Feb. 4, 1969 K. A. BOWEN 3,425,126

AUTOMATIC PERSPECTIVE DRAFTING MACHINE

Filed Aug. 9, 1967 Sheet 1 of 8

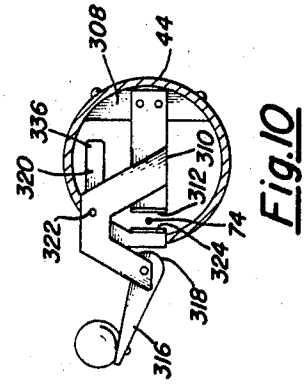


Fig.10

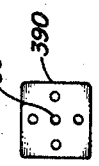


Fig.12

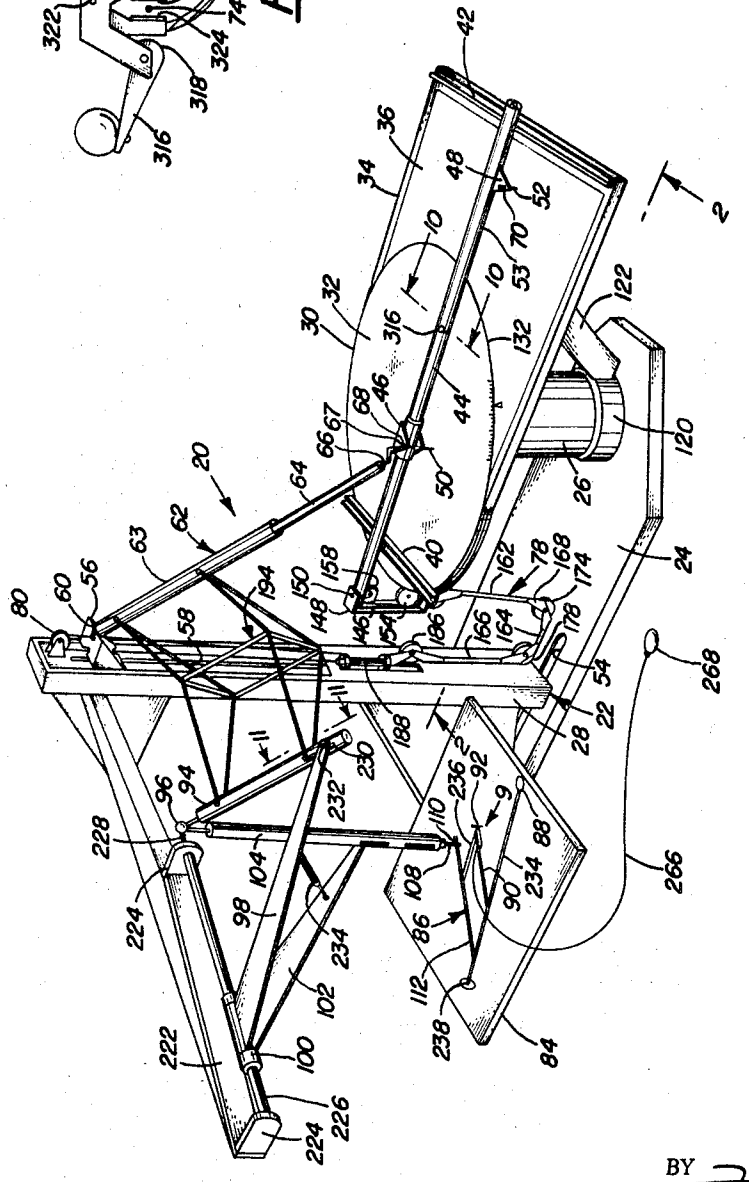


Fig.1

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Feb. 4, 1969 K. A. BOWEN 3,425,126

AUTOMATIC PERSPECTIVE DRAFTING MACHINE

Filed Aug. 9, 1967 Sheet 2 of 8

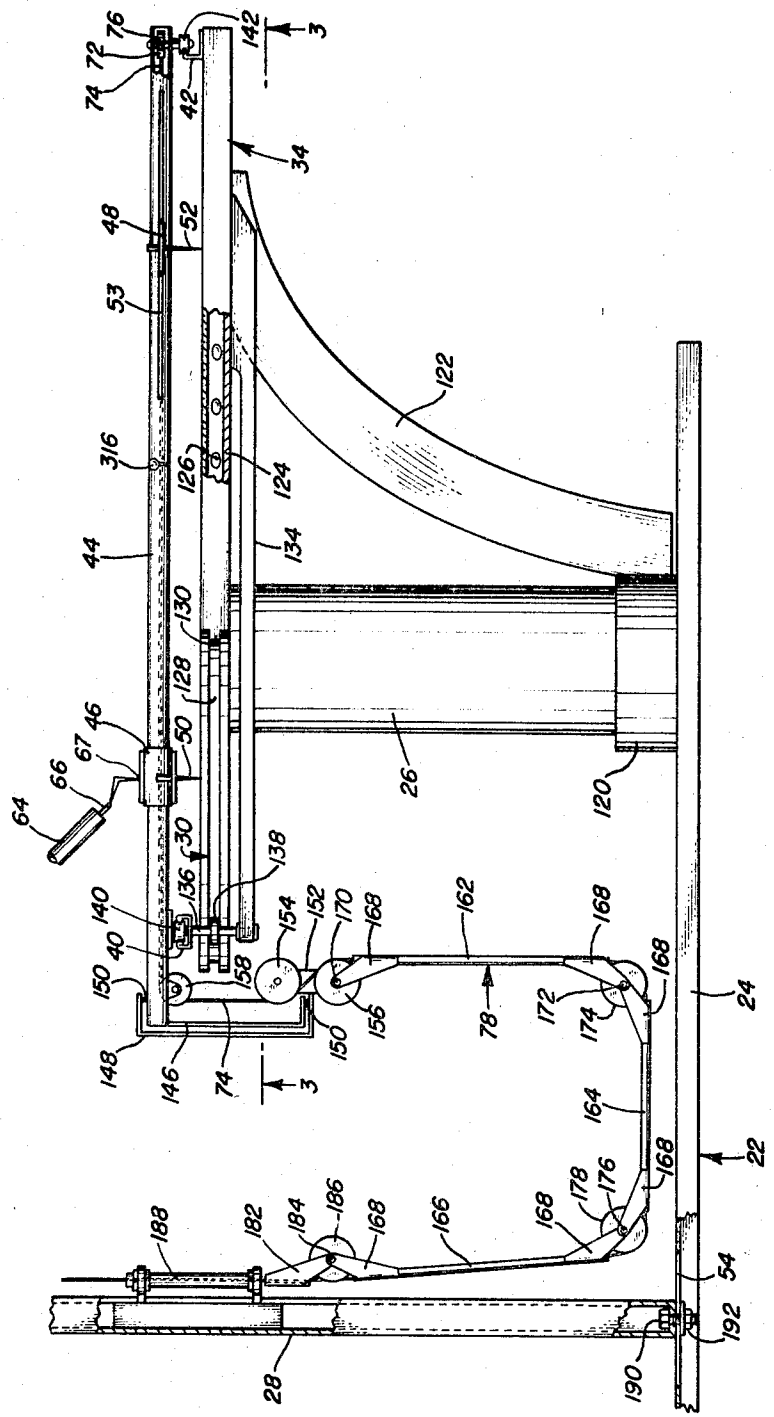


Fig. 2

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AUTOMATIC PERSPECTIVE DRAFTING MACHINE

