a cross bar member 72 one end of which is carried in a carriage member 74 on the left track member 10. The carriage member 74 is substantially rectangular and is supported by front and rear rollers 75 on the track 10 and maintained thereon by front and rear pairs of side rollers 76. Mounted on the carriage are transverse upstanding channel members 78 between which the bar 72 is slidably received.

Substantially centrally of the guide bars 46 and 47 and

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parallel thereto is a rail 81 supported at one end by a foot 82. The rail extends parallel to the guide bars and has a leg 84 at right angles thereto, extending to the track 11 to which it is secured by a fastener 85 passing through its flange 86, a flange 87 being spaced therefrom for receiving the track 11. The leg 84 has a slider 88 thereon carrying a flanged support 89 having spaced uprights 90 and 91 between which the guide bar 47 is slidably received.

Movably mounted on the rod 81 is a carriage 93 similar to the carriage 74. A fastener 83 is provided to hold the carriage in the desired position on the rod 81. At the forward portion of the carriage 93 the bar 72 is slidably received between the transverse upright flanges 78. Secured to the forward portion of the carriage 93 is a rack 95 which moves with the carriage. A rack 97 is secured to the support 89 which carries the guide bar 47, and a pinion 98 is rotatably mounted on a shaft 99 supported near the apex of the rod 81 and its leg 84, the pinion being adapted to simultaneously mesh with the racks 95 and 97 such that movement of the rack 95 longitudinally will produce equal movement transverse of the rack 97.

Referring particularly to Figs. 4, 5 and 6, Fig. 4 illustrates in plan the details of the drawing arm assembly. The assembly comprises left and right carriages 100 and 101 movably mounted on the flange 23 of the member 20. Each of the carriages comprises a substantially rectangular member 102 having bottom rollers 103 near their extremities and adapted to roll on the flange 23, the members being retained on the flange by lateral pairs of rollers 105 suspended by pins 106 adjacent the rollers 103. The racks 36 and 37 are secured to the carriages 100 and 101 by offset arms having slotted brackets 110, fasteners 111 extending through the slots into the members 101 and 100.

Drawing arms 112 and 113 having slots 112' and 113' longitudinally and substantially the length thereof are connected to the carriages 100 and 101 respectively by shafts 114 and 115 extending through the slots into the carriages and secured to the arms by fasteners 116 and 117. The extremities of the arms 112 and 113 are pivotally connected to left and right centrolinead bars 120 and 121 and a marking instrument or pencil 123 is mounted at the intersection of bars 120 and 121.

The left centrolinead bar 120 has a transversely disposed end 124 with a transverse flange 125 pivotally secured adjacent the end of the arm 113 by a pin 126. A pair of spaced parallel plates 128 and 129 are positioned on the upper and lower sides of the bar 120, two pairs of spaced pins 130 rotatably carrying spaced rollers 131, the rollers being provided to guide the bar 120 between the rollers and maintain its angularity with respect to the spaced plates. Centrally of the upper plate 128 on its upper surface an upstanding post 133 is provided having a sleeve 134 adapted to slide axially thereof. Connected to the lower portion of the sleeve 134 is a bracket assembly 136 having an upper horizontal arm 137, an offset vertical arm 138, a lower horizontal arm 139, and a post 141 axially aligned with the post 133. The pencil holder 143 has a shaft 144 received in a bore 145 at the lower end of the post 141. In order that the pencil holder may be easily removed to change or sharpen the pencil the vertical arm 138 is removably connected to the upper horizontal arm 137 by a pin 146 extending from arm 137 through an aperture at the upper extremity of arm 138. The pin 146 has a reduced neck 147 for retaining a spring clip member 148 which normally holds the arms 137 and 138 in engagement.

Pivotally attached to the underside of the lower plate 129 is a plate 150 having two pairs of spaced lateral rollers 151, each roller being suspended therefrom by a post 152, the arm 121 of the centrolinead bar being received and guided between the spaced rollers 151. The extremity of the arm 121 adjacent the drawing arms has a transverse

portion 153 with an offset portion 154 extending therefrom and parallel to the arm 121. The end of the offset portion 154 is pivotally attached to the end of the drawing arm 112 by pivot 155 extending through the arms.

Supported on the upper plate 128 is a post 157 to the upper end of which is pivotally attached an arm 158 which has a flange 159 at its other end. A detent 160 is attached to the sleeve 134 adjacent the arm 158 such that pivotal movement of the arm 158 upward about its pivot point raises the sleeve 134 connected to the offset pencil support assembly 136 in order to raise the pencil point 123 from the surface on which it rests normally.

The tracks 10 and 11 are supported at their extremities by feet 162. A rectangular supporting bar 161 is slidably mounted near the ends of the tracks 10 and 11 by means of a longitudinally disposed channel 163 in the lower portion of the bars 161, fasteners 164 extending into the bars 161 adjacent the tracks 10 and 11 for engagement therewith. Bar 161 has a pivot block 161' mounted on its upper surface on a fastener 156 about which the block 161' may pivot, the fastener being adapted to hold the block in a desired position. Pivotaly mounted on each end of the blocks 161' is a guide 165 having spaced rollers 166 supported laterally on its upper surface and adapted to receive left and right centrolinead guide members 167 and 168, the members 167 and 168 being pivotally connected by pin 169 at their intersection. Slidably mounted on each of the centrolinead members 120 and 121 is a substantially rectangular carriage 170 having a top member 171 riding on a member 120 (or 121) and spaced from a lower portion 172 by pins 173 carrying a pair of rotatably mounted rollers 174 at either extremity of the carriage. The lower portion 172 has a slot 175 for receiving the connected ends of the members 167 and 168. Flush-mounted in the upper portion of the slot 175 of carriage 170 and with its axis at the intersection of the members 167 and 168 is a protractor 176 having graduations 177 thereon for indicating the angles at which the members 167 and 168 are inclined to member 120 or 121.