Filed Aug. 9, 1967

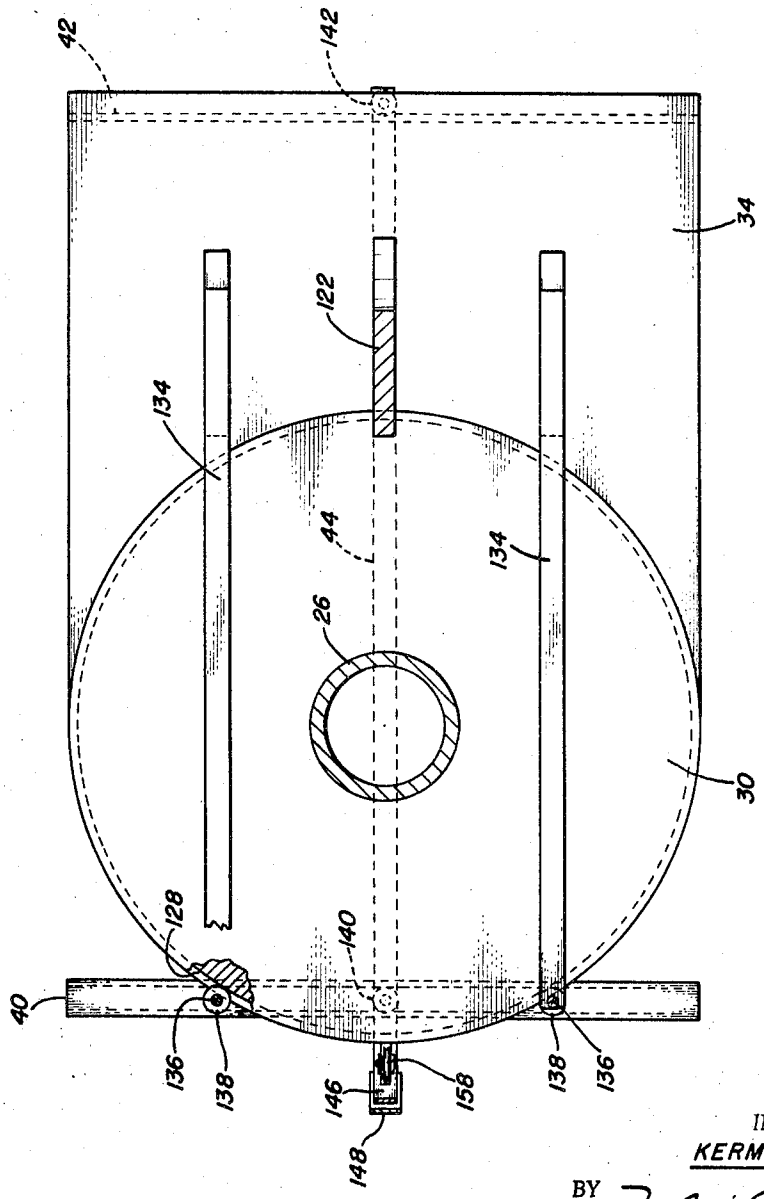


Fig.3

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Feb. 4, 1969 K. A. BOWEN 3,425,126

AUTOMATIC PERSPECTIVE DRAFTING MACHINE

Filed Aug. 9, 1967 Sheet 4 of 8

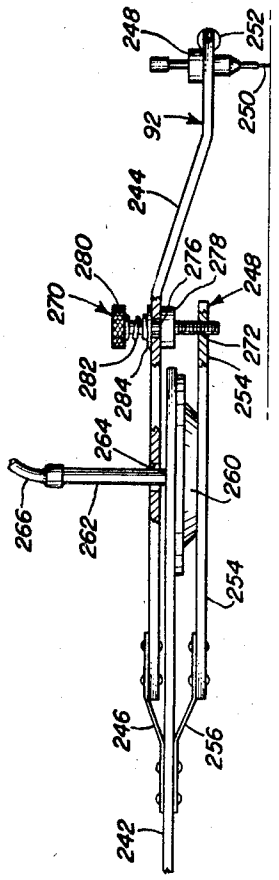


Fig. 9

Fig. 4

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AUTOMATIC PERSPECTIVE DRAFTING MACHINE

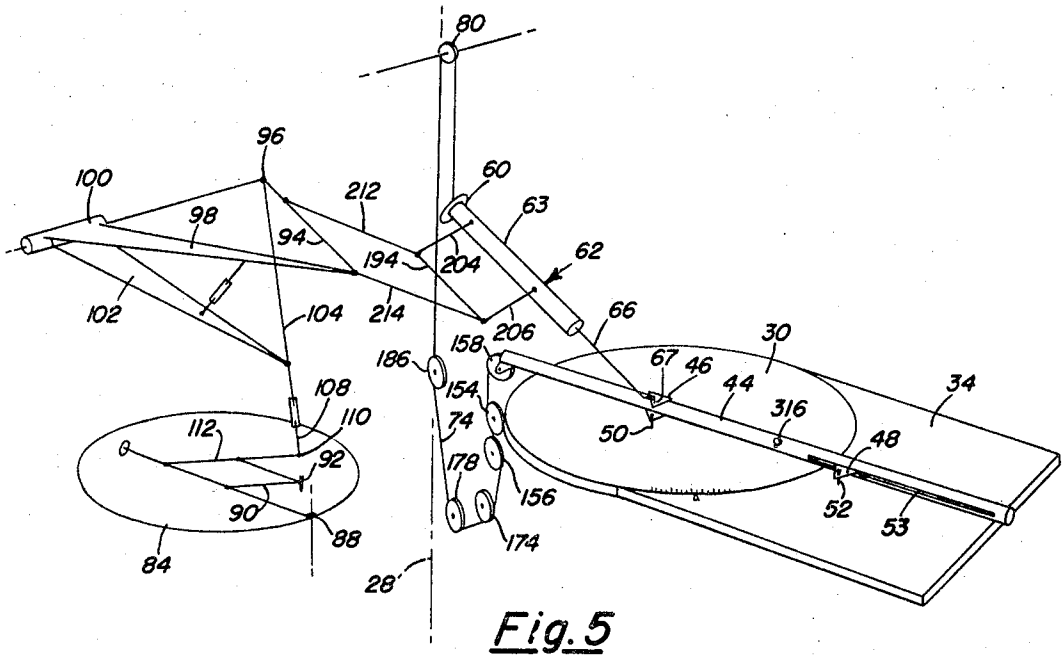


Fig. 5

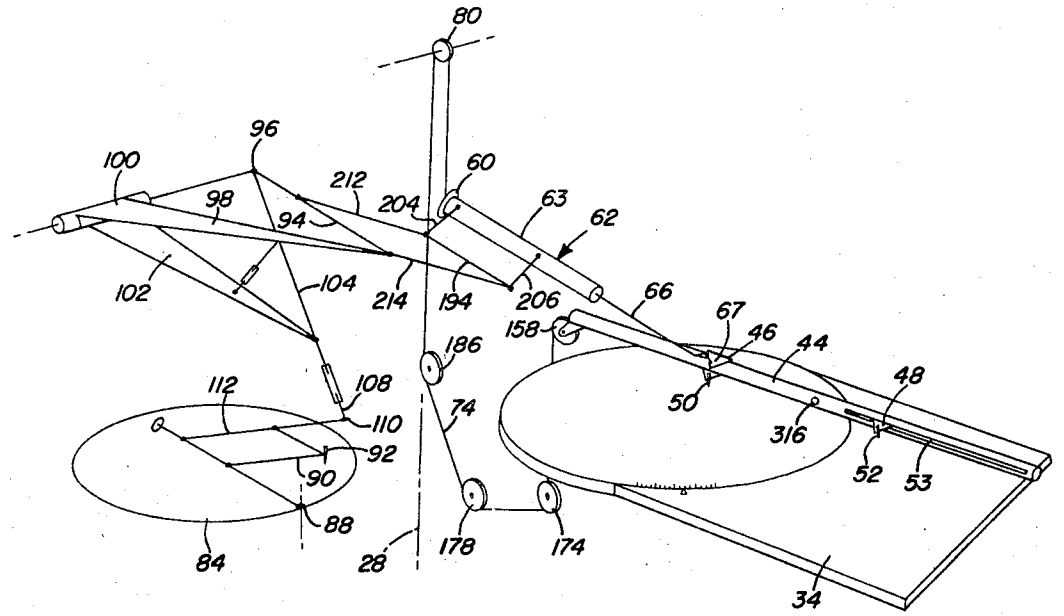


Fig. 6

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AUTOMATIC PERSPECTIVE DRAFTING MACHINE

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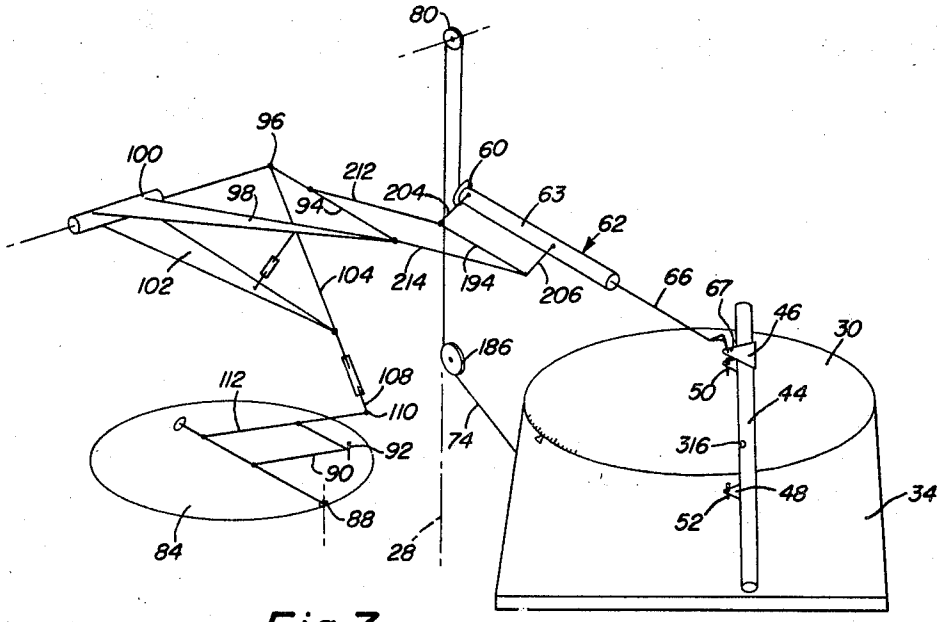


Fig.7

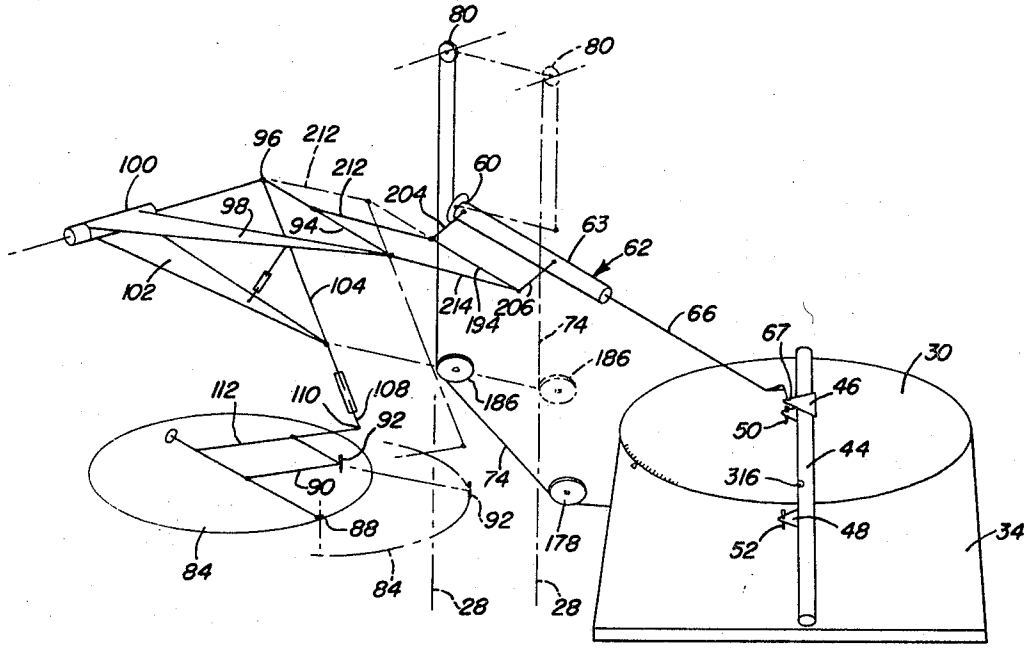


Fig.8

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AUTOMATIC PERSPECTIVE DRAFTING MACHINE

Filed Aug. 9, 1967 Sheet 7 of 8

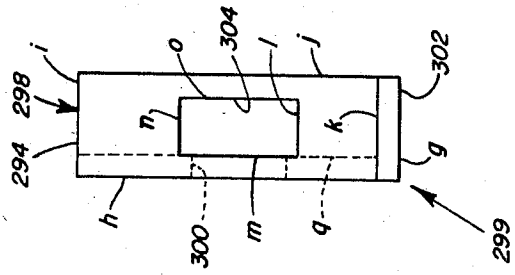


Fig. 13a

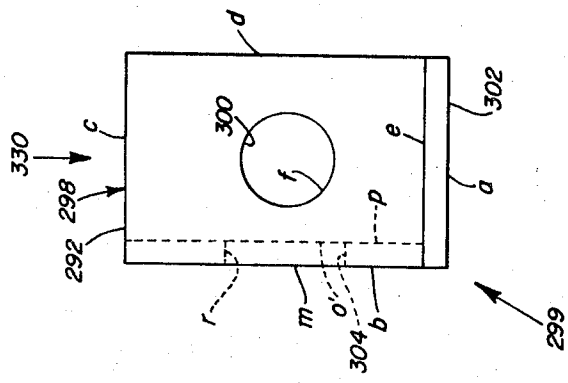


Fig. 13

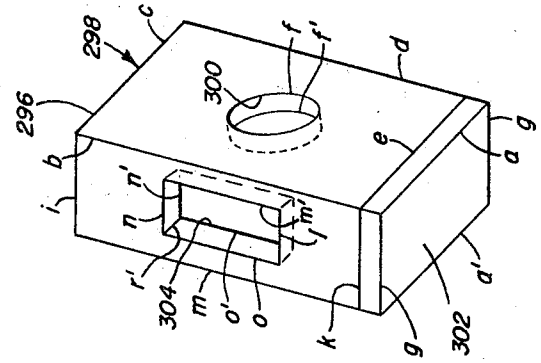


Fig. 13b

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Feb. 4, 1969 K. A. BOWEN 3,425,126