A wing nut fastener 178 has its shaft extending through the lower ledge of portion 172 and threaded into the upper ledge thereof, the head of the fastener being adapted to abut the lower ledge and draw it toward the upper as the wing nut is fastened. Toggle members 179 and 180 each have one end pivotally attached at 181 and 182, respectively, to the centrolinead guide members 167 and 168, and are pivotally joined by pin 183 normally slidable in slots 184 in the upper and lower ledges of member 172 and axially of the member 120 (or 121). When the members 167 and 168 are correctly angularly positioned they may be locked in such position by tightening fastener 178 to bind pin 183 in slots 184. In all cases, each makes the same angle as the other with member 121.

Another protractor 186 having graduations 187 is attached to the bar 161 for indicating the angle that the pivot block 161' makes with the bar 161.

In the operation of the device the machine is first positioned in order to produce the desired perspective. For example, assume that the longest side of the object is to be drawn at an angle of 30° to the picture plane, one corner of the object to lie in the picture plane, the station point S (Fig. 1) to be $13\frac{3}{4}$ inches from the picture plane and perpendicular to it from the point of intersection of the object and the plane, and the horizon 3 inches above the ground line. To begin place the working plan drawing to be traced on the drawing board. Bar 81 is then centered between the elevation views and the tracing instruments attached to sleeves 53, 54 and 65 are positioned on their respective views N, O, and M at a common point. Rod 72 remains clamped between channels 78 unless it is desired to vary the distance between rails 10 and 11.

The next step is to provide the proper proportion of movement between the rack members 33, 34, 36 and 37 and the corresponding pinion gears. For a given setting of the distance of the station point to the picture plane and the angles of incidence referred to, the proportions

will remain constant and therefore the gear ratios need not be varied. It is understood, however, that it is within the scope of the invention to provide different sets of gears, particularly the pinion gears, in order to vary the proportionality of movement of the parts.

During the setting of the tracer mechanism the fasteners 116 and 117 securing the drawings arms to their shafts may be loosened and the fasteners holding the carriages on their supports fastened, which will permit the setting of the tracer portion of the machine independently of the drawing mechanism therefor. The drawing paper on which the perspective is to be made may then be placed in the machine in position to receive the pencil of the drawing mechanism, the paper having on it the ground line and horizon lines previously drawn. Furthermore, the starting point for the ground line must correspond to the starting point set for the tracing portion of the machine.

The next step is to set the centrolineads. This is done by sliding the supporting carriages 161 along the tracks 10 and 11 until the center of each centrolinead is directly above the horizon line on the drawing paper. The protractors 176 are set at the angle for the desired vanishing point distance and fastened, the centrolineads being in their initial position. By the use of mathematics, including trigonometry, the distance of the left and right vanishing points from a line perpendicular to the picture plane passing through the intercept of the object with the picture plane and the observation point may be determined and similarly the distance from the vanishing points to the centrolinead may be computed and if desired a chart made up from which the centrolinead distances and the corresponding centrolinead angles may be read. Furthermore, if it should prove necessary to shift the centrolinead along the tracks in order to complete a drawing which requires movement of the various parts outside the range of the centrolineads the adjustment necessary may also be computed and the instruments reset accordingly by using protractor 176 in conjunction with protractor 186.

Next, the pencil is placed on the point corresponding to that which the tracer points have been placed on, that is, on the ground line, and the centrolinead arms 120 and 121 aligned such that their pivots are in direct line with the drawing point. Then the fasteners 116 and 117 are tightened so that the entire machine may operate as a unit.

In the operation of the device the plan view of the object "M" is positioned adjacent to the pointer of sleeve 66, the left elevation "N" adjacent to the pointer of sleeve 53, and the right elevation "O" adjacent to the pointer of the sleeve 54.

In the use of the machine and referring particularly to Fig. 2 the tracer point attached to sleeve 53 may be moved (the carriage fasteners 40 being released) to the left on the view "N" thus moving the carriage 38 and the rack 33 a corresponding distance to the left. This motion is transmitted through the rack 33 and pinions to the rack 36 which moves to the left a proportional distance in accordance with the sizes of the pinion gears used. This movement will similarly move to the left the carriage 100 to which is rigidly clamped the drawing arm 112; at the same time centrolinead arm 121 is drawn to the left through its guide mechanism moving the pencil to the left in alignment with the left centrolinead arm 120 towards the left vanishing point. Thus the pencil draws the left side of the perspective plan with the length of the line correctly drawn by the proportions set up in the gear mechanism.

Next, the tracing point attached to sleeve 66 is moved up vertically along the left side of the plan view in order to have the drawing point execute the next side of the object. In so moving, the tracer mechanism 65 slides on the bar 45 and moves bar 72 and the supporting carriages 74 and 93 upwardly. The movement of the carriage 93

moves the rack 95 rotating the pinion 98 and thus moving the rack 97 a corresponding amount transversely of the rack 95 and to the right thereof. The rack 97 attached to the member 89 causes it to move to the right thus actuating the attached rack 34. By means of the pinions the rack 37 moves to the right an amount in accordance with the proportions set into the gears thus moving the right drawing arm 113 in the direction of the vanishing point and in alignment with the centrolinead 121.

Having traced two sides of the drawing plan M we have also drawn two sides of the perspective plan and can draw the other two sides in similar manner.

To produce the diagonal shown in the plan view M, the tracer point 65 will follow the diagonal upwardly and cause corresponding movement of both sides of the mechanism. Similarly, movement of the tracing point attached to the sleeve 54 will slide the carriage 13 along the tracks 10 and 11 to produce the vertical line corresponding to the sides drawn.

Figs. 16 and 17 illustrate a modification of the tracing mechanism of Figs. 1-15. In the modification a flexible rod slidable in a tube or sleeve is employed to transmit motion in a direction transverse to the tracing pointer, instead of the gear and rack arrangement operated by movement of the carriage 93 in Figs. 2, 3 and 10.

Referring to Figs. 16 and 17 the rails 10, 11 and guide bars 46, 47 are constructed and positioned similarly to those of the preceding figures, rails 10 and 11 having the movable carriages 74 and 13 mounted thereon. A similar carriage 188 is mounted for lengthwise movement on guide bar 46. Tracing pointers are attached to the sleeves 53 and 54. A cross bar member 72' is supported across the carriages 74 and 188, being slidably received between the upstanding transverse channel members 78 of carriage 74 and secured to carriage 188 by fastener 188' through channel members 189.

Although the sleeve 65' carrying a tracing pointer may be mounted in a position similar to that shown in Fig. 2, the sleeve is shown in Fig. 16 near the other end of member 72' and on the other side of rail 10, such position being alternatively desirable, permitting the tracing pointer to be used at the side of rather than in front of the tracing pointer attached to sleeve 53. A carriage 190 is movably mounted on bar 84' and has guide bar 47 slidably received between its transverse channel members 191.

In order to produce movement of carriage 190, thus moving guide bar 47, along bar 84' and corresponding to movement of carriage 74 along rail 10, a tube or sleeve 192 having a longitudinal slit 193 and carrying a flexible rod 194 is attached to the side of rail 10 and extends part way along that rail, curving off of it to extend along bar 84' to which it is also attached. Ring members 195 extend from the rod 194 adjacent the carriage 74 and 190 for receiving posts 196 projecting from the carriages. It is apparent that motion of the tracing pointer 65 is proportionately transmitted to the guide bar 47 for actuating the drawing apparatus.

Instead of using a gear and rack in the mechanism to obtain the proportionate movement of the pinion parts the invention contemplates the employment of other mechanisms such as a pantograph for obtaining such movement. Accordingly Fig. 18 is an illustration of a modification of my invention in which such substitution has been made.

Referring to Fig. 18, left and right rails or tracks 204 and 205 are employed corresponding to tracks 10 and 11 of Fig. 2. A central track 206 corresponding to the rod 81 of Fig. 2 is similarly provided and has a transverse leg 213 removably fastened to rail 205, similar to leg 84. Transverse rail members 207 and 208 are rigidly connected by struts 203 and have projections 202 on their lower surfaces for engaging channels 204' and 205' in the upper surfaces of the tracks 204 and 205. The track

and rail members 206, 207 and 208 are similarly provided with channels 206', 207' and 208' for the reception of sliding members to be described later. A plan view tracing point 210 is supported by suitable means at the intersection of rules 211 and 209 having slots 211' and 209' extending substantially the length thereof.

The rule 209 has a tracing point 212 supporting one end thereof and is adjustably secured to a slider 214 by a bracket 215 and the fastener 216 associated therewith, the slider 214 being movably mounted in the channel 203' of the member 208. The left end of the rule 211 is carried by a channel engaging member 218 on its underside engaging the channel 204' of the rail 204. Its other end is carried by channel engaging member 220 carried in the channel 206'.

Pivotaly connected to the rule 211 adjacent the slider 220 is strut 221, the other end of which rides in a transverse slot 226' of the slider member 226. A leg 222 extends substantially centrally of the strut 221 to a block 223 attached to the rail member 206.

The other elevation tracing member 224 is secured to arm 225 which is supported at its other end by channel engaging member 226 to which it is adjustably connected by bracket 227 and fastener 228, the member 226 being slidable in the channel 208' of the track 208. By the provision of the slot engagement between member 226 and the strut 221, vertical movement of tracing member 224 does not move strut 221 and its connected parts.

In order that the movement of the tracing pointers may be communicated in the proper proportion to the drawing mechanism, left and right pantographs 232 and 233 are provided. The left pantograph 232 has its arm 235 pivotel at 234 to the track 204. Pivotaly connected to the arm 235 are the spaced parallel transverse arms 237, 238. Connected adjacent the extremity of the arm 237 and parallel to the arm 235 is an arm 240, the pivot point 241 between the arms 238 and 240 corresponding to the tracing pointer of the pantograph, and the extremity of the arm 237 in alignment with the pivot point 234 and the tracing pointer 241 constituting the drawing point of the pantograph. At the locus of the drawing point an aperture is provided to receive pivotally post 243 which is rigidly upstanding from block 244 slidable in the channel 207' of the member 207.

Similarly the right pantograph 233 has a pivot member 246 to which arm 247 is attached. The arm 247 has transversely disposed parallel arms 248 and 249 pivotaly connected thereto and an arm 250 parallel to the arm 247 near the extremity of the arm 248. The tracing and drawing points of the pantograph are respectively positioned at 251 and 252. At 252 the arm 249 is in pivotal relationship with post 253 rigidly attached to block 255 slidable in channel 207'.

The post 243 associated with the left pantograph 232 has rigidly connected thereto a left drawing arm 260 of a drawing arm assembly and the post 254 associated with the right pantograph 233 has rigidly connected thereto a right drawing arm 262 of the drawing arm assembly. The other extremity of the drawing arm 262 is pivotaly connected to an upturned portion 263 of a left centrolinead rule 265, a web 266 connecting the portions 263 and 265. Disposed just beneath the end portion of the centrolinead 265 is the end of the centrolinead rule 267 having a web portion 268 and an upturned portion 269. The end of the upturned portion 269 has a substantially cylindrical head 271 with a slot 271' for holding the lower portion of a drawing pencil 270. The drawing arm 260 has an open ring end 269' engaged in a groove on the outer surface of head 271, the ring being adapted to receive the pencil within the slot 271' at that one instant of drawing a point in the picture plane. The rules 265 and 267 have elongated slots 265' and 267' longitudinally thereof the arm 260 being pivoted to the slotted rule 267 as explained above in connection with the pivotal mounting of arm 112 on the bar 120, and arm 262 is similarly piv-

oted to the slotted rule 265 as has been described above in connection with the pivotal mounting of the arm 113 on bar 120. The slot 271' is provided to fulfill the requirement for the one instant of drawing a point in the picture plane. At that instant only the arm 260, which is pivoted on bar 267, is predetermined to turn itself in such a position to rule 267 that the open section of ring 260' is in position with the open slot 271'. The pencil sliding down the intersection of slots 265' and 267' can slip into the opening 271' for that one instant to be in vertical line with the center line of the pivot points. As soon as the machine is operated again, the pencil immediately slips out of the opening free from the pivot head 271 and is controlled only by the slots 265' and 267'. The pivot head then acts only as a pivot for the arm 260 and rule 267. The open ring section of the ring 260' may be made to extend almost to one-half of the circumference of the ring and, by the same token, the ring itself may be made to extend just over half of the circumference so that it will be not able to slip off of the slotted head 271, and will always act as a pivot for arm 260 and rule 267.