AUTOMATIC PERSPECTIVE DRAFTING MACHINE

Filed Aug. 9, 1967 Sheet 8 of 8

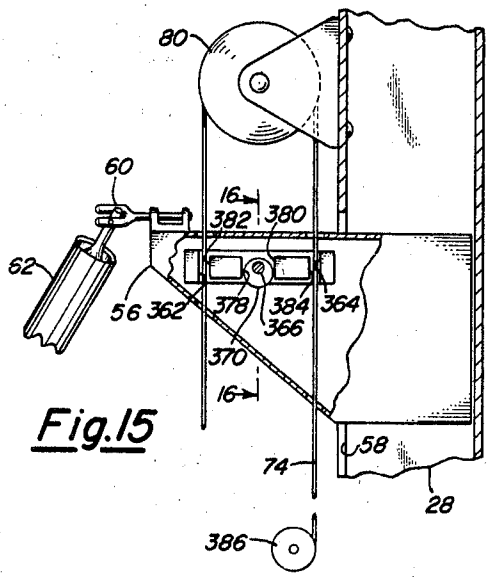


Fig.15

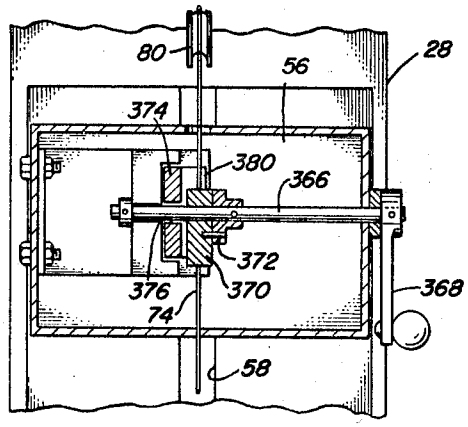


Fig.16

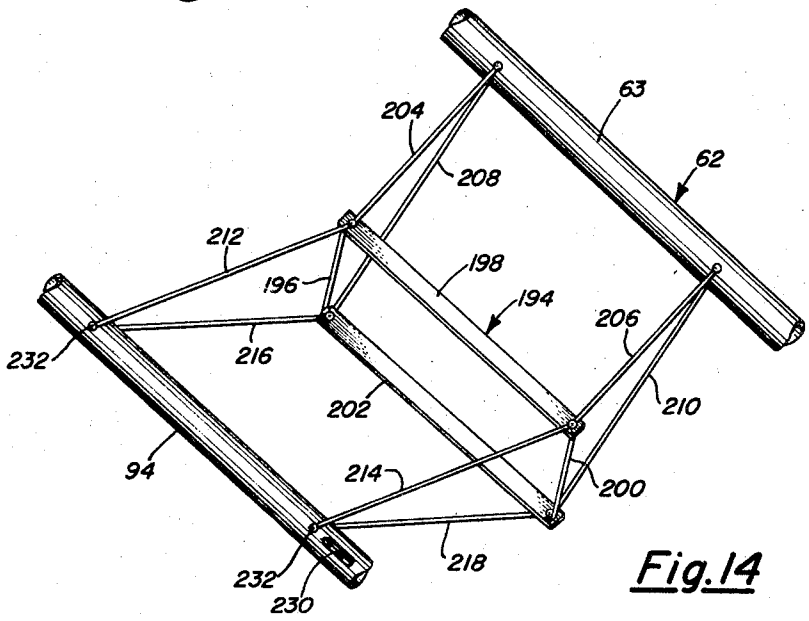


Fig.14

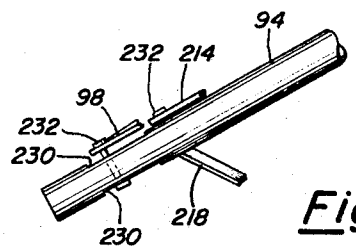


Fig.11

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United States Patent Office 3,425,126
Patented Feb. 4, 1969

3,425,126

AUTOMATIC PERSPECTIVE DRAFTING MACHINE

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Continuation-in-part of application Ser. No. 437,832, Mar. 8, 1965. This application Aug. 9, 1967, Ser. No. 659,422
U.S. Cl. 33—18 22 Claims
Int. Cl. B43l *13/14*

ABSTRACT OF THE DISCLOSURE

An instrument for drawing perspective views including a tracing lever mounted for nutation about a plurality of axes whereby orbital movement can be imparted to the free end of the lever about a plurality of axes. The lever is of the telescope type and the free end is connected with either of two styluses for tracing several views of the object to be drawn in perspective. The lever is connected to a marking device, such as a pen or pencil through motion transmitting mechanism, such as through a pantograph.

The present application is a continuation-in-part of my copending application, Ser. No. 655,263, filed July 3, 1967, which application is a continuation of my copending application, Ser. No. 437,832, filed March 8, 1965, now abandoned.

The tracing lever includes relative stationary and movable elements. The stationary element is mounted, through a universal coupling for nutating movement, and the universal coupling together with the relative stationary element of the lever is translatably shiftable. Movement translating mechanism connects the lever and the universal coupling with the marking device.

Two or more different views of the object to be drawn are placed in such position that they can be traced by two separate tracing members in the form of styluses.

One of these tracing members is associated with the slidable element of the tracing lever whereby, when it traces one of the views, the movable element of the lever can move longitudinally of the relative stationary element to impart nutating movement of the lever, and this movement is transferred to the marking device through the aforementioned movement translating mechanism.

The other stylus or tracing member is connectable with mechanism which translatably shifts the universal coupling, carrying with it the stationary element of the lever. The second mentioned tracing member is also connectable with the end of the relatively movable element of the lever. When the second mentioned tracing member traces another view, it causes translatable shifting of the universal coupling and the telescoping of the lever element. This movement of the lever, like above set forth, is transferred to the marking device.

The movement translating mechanism, which is interposed between the lever and the marking device, includes at least one pantograph.

Two supports are provided, one providing the table or tables for the drawings and the other providing the pivotal support for the telescoping tracing lever, the table for the perspective drawing and supports for some of the movement translating mechanism. The angle of the ultimate perspective view can be varied by shifting the supports toward and away from one another.

The telescoping lever is connected with a lever, which is maintained parallel at all times relative to the telescoping lever. Two matching parallelly disposed pantographs are connected with the telescoping lever and the other lever, so as to maintain constant parallelism between the levers although the telescoping lever and the other lever are movable toward and away from one another.

The support for the two drawings includes a table forming a complete circle and it carries one of the drawings to be traced. A second table is pivotally supported by that support, it having a curvature which complements the arc of the first mentioned table and lies in the same plane as the first mentioned table; it carries the other or other drawings to be traced. The second mentioned table carries track means in the form of two tracks for an elongated carrier, herein referred to as a "straightedge," which is movable transversely of the tracks; this straightedge is disposed above both surfaces of the tables. A movable cable is carried by the straightedge and one of the tracing members is connectable with the cable. The second mentioned table is movable about the first mentioned table, and it is preferably translucent and a lamp is disposed below it.

Other features and the advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the invention is illustrated.