Each of the centrolinead arms 265 and 267 extend to the intersection of pairs of arms 272 and 273, the angle between which may be adjusted as desired. The arms 265 and 267 are slidably received by a block 274 at the intersection of the arms 272 and 273. Slidably mounted on each of the tracks 204 and 205 is a carriage 276 having pins 277 and 278 extending upwardly. The pins engage slots 272' and 273' in the centrolinead arms 272 and 273. Protractors 280 and 281 are mounted similarly to those discussed in connection with the preferred form of the invention, and may be used to set the mechanism initially.

The modification shown in Fig. 18 is set up for operation and used similarly to that described in the preceding figures. Plan tracing pointer 210 may be moved to the left along the front of the plan M. This moves the rule 209 to the left without affecting the rule 211 in whose slot the tracing pointer slides. The movement of the rule 209 to the left moves the slider 214 to the left which is attached to the left pantograph through its tracing pointer 241. Movement of the tracing pointer 241 causes a proportional movement of the post 243 at the drawing point of the left pantograph moving the drawing arm 260 of the drawing mechanism and causing the drawing pencil 270 to move upwardly to the left in the slot 265' of the centrolinead rule 265.

Similarly, movement of the tracing pointer 210 upwardly causes the arm 225 to move a corresponding distance to the right, thus actuating the right pantograph tracing and drawing points to cause the drawing arm mechanism to draw the right side of the object. The other side of the object may be traced to actuate the mechanism in a manner similar to that of the preferred form of the invention.

When it is desired to draw a line on an object which is not in the main plane of any of the object's sides or, in other words, a line having three coordinates in space, two tracing pointers such as 212 and 224 may be employed at the same time, the resulting motion corresponding to the perspective of the line.

It is apparent, therefore, that the invention contemplates the provision of a perspective drawing machine employing tracing and drawing mechanisms the direction and movement between which is proportioned according to the view point of the observer in order to obtain a perspective equivalent to the vanishing point method through mechanical means.

While the devices illustrated are particularly designed to produce perspective drawings, various modifications of the elements thereof may be employed for the production of other types of drawings. For example, an arrangement of similar elements particularly adapted for producing one point perspectives is illustrated in Figs. 22 to 26.

Referring to these views, the device illustrated has left and right rails 310 and 311 corresponding to those of Fig. 2 on which carriage members 313 are slidably mounted and carry transverse rail member 312. Mounted on the rail 312 are left and right spaced carriage members 338 and 339 which are adapted to move along the rail 312. Near the extremity of the members 338 and 339 toward the central portion of the device is a pair of spaced upstanding flanges 345 for the reception of left and right guide bars 346 and 347, which are secured to the carriage members 338 and 339, respectively. The member 347 corresponds to the member 47 of Fig. 2, and carries similar tracing means, and the member 346 corresponds to the member 46 and carries similar tracing means except that member 346 extends for a substantially greater length as will be hereinafter described.

A third pointer mechanism 365 corresponds to mechanism 65 of Fig. 2 and is mounted by sleeve 366 and channel 367 in slider member 371 riding on cross bar member 372, one end of which is carried by carriage member 374. Substantially centrally of the guide bars 346 and 347 and parallel thereto is a rail 381 corresponding to rail 81 of Fig. 2. At the forward portion of the carriage 393, the bar 372 is slidably received between the transverse upright flanges 378. Rail 381 extends to the axis of gear 398 and has a leg 384 at right angles, the end of which is mounted on the track in the manner of the corresponding element 84 of Figs. 2 and 10.

At the other extremity of the rails 310 and 311, carriages 374a and 374b are mounted. Transversely mounted on these carriages is a rod 322 on which carriages 338a and 339a are slidably mounted. Rod 346 has a similar rod 348 slidably mounted thereon and extending beyond the carriage 338a on which it is axially slidably mounted. A centrolinead guide bar 320a has one end portion slidably mounted on a guide plate 325 which is pivotally mounted on the carriage 339a. The extremity of the end portion has an offset arm 326 pivotally attached to an L-shaped member 327 extending upwardly and across from the rod 348. The other end portion of the rod 320a is mounted in a centrolinead guide mechanism 370 corresponding to centrolinead 170 of Fig. 2 and indicated schematically by broken lines.

Bars 346 and 347 are secured to members 338 and 339, respectively, as has been noted, bar 348 sliding through the member 338, and sleeve or cap 366 is secured to this bar 348.

When using tracer on bar 346 to trace the height vertically upward in plan N, Fig. 22, the bar 348 secured to cap 366, and also slide 371 through flange 367, remain perfectly motionless. On the other hand, however, the bar 346 slides through the flange 367 and pushes carriage 338 on the transverse rail member 312, which is on carriage member 313 also upwards, being secured to carriage 338. Also, the extension of the bar 346 beyond the carriage 338, which is secured to holder 327 and which in turn is pivoted to guide 321a is forced upward. This operation draws the unit D up bar 347a, making the pencil of unit D draw the vertical edge of the object. When the tracer that is secured to the cap 366 together with the cap 366 which also is secured to bar 348 and flange 367 (bar 346 slides through flange 367 and slides under bar 348) is pushed upward to trace the side of plan M, then carriage 338 on bar 312 that is on carriage 313 and also bar 346 attached to carriage 338 remain perfectly motionless. On the other hand, bar 348 moving upwardly will carry with it flange 367, slide 371, bar 372 and carriages 374 and 393. The carriage 393 automatically operates bar 347 to position this bar. The other extremity of bar 348 that slides through carriages 338 and 338a is secured to holder 327 that in turn is pivoted to offset arm 326 of guide bar 320a. The bar 320a is drawn through swivel plate 325 on carriage 339a, thereby moving it to the right. This also moves mar 347a, also secured to carriage 339a to the right. When this

occurs, pencil mechanism at D is drawn up the guide 321a, thereby guiding the pencil to draw the right hand bottom edge of the object.

In line with the foregoing it will be seen that rigidly mounted on carriage 339a and transversely thereof, is a rod 347a extending substantially parallel to rod 348. Another centrolinead guide bar 321a is connected to the drawing mechanism D corresponding to that of Fig. 2, the rod 347a likewise being connected thereto. The one end of guide bar 321a is guided by centrolinead mechanism indicated by numeral 370, and the other end beyond the drawing mechanism D has an offset portion 326 pivotally connected to an arm of the L-shaped member 327 extending from the rod 346.

The operation of the device is believed to be understandable from the previous description of the operation of the device of Fig. 2. As an example, however, in order to draw the top line of the plan view M, the tracer 365 is moved upwardly to the top line of M and in so moving rod 372 is likewise moved, thus moving tracer point 354 into proper position on its view O. At the same time rod 348 slides through carriages 338 and 338a and moves guide 320a an equal distance. As the guide bar 320a moves through guide plate 325, carriage 339a moves to the right carrying the rigidly attached rod 347a, thereby moving the drawing mechanism D along the guide bar 321a, the attached drawing pencil thus executing the line. As the tracing instrument 365 moves along the top edge of view M, carriages 338 and 338a move the entire unit across such that the pivoted connection between the members 348 and 326 causes the guide bar 320a to slide through plate 325, thus moving carriage 339a and the attached rod 347a to the left. Simultaneously, the pivoted connection between members 346 and 321a causes the guide bar 321a to move through the drawing mechanism D to the left, thus carrying the drawing instrument attached thereto to the left and drawing the corresponding line of the perspective view. In similar manner the other lines of the various views may be drawn.

The modification illustrated in Figs. 27 and 28 is an adaptation illustrating an embodiment of the invention for producing an oblique drawing.

Referring to Figs. 27 and 28, the device illustrated has left and right rails 410 and 411 corresponding to those of Fig. 2 on which left and right carriage members 413 are slidably mounted and carry transverse rail member 412. Mounted on the upstanding flange 412' of member 412 are left and right spaced carriage members 438 and 439 which are adapted to move along the rail 412. Left and right guide bars 446 and 447 are connected to the carriage members 438 and 439, the former being rigidly attached thereto and the latter being received between spaced upstanding flanges 445. Guide bars 446 and 447 correspond to guide bars 46 and 47 of Fig. 2 and carry similar tracing means. A third pointer mechanism 465 corresponds to mechanism 65 of Fig. 2 and is mounted on sleeve 466 riding on crossbar member 472, one end of which is carried by carriage member 474. Substantially centrally of the guide bars 446 and 447 and parallel thereto is a rail 481 corresponding to rail 81 of Fig. 2. Movably mounted on the rail 481 is carriage 493. Gear and rack members 498, 495, and 497 are arranged and correspond to those of the elements 98, 95 and 97 of Fig. 2. At the forward portion of the carriage 493 the bar 472 is slidably received between transverse upright flanges 478 extending upwardly from the carriage 493. Rail 481 extends to the axis of gear 498 and has a leg 484 at right angles whose end is mounted on the track 411 in the manner of the corresponding element 84 of Figs. 2 and 10. Carriage 474a is movably mounted on rail 410 and 474b on flange 412b of member 412a, later to be described.

Positioned beyond the rail 412, carriages 474a and 474b are mounted. Transversely mounted on these carriages is a rod 422 extending through the drawing mechanism D which corresponds to that shown in the preceding views.

nism D which corresponds to that shown in the preceding views.

Extending transversely from the parallel member 412 and substantially parallel to the track 411 is a longitudinal leg member 412a. Rotatably mounted on the leg 412a are concentric gear members 428 and 429, the gear 429 being substantially smaller than the gear 428. A gear 431 is similarly mounted on member 412a and engaged with the gear 429, the gear 428 being engaged with rack 434 attached to the carriage 439 by a bracket 449.

The leg member 412a has an upstanding flange 412b on its inner margin on which the carriage member 474b is movably mounted. The carriage member has a rack 434a connected to it substantially parallel to the rail 411 and in engagement with the gear 431.

A guide bar 421 has one end rigidly connected at the desired angle (45° if a 45° oblique is desired) to carriage member 438 and its other end extending through the drawing mechanism D.

As an illustration of the employment of the structure, to draw the left side of the side elevation O, tracer mechanism 454 is moved upwardly along the appropriate representation resulting in the upward movement of the member 412 and of the carriages 413, thus moving carriage 474b and the connected rod 422 and carriage 474a upwardly in a vertical direction to draw the vertical line. In tracing across the top line of the side elevation O, carriage 439 moves to the right moving rack 434 and the engaged gear and rack members, the gear 431 being moved clockwise thus moving the rack 434a and the attached carriage 474b upwardly. The rod 422, sliding through drawing mechanism D and moving it upwardly along the fixed guide member 421 moves the drawing mechanism D along the guide member 421 to produce a line whose correct length is essentially determined, from the line traced, by the gears 428 and 429.

In Figs. 29 and 30 a modified drawing arm arrangement is illustrated which may be used with tracing and motion transmitting apparatus, as shown in the lower portion of Fig. 2, to produce isometric views. Carriages 100 and 101 and the apparatus omitted from Fig. 29 are constructed and arranged as described above in connection with Fig. 2. Left and right drawing arms 512 and 513 are rigidly connected at one end to carriages 100 and 101, respectively, each forming an angle of 30° with flange 23 of the frame assembly 12. Each of the drawing arms is supported for free lateral movement at its other end by an angularly disposed foot 512a (513a) supported on a swivel mounted roller 522. The drawing arms are connected at their mutual intersection to a drawing mechanism D similar to that previously described. For a full scale drawing the gears 28, 29 and 31 are preferably selected so that racks 33 and 34 move one inch laterally to produce approximately 1.732 inches lateral movement of racks 36 and 37, respectively.

My invention is particularly useful for illustrating a perspective of an object in order to expedite and simplify the teaching thereof to those unskilled in reading ordinary mechanical drawings.

While a preferred and a modified form of my invention have been shown, the invention is not necessarily limited to the specific apparatus described but contemplates reasonable variations therefrom and is only limited as defined in the appended claims.