In the drawings:

FIG. 1 is a perspective view, diagrammatic in part of one form of the invention;

FIG. 2 is a side view but on a large scale, parts thereof being shown in section, the section being taken along line **2—2** of FIG. 1;

FIG. 3 is a view, partly in section, and looking in the direction of arrows **3—3** of FIG. 2;

FIG. 4 is a schematic view of the instruments, the various parts of the instrument being shown substantially as shown in FIG. 1; in this view, like in FIG. 1, the universal coupling for the tracing lever is approximately in its uppermost position;

FIG. 5 is a view similar to FIG. 4, but showing the universal coupling for the tracing lever at a lower level and with the straightedge approximately midway of the tables which support the objects to be traced;

FIG. 6 is a view similar to FIG. 5, but showing the straightedge in one of its extreme positions;

FIG. 7 is a view similar to FIG. 5, but showing the pivoted object-bearing table at a different angle;

FIG. 8 is a view similar to FIG. 7, but showing the movable support of the universal coupling for the tracing lever and for the marking device mechanism disposed at a greater distance from the table support;

FIG. 9 is a side view of the marking device, parts of the arm which supports the marker are shown in section;

FIG. 10 is a section view taken on line **10—10** of FIG. 1, but on a larger scale and showing a form of locking device for preventing movement of a stylus longitudinally of the straightedge;

FIG. 11 is a fragmentary sectional view taken along line **11—11** of FIG. 1;

FIG. 12 is a top plan view of an attachment for one of the tracing member carriage;

FIGURE 13 and FIGURE 13*a* show two orthographic views of a hollow box. FIGURE 13*b* shows a perspective view of the same box looking in the direction of arrows in said orthographic views;

FIG. 14 is a schematic view of a pair of interconnecting pantographs employed between the tracing lever and the marking device;

FIG. 15 is a schematic view of a different form of mechanism for connecting the cable to the universal coupling for the tracing lever;

FIG. 16 is a view, partly in section, looking in the di-

rection of arrows 16—16 of FIG. 15, but on a larger scale.

Referring generally to the drawings, the instrument 20 includes a supporting means 22 in the form of a support or base 24, a pedestal 26 and a support in the form of a tower 28 which is slidably adjustably held in desired spaced relationship with the pedestal 26.

The pedestal carries a circular table 30 having a top surface 32 and an oscillatable table 34 forming a table top 36 in continuation with the table top surface 32. Track means in the form of two parallel tracks 40 and 42 are affixed to the oscillating table 34, and these tracks extend above the table tops for guiding a rectangularly disposed carriage in the form of a hollow straightedge 44.

Two carriages 46 and 48 are guided longitudinally of the straightedge 44; carriage 46 has a tracing member 50 affixed thereto, and carriage 48 has a tracing member 52 affixed thereto; these tracing members are in the form of styluses. Carriage 48 extends through a longitudinal slot 53 in the straightedge.

The tower 28 is slidable in a slot 54 in base 24 and is adjustably fixed to the base in any suitable manner. A carriage 56 is guided vertically in a vertical groove 58 in the tower, and is prevented from escaping from the groove in any suitable manner. This carriage is provided with a universal coupling 60 to which a tracing lever 62 is attached. This lever 62 includes the upper hollow tube or section 63, a hollow tube or section 64 which is in telescoping relationship with section 63, and a rod 66 which is in telescoping relationship with section 64. Thus, the section 64 and rod 66 are in longitudinal extendible relationship with the section 63 and the universal coupling 60. The outer or lower end 67 of the rod 66 is pointed, is axially aligned with the longitudinal axis of lever 62, and is adapted to rest in a socket 68 in carriage 46 or a like socket 70 in carriage 48, which are guided by the straightedge 44.

A spring 72, having a constant tension of the coil type (see FIG. 2), is fixed to the right end and within the tubular straightedge 44. A cable 74 has one end 76 attached to the outer end of the spring 72. This cable extends through the straightedge, through a series of sheaves and sheave linkage 78, over a sheave 80 (FIG. 1), and has its other end connected to the carriage 56. Carriage 48 is preferably permanently affixed to cable 74.

The carriage 48 slides within a groove 53 in the straightedge and is adjustably connectable with the cable 74 in any suitable manner. When connected with the cable, longitudinal movement of the carriage will effect vertical movement of the carriage 56 on the tower 28, and consequent vertical movement of the universal coupling 60 and the section 63 of lever 62. Nutating or orbital movement can be imparted to the lever 62 whether the end of the rod 66 rests in socket 68 in carriage 46 or rests in socket 70 in carriage 48.

Straightedge 44, carriage 46 and table 34 can be independently moved from one extreme position to the opposite extreme position without causing movement of carriage 56.

The movable tower 28 carries a table 84. A pantograph 86 connected with the table 84 by a pivot 88. One of the links 90 of the pantograph 86 carries the marking device 92. The movement of the lever 62 is transmitted to the marking device through a pair of parallel pantographs connected with section 63 of the main lever 62, a second pair of pantographs connected in series with the first pair of pantographs, a second lever 94 connected with the second pair of pantographs, a stationary universal coupling 96 for the lever 94, an arm 98 guided by a guided movable carriage 100, an arm 102 on the movable carriage 100, a third lever 104 connected to the universal coupling 96, and a telescoping section 108 which is connected by a universal coupling 110 to a link 112 of pantograph 86.

Referring more in detail to the drawings, the pedestal 26 is cylindrically shaped. A collar 120 surrounds the bottom of the pedestal, which collar is formed integrally with an arm 122, which extends upwardly and radially from the pedestal. The arm 122 supports the bottom and outer frame 124 of the table 34. The top 36 of table 34 (see FIG. 1), which is on the same plane as the top 32 of table 30, is formed of translucent material and lamps 126 (see FIG. 2) are disposed below the translucent top. The periphery of the circular table 30 is provided with a groove 128, which received the mortise 130 on the arcuate portion 132 of the table frame 124 of table 34, which arcuate portion complements the circular periphery of the table 30. Thus, the table 34 is supported and guided by the pedestal and the periphery of table 30.

Referring more specifically of FIG. 3 and FIGS. 1 and 2, the underside of table 34 has arms 134 affixed thereto. The left end of these arms carry upwardly extending pins 136, which pins carry rollers 138, which ride in the circular groove 128 in the periphery of table 30, to thereby provide for ready and smooth oscillation of the table 34. The upper ends of pins 136 extend above the top of table 30 and carry the track 40. Referring specifically to FIG. 2, it is seen that the right end of frame 124 of table 34 carries the track 42.

The straightedge 44 is provided on the underside with two rollers 140 and 142 which are guided, respectively, by tracks 40 and 42. Thus, it is apparent that the straightedge 44 is turned with the turning of the table 34, and spans tables 30 and 34.

Still referring specifically to FIG. 2, it will be seen that the left end of straightedge 44 carries a depending frame 146, which pivotally supports a C-shaped frame 148 having upper and lower needle type bearings 150, which ride in sockets (not shown) in the upper part of the straightedge and the lower part of depending frame 146. The lower arm of the C-shaped frame 148 includes an integrally formed extension 152, which carries two sheaves 154 and which are oscillatable as a unit. A sheave 158 is carried by the underside of straightedge 44, and the cable 74 rides in the left edges of these grooves in the sheaves 158 and 154. The left edges of the grooves of sheaves 158 and 154 are in vertical alignment. The cable is then strung over to the right side of the groove in sheave 156. Pivots 150 are in vertical alignment with that pair of cable 74 which is in spanning relationship with sheaves 154 and 158 (FIG. 2).

The sheave linkage 78 includes three tubular links 162, 164 and 166, each tube supporting a pair of bifurcated arms 168 at the ends thereof; the bifurcated end of link 162 is pivotally attached to the pin 170 on extension 152 of C-shaped frame 148, which pin also rotatably supports sheave 156; the bifurcated arms of the lower end of link 162 and the right end of link 164, carry a pin 172 for a sheave 174; the arms 168 at the left end of link 164 and the lower end of link 166 carry a pin 176 for a sheave 178; the arms 168 at the upper end of link 166 and the arms of a caster type sheave support 182, carry a pin 184 for a sheave 186. The cable 74 is extended through the hollow links and is strung about the sheaves 174 and 178. The sheave support 182 is journaled for oscillating movement in a vertically extending bearing 188. Any suitable means can be employed for preventing the sheave support 182 from dropping out of the bearing. The bearing is frictional or otherwise supported for vertical height adjustment on the tower 28. The left edge of the groove in sheave 186 is vertically aligned with the left edge of the groove in the sheave 80 at the top of the tower 28, regardless of the moving position of the sheave 186.

The tower 28 is movable relative to the table pedestal 26 in any suitable manner. Here the base is slotted at 54 and the tower is held in adjusted position by a bolt 190 and nut 192. The purpose of the relative movement between the tower 28 and the pedestal, is to change the angular relationship between the main lever 62 and the tables

30 and 34. In this manner the point of vision, i.e., angle, at which the perspective is to be made, can be selected.

Since it is desirable to shift the tower relative to the tables, flexibility of the cable connection between the tower and pedestal must be had, and the sheave linkage 78 provides such flexibility. Too, since the oscillatable table 34, together with the straightedge 44 is movable relative to the tower, and since the straightedge is movable relative to the tables 30 and 34, flexibility of the cable connection between the straightedge and the tower must be had. This flexibility must allow straightedge 44 to move from one extreme to another, and table 34 to oscillate about table 30, without affecting the vertical position of carriage 56. The oscillatable C-shaped frame 148, the linkage 78 and the oscillatable connection, provided by the caster type sheave support 182, assures such flexibility.

The two pair of pantographs between the input or tracing lever 62 and the secondary lever 94 are more clearly shown in FIG. 14. These pantographs including a common frame 194, here diagrammatically shown rectangular in shape, including integral sections 196, 198, 200 and 202. One of the pairs of pantographs, which is connected to the tracing lever 62, includes as a link, section 198 of frame 194, a link 204 which is pivotally connected to the frame 194 and the tracing lever section 63, the section 63, and a link 206 pivotally connected to section 63 and link section 198. The other pair of pantographs, which are connected to the tracing lever 62, includes, as a link, section 202 of frame 194, link 208 which is pivotally connected with the frame 194 and with tracing section 63, the section 63, and a link 210 which is pivotally connected with section 63 and the frame.

One of the pairs of pantographs which connects frame 194 with the secondary lever 94, includes as a link, section 198 of frame 194, a link 212 which is pivotally connected to the frame 194 and to the secondary lever 94, the lever 95 functioning as a link, and a link 214 which is pivotally connected with the secondary lever and the frame 194. The other of the pair of pantographs, disposed between frame 194 and the secondary lever 94, includes as a link, section 202 of frame 194, a link 216 which is pivotally connected with the frame 194 and lever 94, the lever 94 functioning as a link, and a link 218 which is pivotally connected with the lever 94 and the frame 194.

For the sake of simplicity only one of each pair of pantographs, connecting tracing lever 62 with the second lever 94, are shown in the diagrammatic views 4 to 8 inclusive, namely the pantograph including frame 194, links 204 and 206, and section 63, and the pantograph frame 194, links 212 and 214, and the secondary lever 94.

It will be seen from all of the FIGS. 4 to 8, that by the pantographs between levers 62 and 94, parallel relationship is maintained between the tracing lever 62 and the secondary lever 94, regardless of the position of the lever 62. It should be noted that if table 84 could be suitably placed and a telescoping stylus installed on the free end of secondary lever 94, it would be possible to perform the function of lever 104, thereby eliminating the need for lever 104, arms 98 and 102, and carriage 100.

Referring now to FIG. 1, it will be observed that the tower 28 has an arm 222 affixed thereto. This arm is provided with ears 224 for supporting a shaft 226. The universal coupling 96 is carried by a rod 228 which is mounted for oscillating movement within the shaft 226, suitable means (not shown) prevents reciprocation of the rod with respect to the shaft. The coupling 96 is of the type which permits universal movement of levers 94 and 104 independently of one another.

Orbital movement of the tracing lever 62 is imparted to the second telescoping lever 104 through the series connected with the pantographs, the secondary lever 94, arm 98, guide 100 and arm 102. As shown more clearly in FIG. 11, the secondary lever 94 is provided with a longitudinally extending slot 230 which slidably receives a pin 232. Similarly, a like slot (not shown) is formed in telescoping lever 104 which receives a pin (not shown) like 232.

Since the angles between the shaft 226 and the arms 98 and 102 are fixed, and since the distances between pins 232 and the shaft 226 are fixed, and since lever 94 is subjected to orbital movement about the universal 96, slidable engagements between pins 232 and slots 230 in levers 94 and 104 are necessary.

An expansible and contractible coupling 234 is interposed between arms 98 and 102 for adjustably fixing the position of these arms with respect to one another; such adjustment is desirable to provide for aligning the telescoping lever 104 perpendicular with the center of the paper on which the perspective drawing is to be made while fastened to the table 84. This adjustment falls due when the tower 28 is changed with respect to the base 24, or when the universal 60 is varied in its height position.

The pantograph 86, in addition to links 90 and 112, includes also links 234 and 236, links 234 and 236 being pivotally connected to links 90 and 112. Link 234 is pivotally connected at one end to pivot pin 88, and the opposite end carries a roller 238.

Referring now to FIG. 9, the marking device 92 includes an arm 242 which is an extension of arm 90 of the pantograph 86. An arm 244 is attached to arm 242 by a leaf spring 246. The free end of arm 244 carries the inkwell 248, the pen 250 connected therewith, and a height adjustment 252 is provided for the pen. A second arm 254 is connected to the arm 242 by a leaf spring 256; the three arms are disposed above one another.

An expansible and contractible container 260 is interposed between the bottom side of arm 242 and the top side of arm 254. A fixed tube 262 is connected with chamber 260 and extends through a hole 264 in the upper arm 244. This tube is connected by a flexible tube 266 to a bulb 268. A sutiable fluid is confined in the chamber 260, tube 262 and bulb 268.

The free end of lower arm 254 and the arm 244 are adjustably interconnected. Such interconnection includes a member 270, the lower end of which is threaded as at 272 for vertical adjustment relative to arm 254. The member 270 includes an integral shank which extends through a hole 276 in arm 244. The shank is of the spool type having rims 278 and 280. The rim 278 abuts the underside of arm 244 and is forced upwardly by a leaf spring 256. The compression between the container 260 and the arm 254 is adjustable by varying the compression of spring 282. Thus, the downward pressure on the pen 250 can be controlled. The bulb is depressed when lines are to be drawn.

Referring specifically to FIG. 4, the movement of the various parts are illustrated graphically. X indicates the movements of the styluses 50 and 52 along the straightedge; Y indicates the movements of the straightedge, and Z indicates the vertical movements imparted to the universal 60 by the cable 74. Arrows S indicate the oscillating movement of table 34, T the levers 94 and 104, U the sheave linkage 78; Q the carriage 100 for the arms 98 and 102; arrow W indicates the orbital movement of the tracing lever 62; arrow P indicates the reciprocating movements of the tower 28.

Referring now to the embodiment shown in FIGS. 15 and 16, the carriage 56 includes a clutch, having two integral abutments 362 and 364 which are horizontally spaced from one another. A shaft 366 is carried by the carriage 56, and this shaft is oscillated by a crank 368. A cam 370 is fixed to the shaft by a pin 372. A block 374 is mounted for horizontal movement in the carriage, it being provided with a slot 376 which received the shaft 366. The block 374 is provided with two confronting shoulders 378 and 380, which are adapted to be engaged by the cam 370. The outer ends 382 and 384 of the block confront, respectively, the abutments 362 and 364.