Having thus described my invention, what I claim as new and wish to secure by Letters Patent is:

1. A perspective drafting machine comprising parallel left and right main supporting rails, a main frame mounted transversely of said rail for movement therealong, first and second left and right slider members independently and movably mounted on the main frame, elongated rule members attached to the first left and right slider members, a tracing pointer attached to each

of the rule members, the left rule member having elongated slots along its length, a rail disposed between said left and right rule members and having lengthwise channel means, a slotted cross member engaging the last mentioned channel means and the left rail and overlapping the left rule member intermediate its extremities and defining a cross-over with the left rule member, a tracing pointer engaged in the slots of the left rule member and the cross member at the cross-over, means connecting one end of the cross member to adjacent the extremity of the right rule member; left and right pantograph assemblies each comprising a main pivot arm having one extremity pivotally secured adjacent the left and right rails respectively, a pantograph arm pivotally connected at one end to the other extremity of the main pivot arm and having its other extremity pivotally engaged with the second left and right slider members, respectively, and a pair of pivotally connected arms engaged with the pivot and pantograph arms, the said pair of pivotally connected arms having their pivot slidably engaged transversely of the first left and right slider members, respectively; and a drawing arm assembly, said drawing arm assembly comprising left and right drawing arms rigidly connected to said second left and right slider members, respectively, left and right guide means angularly disposed relative to each other in overlapping relation, the said drawing arms being angularly disposed to each other and pivotally connected to the right and left guide means and a drawing pencil mounted at the cross-over of the said guide means, said guide means being slidably mounted on said left and right rails respectively.

2. A drafting device comprising left and right main supporting rails, a main frame mounted transversely of said rails for movement therealong, left and right members movably mounted on said main frame, tracing members adapted to follow the outline of an orthographic projection and operatively connected to said left and right members, left and right centrolinead bars angularly disposed and pivotally connected to said left and right members respectively, and in overlapping relation, scribing means mounted at the cross-over of said centrolinead bars, and left and right guide means slidably engaged with said left and right centrolinead bars respectively, said guide means being mounted adjacent the remote extremities of the centrolinead bars.

3. In a perspective drafting device including parallel left and right main supporting rails, a main frame mounted on the rails transversely thereof and adapted for movement along the rails, left and right members movably mounted adjacent a forward edge of said main frame, left and right members movably mounted adjacent a rearward edge of said main frame, means engaged with said left movable members and other means engaged with said right movable members for selectively causing movement of said rearward movable members proportional to movement of said forward movable members and in response thereto, the improvement comprising a first tracing means connected to the left forward member, a second tracing means connected to the right forward member, a third tracing means, and means connecting said third tracing means to the left and right forward members the said last-mentioned means including instrumentalities transmitting movements of the third tracing means in one direction to the left forward member, and additional instrumentalities transmitting movements of the third tracing means in a transverse direction to the right forward member.

4. The structure of claim 3, the means connecting said third tracing means to the right forward member comprising transversely disposed racks connected to the third tracing means and the right forward member, respectively, and a pinion mounted adjacent the intersection of said racks for transmitting motion from one to the other.

5. The structure of claim 3, the means connecting said third tracing means to the right forward member comprising a flexible rod member, means connecting said rod member to the third tracing means and the right forward member, respectively, and guide means for the rod.

6. A drafting device comprising in combination, parallel rail means, main frame means mounted on the rail means for movement therealong, left and right members movably mounted adjacent to a forward edge of the main frame, left and right members movably mounted adjacent to a rearward edge of the main frame, means engaged with the left movable members and additional means engaged with the right movable members for selectively causing movement of the rearward movable members proportional to movement of the forward movable members and in response thereto, tracing members adapted to follow the outline of an orthographic projection and operatively connected to the forward left and right movable members, left and right superposed arms connected to the right and left rearward movable members and defining a cross-over between said arms, and scribing means mounted at the cross-over of the said arms.

7. A perspective drafting device comprising parallel left and right main supporting rails, a main frame mounted transversely of the said rails for slidable movement therealong, left and right racks slidably mounted adjacent to a forward edge of the main frame, left and right racks slidably mounted adjacent to a rearward edge of the main frame, engaged pinions engaged with the left racks, and other engaged pinions engaged with the right racks for causing movement of the rearward racks proportional to movement of the forward racks and in response thereto, a carriage connected to each of the racks and slidable therewith, a rod member mounted transversely of each carriage of the left and right forward racks, a cross-bar member intersecting the left rod member at a cross-over thereof, a tracing pointer mounted at the cross-over of the left rod member and cross-bar member, the cross-bar member being mounted transversely of the left rod member and slidable therealong, one extremity of the said cross-bar member being mounted for slidable movement along the left supporting rail, a rail disposed between the left and right rod members and parallel thereto, a carriage slidably mounted on the last-named rail and having a first rack connected thereto, the other extremity on the said cross-bar member being attached to the last-named carriage, a support slidably mounted on the right rod member, a second rack attached to the support and positioned transversely of the first rack, a pinion engaging the first and second racks for transmitting motion of one of the said racks to the other thereof, mounting means attached to the rod members, and tracing means attached to each of the said mounting means; and a drawing arm assembly associated with the main frame, the said drawing arm assembly comprising left and right drawing arms rigidly connected to the carriages connected to the left and right rearward racks respectively, left and right centrolinead bars having a cross-over therebetween, the drawing arms being angularly disposed to each other, the left drawing arm being connected to the right centrolinead bar and the right drawing arm being pivotally connected to the left centrolinead bar, a drawing pencil mounted at the cross-over between the centrolinead bars, and left and right centrolinead guide members slidably engaged with the left and right centrolinead bars respectively, the centrolinead guide members being slidably mounted on the left and right rails respectively.