As in the other embodiment, the cable 74 is looped

about sheave **80**, but in this embodiment the cable passes between abutment **362** and end **382** of block **374**, and between abutment **364** and end **384**. Also in this embodiment, a spring **386** is used to balance the weight of the carriage **56** and all mechanism carried thereby. When the cam **370** is turned to bind the cable **74** between abutment **362** and end **382** of the block **374**, then as the stylus carriage **48** is moved to the right and left, as viewed in FIG. 1, the carriage **56** and lever **62**, are moved downwardly and upwardly, respectively. When the cam **370** is turned to bind the cable **74** between abutment **364** and end **384**, then as the stylus carriage is moved to the right and left, the carriage **56** and lever **62** are moved upwardly and downwardly, respectively.

Referring now to FIG. 13, which shows orthographic drawings of a top plan view **292**, a side view **294** and a resultant perspective view **296** of a hollow box **298**. The top is provided with a circular hole **300** and is provided with a removable cover **302**. One side of the box is provided with a rectangularly shaped opening **304**.

When drawing a perspective view of the box **298**, and when it is desirable to have the perspective drawing disclose the top and the side showing the rectangularly shaped opening **304**, as for example, when viewed in the direction indicated by arrows **299**, it is preferable to trace all lines of drawing **292** with the stylus **50** of carriage **46**, these lines will then be shown on drawing **296**. At this time, lines of drawings **292** and **294** are aligned, and stylus **52** is locked on line *h*. Then stylus **50** is locked to the straightedge **44** on line *b* of drawing **298**, whereby it can move only along line *b*, and while so locked all lines in drawing **294** are traced by stylus **52**. All of these lines are now shown in drawing **296**. The dotted line *p* depicts the thickness of the side having the rectangularly shaped opening **304**. The stylus **50** of carriage **46** is then locked on dotted line *p* of drawing **292**, lines *o* and *n* are traced on drawing **294** by stylus **52** to draw lines *o'* and *n'* in the perspective view. Then stylus **52** is locked on dotted line *q* of drawing **294** and circular line *f* is retraced by stylus **50** of carriage **46** to draw line *f'*, thereby showing the thickness of the wall of the box.

The locking of the straightedge and the carriages **46** and **48** may be manual or mechanical.

In the embodiment shown in FIGS. 1 to 12, wherein no clutch for the cable **74** is provided at the carriage **56**, it is necessary to place drawing **294** with the face side confronting the table surface **36**, at which time the lamp or lamps **126** (FIG. 2) will be lighted so that the lines on the drawing **294** are visible to the operator.

By providing a clutch mechanism (FIGS. 15 and 16), for reversing the direction of travel of carriage **56**, it becomes unnecessary to invert the elevation views as described in the previous paragraph and the illuminated table surface **36** is no longer required.

The stylus carriage **48** can be locked in position mechanically by mechanism like that shown in FIG. 10, in which the interior of the straightedge **44** is provided with a web **308** which has an arm **310** affixed thereto. The arm is provided with an abutment **312**. A portion of the arm extends to the exterior of the straightedge and pivotally supports a lever **316** forming a cam **318**. A lever **320** is carried by a pivot **322** on arm **310**, and one end of lever **320** has an abutment **324** which confronts abutment **312** on arm **310**. The other end of lever **320** forms a counterweight **336** which normally urges clockwise movement to the lever. The cable **74** is disposed between abutments **312** and **324** and can be locked therebetween by turning the cam **318** counterclockwise. Thus, the carriage **48**, being fixed to the cable **74** can be locked in position by depressing lever **316**.

When it is desirable to make perspective of other areas of an object, in addition to the areas viewed in FIG. 13, as for example, a view of the box looking in the direction of arrow **330**, a drawing of that view is placed on table **34** and the table is turned 90° from that shown in FIG. 1, and then it is traced as aforesaid. The table is movable through an angle of at least 180°, whereby views can be completed in perspective of all areas of the object.

The word "sheave" as herein employed includes "pulleys"; also the word "translucent" comprehends "transparent."

If an exploded view to the left of elements in drawing **294** is desirable, the caster type sheave support **188** is moved downwardly, and the portions of the drawing are retraced as aforesaid. Likewise, if explosion views, to the right of elements in drawing **294** are desirable, the sheave support **188** is moved upwardly.

If exploded views of elements shown in drawing **292** are desirable, one of various accessories **390** (FIG. 12) is attached to carriage **46** in any suitable manner. The center socket in the attachment is aligned with the socket **68** in carriage **46**. The other sockets shown in accessory **390** receives the point **67** for forming gaps or explosions according to distance and direction of removal of the point **67** from the center socket. These accessories will have sockets spaced different distances from the center socket depending upon the size of the gap between exploded elements.

From the foregoing, it will be apparent that by virtue of the present invention, various perspective views at various angles of viewing can be readily formed by merely tracing orthographic views of the object.

While the forms of embodiment herein shown and described, constitutes preferred form, it is to be understood that other forms may be adopted falling within the scope of the claims that follow.

I claim:

1. An instrument, for drawing perspective views, comprising in combination:

(A) support means;

(B) a universal coupling connected with the support means;

(C) a lever including:

(1) an element connected with the universal coupling,

(2) a second element in longitudinal extendible relationship with the first mentioned element;

(D) a movable tracing member connectable with the second mentioned element of the lever;

(E) a marking device;

(F) movement translating mechanism connecting the lever and universal coupling with the marking device;

(G) a movable second tracing member connectable with the second mentioned element of the lever;

(H) and means responsive to movement of the second mentioned tracing member, when the latter is connected with the second mentioned element of the lever, for translatably shifting the universal coupling, with the lever attached thereto, relative to the support means.

2. An instrument as defined in claim **1**, characterized in that the movement translating mechanism includes:

(F) (1) a pantograph interposed between the lever and the marking device.

3. An instrument as defined in claim **1**, characterized in that the tracing member (D) is movable in all horizontal directions while the universal coupling remains vertically immovable.

4. An instrument as defined in claim **1**, characterized in that the means (H) includes:

(H) (1) elongated track means carried by the support means (A),

(2) a straightedge disposed transversely of and guided by the track means,

(3) a carriage in guided relationship with the straightedge and providing a support for carrying the second mentioned tracing member,

(4) means connecting the carriage with the universal coupling (B).

5. An instrument as defined in claim 4, characterized in that the means (H) (4) includes:

(H) (4) (a) a cable.

6. An instrument as defined in claim 1, characterized in that the means (H) includes:

(H) (1) elongated track means carried by the support means (A),

(2) a straightedge disposed transversely of and guided by the track means; and further characterized to include:

(I) a movable carriage in guided relationship with the straightedge and providing a support for carrying the first mentioned tracing member.

7. An instrument as defined in claim 1, characterized in that the means (H) includes:

(H) (1) elongated track means carried by the support means (A),

(2) a straightedge disposed transversely of and guided by the track means; and further characterized to include:

(I) a movable carriage in guided relationship with the straightedge and providing a support for carrying the first mentioned tracing member; and further characterized in that the means (H) includes:

(3) a second carriage in guided relationship with the straightedge and providing a support for carrying the second mentioned tracing member,

(4) means connecting the second mentioned carriage with the universal coupling.

8. An instrument as defined in claim 1, characterized in that the support means (A) includes:

(A) (1) a support, said tracing members being disposed above and movable relative to said support;

(2) a second support movable relative to the first mentioned support, said lever (C) being pivotally connected with the second mentioned support.

9. An instrument as defined in claim 7, characterized in that the means (H) includes:

(H) (1) track means carried by the first mentioned support,

(2) means movable along the track means,

(3) a carriage carried by the last mentioned means, said second mentioned tracing member being connectable with the carriage for moving the carriage and last mentioned means relative to the first mentioned support,

(4) a cable connecting the second mentioned tracing member with the universal coupling;

(5) means for supporting the cable including:

(a) a pulley supported by the means (H) (2),

(b) a second pulley,

(c) a third pulley,

(d) means for pivotally supporting, as a unit, the second and third mentioned pulleys by the means (H) (2) for oscillatory movement relative to the first mentioned pulley,

(e) a pulley linkage including:

(i) a downwardly extending link pivotally connected with the means (H) (5) (d),

(ii) a fourth pulley,

(iii) means for rotatably connecting the fourth mentioned pulley at the lower end of said link,

(iv) a second link having one end pivotally connected with the means (H) (5) (e) (iii) and extending laterally of the first mentioned link,

(v) a fifth pulley,

(vi) means for rotatably connecting the fifth mentioned pulley to the opposite end of the second mentioned link,

(vii) a third link having one end connected with the means (H) (5) (e) (vi) and extending upwardly,

(viii) a sixth pulley,

(ix) means for rotatably connecting the sixth mentioned pulley to the upper end of the third mentioned link,

(x) a support carried by the second mentioned support (A) (2), said third mentioned link being pivotally connected to the support (H) (5) (e) (x) by the means (H) (5) (e) (ix).

10. An instrument as defined in claim 9, characterized in that the first mentioned support (A) (1) includes:

(A) (3) a table,

(4) a second table oscillatably movable relative to the first mentioned table;

and further characterized in that the support means (H) (5) (d) for the second and third mentioned pulleys is carried by the tables and further characterized in that the support means (H) (5) (e) (x) is in the form of a caster.

11. An instrument as defined in claim 1, characterized in that the movement translating mechanism (F) includes:

(F) (1) an arm connected with the lever,

(2) a second arm for supporting the marking device,

(3) a leaf spring connecting the arms,

(4) a third arm

(5) a leaf spring connecting the first and third mentioned arms,

(6) adjustable spring means connecting the second mentioned arm with the third mentioned arm,

(7) an expansible and contractable container connected with the third mentioned arm; and further characterized to include:

(I) a manually expansible and contractable container connected with the first mentioned container.

12. An instrument as defined in claim 9, characterized in that the axis of the pivot means (H) (5) (d) is aligned with that part of the cable which spans the first and second mentioned pulleys.

13. An instrument as defined in claim 1, characterized in that the support means includes:

(A) (1) (a) a table for supporting an object to be traced,

(b) a second table for supporting an object to be traced,

(c) means for rotatably supporting the second mentioned relative to the first mentioned table.

14. An instrument as defined in claim 13, characterized in that the means (H) includes:

(H) (1) elongated tracking means fixed to the second mentioned table (A) (1) (b),

(2) a straightedge carried by and extending transversely of the tracking means, said straightedge lying above both tables,

(3) a movable carriage in guided relationship with the straightedge and providing a support for carrying the second mentioned tracing member,

(4) means connecting the carriage with the universal coupling (B).

15. An instrument as defined in claim 14, characterized to include:

(I) a second carriage in guided relationship with the straightedge and providing a support for carrying the first mentioned tracing member.

16. An instrument as defined in claim 14, characterized in that the second mentioned table is translucent; and further characterized to include:

(I) lighting means below the translucent table.

17. An instrument as defined in claim 1, characterized in that the means (H) includes:

(H) (1) a carriage track supported by the support means (A),

(2) a carriage guided by the track and supporting the universal coupling (B),

(3) an element connecting the second mentioned tracing member with the carriage,

(4) a clutch engageable with the element (H) (3) for imparting movement to the carriage in one direction when the second mentioned tracing member is moved in one direction,

(5) and a second clutch engageable with the element (H) (3) for imparting movement to the carriage in the opposite direction when the second mentioned tracing member is moved in the said one direction.

18. An instrument as defined in claim **10**, characterized to include:

(6) a pulley supported by the support means (A), and further characterized in that the element (H) is a cable which is connected to the second mentioned tracing member, looped about the pulley and connectable with the carriage (H) (2), one of the clutches being connectable with that part of the cable which is disposed between the second mentioned tracing member and the pulley, and the other clutch being connectable with that part of the cable which is disposed on the opposite side of the pulley.

19. An instrument as defined in claim **9**, characterized in that the support (H) (5) (e) (x) is adjustable vertically with respect to the second mentioned support (A) (2).

20. An instrument as defined in claim **1**, characterized in that the movement translating mechanism (F) includes:

(F) (1) a second universal coupling,

(2) a second lever including:

(a) an element connected with the second mentioned universal coupling (F) (1),

(b) a second element in longitudinal extendible relationship with the first mentioned element (F) (2) (a) of the second mentioned universal coupling,

(3) a pantograph connected with the first mentioned lever (C) and the element (F) (2) (*a*) of the second mentioned universal coupling,

(4) a pantograph supported by the support means having a link connected with the second mentioned element (F) (2) (b) of the second mentioned lever (F) (2) and having a link connected with the marking device.

21. An instrument as defined in claim **1**, characterized in that the movement translating mechanism (F) includes:

(F) (1) a second universal coupling connected with the support means;

(2) a lever connected with the second mentioned universal coupling,

(3) interconnected pantographs connected with and between the lever (C) and the lever (F) (2),

(4) a guide fixed to the support means and aligned with the center of the second mentioned universal coupling,

(5) a carriage guided by the guide,

(6) an arm having an end connected with and movable with the carriage (F) (5),

(7) means for slidably connecting the other end of the arm (F) (6) with the free end of the second mentioned lever (F) (2),

(8) a third lever including:

(a) an element connected with the second mentioned universal coupling,

(b) a second element in longitudinal extendible relationship with the first mentioned element (8) (a),

(9) an arm having an end connected with and movable with the carriage,

(10) means for slidably connecting the second mentioned arm with the first mentioned element (8) (a) of the third mentioned lever intermediate the end of said first mentioned element (8) (a),

(11) a third pantograph,

(12) an arm fixed to one of the links of the third mentioned pantograph;

(13) means for pivotally connecting the arm (12) with the extended end of the second mentioned element (8) (b) of the third mentioned lever,

(14) an arm fixed to a second link of the third mentioned pantograph,

(15) means for pivotally connecting the second mentioned link of the third mentioned pantograph to the support means, a third link of the third mentioned pantograph being pivotally connected with the second mentioned link of the third mentioned pantograph, and a fourth link of the third mentioned pantograph being pivotally connected to the first and third mentioned links of the third mentioned pantograph,

(16) and means for connecting the marking device with the fourth mentioned link of the third mentioned pantograph.

22. A marking device, comprising in combination:

(A) a marker;

(B) an arm supporting the marker;

(C) a member adapted to be moved by an extraneous source;

(D) a leaf spring connecting the arm with the member;

(E) a second arm;

(F) a leaf spring connecting the second mentioned arm with the member;

(G) adjustable spring means connecting the arms;

(H) an expansible and contractable container connected with the second mentioned arm.

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