8. A perspective drafting device comprising parallel left and right main supporting rails, a main frame mounted transversely of the rails for movement therealong, left and right racks movably mounted adjacent to a forward edge of the main frame, left and right racks movably mounted adjacent to a rearward edge of the main frame, engaged pinions engaged with the left racks and other

engaged pinions engaged with the right racks for causing movement of the rearward racks proportional to movement of the forward racks and in response thereto, a carriage connected to each of the racks and movable therewith, a rod member mounted transversely of each carriage of the left and right forward racks, a cross-bar member intersecting the left rod member at a cross-over thereof, a tracing pointer mounted at the cross-over of the left rod member and cross-bar member, the cross-bar member being mounted transversely of the left rod member and movable therealong, one extremity of the cross-bar member being mounted for movement along the left supporting rail, an additional rail disposed between the left and right rod members and parallel thereto, a carriage movably mounted on the last-named rail and having a first rack connected thereto, the other extremity of the cross-bar member being attached to the last-named carriage, a support movably mounted on the right rod member, a second rack attached to the support and positioned transversely of the first rack, a pinion engaging the first and second racks for transmitting motion of one of the said racks to the other thereof, mounting means attached to the rod members, and tracing means attached to each of the mounting means; and a drawing arm assembly associated with the main frame, the drawing arm assembly comprising left and right drawing arms rigidly connected to the carriages connected to the left and right rearward racks respectively, left and right centrolinead bars forming a cross-over therebetween, the drawing arms being angularly disposed to each other, the left drawing arm being pivotally connected to the right centrolinead bar and the right drawing arm being pivotally connected to the left centrolinead bar, a drawing pencil mounted at the cross-over of the centrolinead bars, and left and right centrolinead guide members movably engaged with the left and right centrolinead bars respectively, the centrolinead guide members being movably mounted on the left and right rails respectively.

9. A perspective drafting device comprising parallel left and right main supporting rails, a main frame mounted transversely of the rails for movement therealong, left and right forward and rearward pairs of racks movably mounted on the main frame, engaged pinions engaged with the left racks and other engaged pinions engaged with the right racks for causing movement of the rearward racks proportional to movement of the forward racks and in response thereto, a carriage connected to each of the racks and movable therewith, a rod member mounted transversely of each carriage of the left and right forward racks, a cross-bar member defining a cross-over with the left rod member, a tracing pointer mounted at the cross-over of the left rod member and the cross-bar member, the cross-bar member being mounted transversely of the left rod member and movable therealong, one extremity of the cross-bar member being mounted for slidable movement along the left supporting rail, an additional rail disposed between the left and right rod members and parallel thereto, a carriage movably mounted on the last-named rail and having a first rack connected thereto, the other extremity of the cross-bar member being attached to the last-named carriage, a support movably mounted on the right rod member, a second rack attached to the said support and positioned transversely of the said first rack, a pinion engaging the first and second racks for transmitting motion of one of the said racks to the other thereof, mounting means attached to the rod members, and tracing means attached to each of the mounting means; and a drawing arm assembly associated with the main frame, the drawing arm assembly comprising left and right drawing arms rigidly connected to the carriages connected to the left and right rearward racks respectively, left and right centrolinead bars forming a cross-over therebetween, the left centrolinead bar being pivotally connected to the right drawing arm and the right cen-

trolinead bar being pivotally connected to the left drawing arm, scribing means mounted at the cross-over of the left and right centrolinead bars, and left and right centrolinead guide members movably engaged with the left and right centrolinead bars respectively.

10. A perspective drafting device comprising parallel left and right main supporting rails, a main frame mounted transversely of the rails for movement therealong, left and right forward and rearward pairs of racks movably mounted on the main frame, engaged pinions engaged with the left racks and other engaged pinions engaged with the right racks for causing movement of the rearward racks proportional to movement of the forward racks and in response thereto, a rod member mounted transversely of each of the left and right forward racks, a cross-bar member defining a cross-over with the left rod member, a tracing pointer mounted at the cross-over of the left rod member and the cross-bar member, the said cross-bar member being mounted transversely of the left rod member and movable therealong, one extremity of the cross-bar member being mounted for slidable movement along the left supporting rail, an additional rail disposed between the left and right rod members and parallel thereto, means movably mounting a first rack on the last-named rail, the other extremity of the cross-bar member being attached to the last-named means, a support movably mounted on the right rod member, a second rack attached to the said support and positioned transversely of the said first rack, a pinion engaging the first and second racks for transmitting motion of one of the said racks to the other thereof, and tracing means attached to each of the said rod members; and a drawing arm assembly associated with the main frame, the drawing arm assembly comprising left and right drawing arms rigidly connected to the left and right rearward racks respectively, the drawing arms being angularly disposed to each other, left and right centrolinead bars forming a cross-over therebetween, the left centrolinead bar being pivotally connected to the right drawing arm and the right centrolinead bar being pivotally connected to the left drawing arm, a drawing pencil mounted at the cross-over of the left and right centrolinead bars, and left and right centrolinead guide members movably engaged with the left and right centrolinead bars respectively, the centrolinead guide members being movably mounted on the left and right rails respectively.

11. A perspective drafting device comprising parallel left and right main supporting rails, a main frame mounted transversely of the rails for movement therealong, left and right members movably mounted adjacent to a forward edge of the main frame, left and right members mounted adjacent to a rearward edge of the main frame, means engaged with the left movable members and other means engaged with the right movable members for selectively causing movement of the rearward movable members proportional to movement of the forward movable members and in response thereto, a rod member mounted transversely of each of the left and right forward movable members, a cross-bar member defining a cross-over with the left rod member, a tracing pointer mounted at the cross-over of the left rod member and the cross-bar member, the said cross-bar member being mounted transversely of the left rod member and movable therealong, one extremity of the cross-bar member being mounted for movement along the left supporting rail, an additional rail disposed between the left rod member and the right rod member and parallel thereto, a first member mounted on the last-mentioned rail, means movably mounting the other extremity of the cross-bar member on the said first member, a second member movably mounted on the right rod member and positioned transversely of the first movable member, means engaging the first and second members for transmitting motion of one to the other, and tracing means attached to each

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of the rod members; and a drawing arm assembly associated with the said main frame, the drawing arm assembly comprising left and right drawing arms rigidly connected to the left and right rearward members, the drawing arms being angularly disposed to each other, left and right superposed centrolinead bars forming a cross-over therebetween, the left drawing arm being pivotally connected to the right centrolinead bar, and the right drawing arm being pivotally connected to the left centrolinead bar, scribing means mounted at the cross-over of the centrolinead bars, and left and right centrolinead guide members slidably engaged with the left and right centrolinead bars respectively.

12. A perspective drafting device comprising parallel left and right main supporting rails, a main frame mounted transversely of the said rails for movement therealong, left and right members movably mounted adjacent to a forward edge of the main frame, left and right members movably mounted adjacent to a rearward edge of the main frame, means engaged with the left movable members and other means engaged with the right movable members for selectively causing movement of the rear movable members proportional to movement of the forward movable members and in response thereto, a rod member mounted transversely of each of the left and right forward movable members, a cross-bar member defining a cross-over with the left rod member, a tracing pointer mounted at the cross-over of the left rod member and cross-bar member, the cross-bar member being mounted transversely of the left rod member and movable therealong, an additional rail disposed between the left and right rod members and parallel thereto, one extremity of the cross-bar member being mounted for movement along the last-mentioned rail, a first member movably mounted on the said last-mentioned rail, means movably mounting the other extremity of the cross-bar member on the said first member, a second member movably mounted on the right rod member and positioned transversely of the first movable member, means engaging the first and second members for transmitting motion of one of the said members to the other thereof, and tracing means attached to each of the rod members; and a drawing arm assembly associated with the main frame, the drawing arm assembly comprising left and right drawing arms rigidly connected to the left and right rearward members, left and right superposed guide means forming a cross-over therebetween, the left guide means being pivotally connected to the right drawing arm and the right guide means being pivotally connected to the left drawing arm, and a drawing pencil mounted at the cross-over of the left and right superposed guide means, the guide means being slidably mounted on the left and right main supporting rails respectively.

13. In a drawing device including parallel left and right main supporting rails, a main frame mounted transversely of the rails for movement therealong, left and right members movably mounted on the main frame, and tracing members adapted to follow the outline of an orthographic projection and operatively connected to the left and right members; the improvements comprising a drawing arm assembly associated with the main frame, the said drawing arm assembly comprising left and right drawing arms rigidly connected at an extremity thereof to the left and right members, respectively, left and right superposed centrolinead bars defining a cross-over therebetween, the left and right drawing arms being pivotally connected to the right and left centrolinead bars at extremities of the latter between the drawing arms and the said left and right members, the left drawing arm being pivotally connected to the right centrolinead bar and the right drawing arm being pivotally connected to the left centrolinead bar, scribing means mounted at the cross-over of the centrolinead bars, and left and right centrolinead guide members

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slidably engaged with the left and right centrolinead bars respectively.

14. A perspective drafting machine comprising left and right main supporting rails, a main frame mounted transversely of these rails for slidable movement therealong, the main frame having channel means disposed adjacent to its forward and rearward portions, left and right slider members disposed in each channel means, elongated rule members attached to the left and right slider members of the forward channel means, a tracing pointer attached to each of the rule members, the left rule member having an elongated slot along its length, a rail disposed between the left and right rule members and having lengthwise channel means, a slotted cross-member engaging the last-mentioned channel means and the left rail and intersecting the left rule member intermediate its extremities, a tracing pointer engaged in the slots of the rule member and the cross member at their cross-over, and a strut pivotally connected at one end to the right extremity of the cross-member and at the other end adjacent to the extremity of the right rule member; left and right pantograph assemblies each comprising a main pivot arm having one extremity pivotally secured adjacent to the left and right rails respectively, a pantograph arm pivotally connected at one end to the other extremity of the main pivot arm and having its other extremity pivotally engaged with the left and right slider members respectively on the rearward rail, and a pair of pivotally connected arms pivotally connected to the main pivot and pantograph arms, the said pair of pivotally connected arms being slidably engaged at their pivotal connection transversely of the left and right slider members, respectively, of the forward channel member; and a drawing arm assembly, the said drawing arm assembly comprising left and right drawing arms rigidly connected to the left and right slider members, respectively, on the rearward channel member, the said drawing arms being angularly disposed to each other, superposed left and right centrolinead bars pivotally connected to the right and left drawing arms and defining a cross-over, the left centrolinead bar being pivotally connected to the right drawing arm and the right centrolinead bar being pivotally connected to the left drawing arm, a drawing pencil mounted at the cross-over of the superposed left and right centrolinead bars, and left and right centrolinead guide members slidably engaged with the left and right centrolinead bars respectively, the centrolinead guide members being slidably mounted on the left and right rails respectively.

15. A perspective drafting machine comprising parallel left and right main supporting rails, a main frame mounted transversely of these rails for movement therealong, the main frame having guide means adjacent to its forward and rearward portions, left and right members movably mounted on each guide means, elongated rule members attached to the left and right members of the forward channel means, a tracing pointer attached to each of the rule members, the left rule member having an elongated slot along its length, a rail disposed between the left and right rule members and having lengthwise channel means, a slotted cross-member engaging the last-mentioned channel means and the left rail and superposed relative to the left rule member intermediate its extremities and defining a cross-over with the left rule member, a tracing pointer engaged in the slots of the left rule member and the cross-member at their cross-over, and means connecting the right extremity of the cross-member to the right rule member adjacent to the extremity of the said right rule member; left and right pantograph assemblies each comprising a main pivot arm having one extremity pivotally secured adjacent to the left and right rails respectively, a pantograph arm pivotally connected at one end to the other extremity of the main pivot arm and having its other extremity pivotally engaged with the said left and right members respectively on the rearward rail, and a pair of pivotally con-

nected arms pivotally connected to the main pivot arms and to the pantograph arms, the said pair of pivotally connected arms being slidably engaged at their pivotal connection transversely of the left and right slider members, respectively, of the forward channel member; and a drawing arm assembly, the said drawing arm assembly comprising left and right drawing arms rigidly connected to the left and right members, respectively, on the rearward channel member, the drawing arms being angularly disposed relative to each other, superposed left and right centrolinead bars pivotally connected to the right and left drawing arms and defining a cross-over, the left centrolinead bar being pivotally connected to the right drawing arm and the right centrolinead bar being pivotally connected to the left drawing arm, a drawing pencil mounted at the cross-over of the superposed left and right centrolinead bars, and left and right centrolinead guide members slidably engaged with

the left and right centrolinead bars, respectively, the centrolinead guide members being slidably mounted on the left and right supporting rails respectively.

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