Jan. 11, 1944. D. J. McQUAID, SR 2,338,729

DRAWING MACHINE

Filed Feb. 8, 1941 9 Sheets-Sheet 1

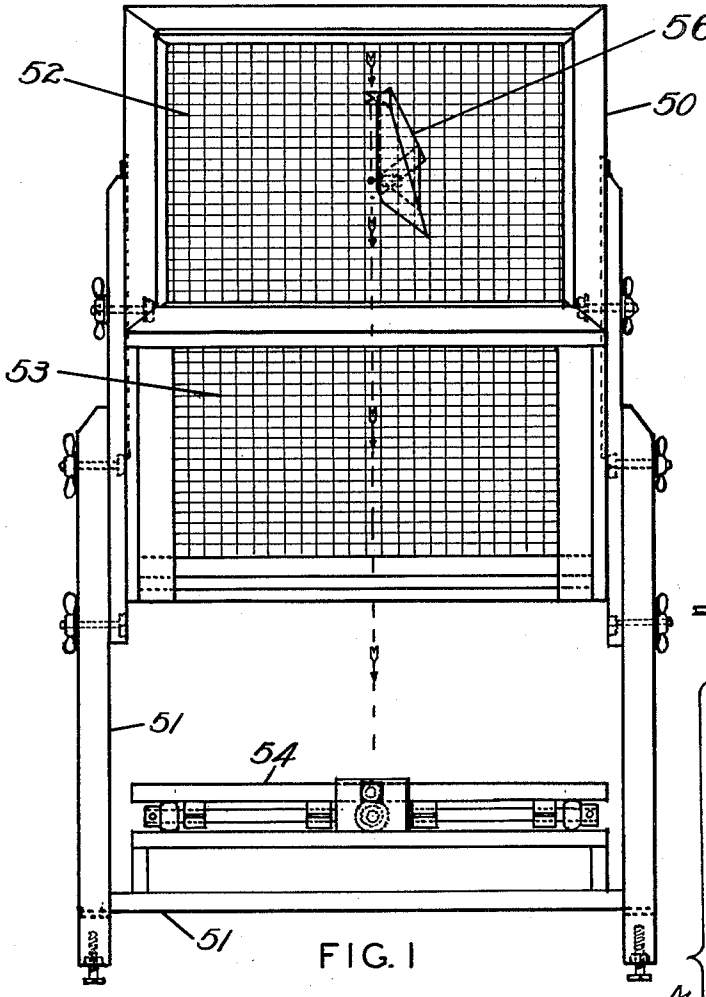


FIG. 1

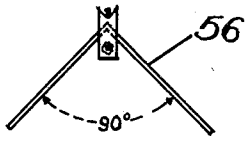


FIG. 2

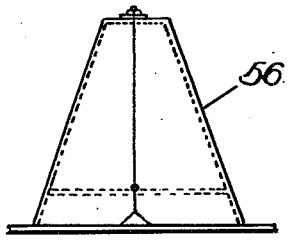


FIG. 3

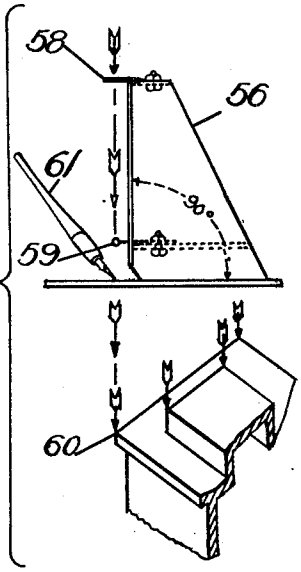


FIG. 4

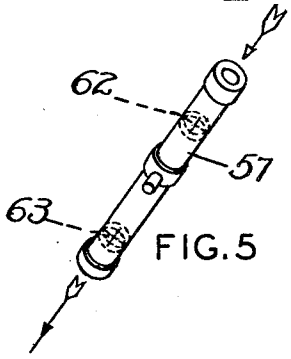


FIG. 5

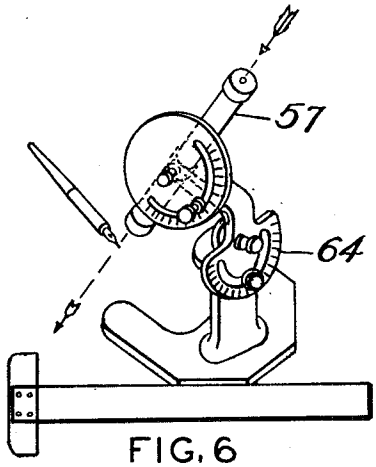


FIG. 6

INVENTOR.
DANIEL J. McQUAID SR.

BY Rolland & McGrew & Campbell
ATTORNEYS.

Jan. 11, 1944. D. J. McQUAID, SR 2,338,729

DRAWING MACHINE

Filed Feb. 8, 1941 9 Sheets-Sheet 2

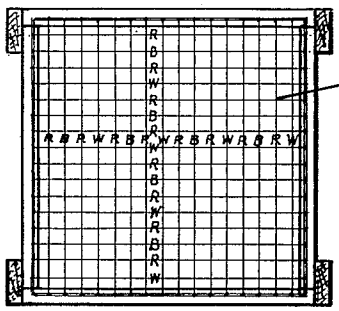


FIG. 11

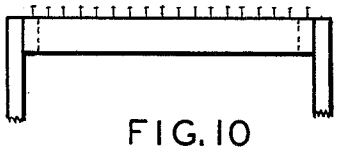


FIG. 10

FIG. 7

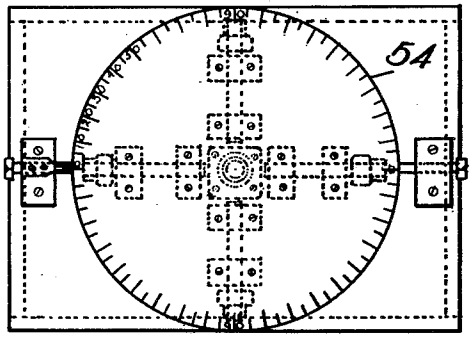


FIG. 8

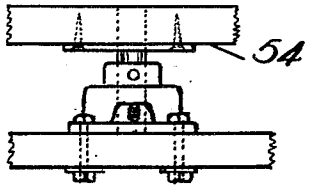


FIG. 9

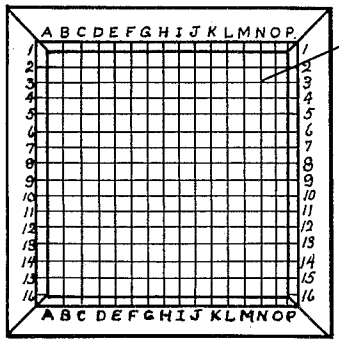
INVENTOR.
DANIEL J. McQUAID SR.

BY Rolland & McGrew & Campbell
ATTORNEYS.

Jan. 11, 1944. D. J. McQUAID, SR 2,338,729

DRAWING MACHINE

Filed Feb. 8, 1941 9 Sheets-Sheet 3



52-53

FIG. 14

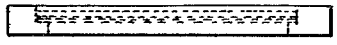


FIG. 15

FIG. 12

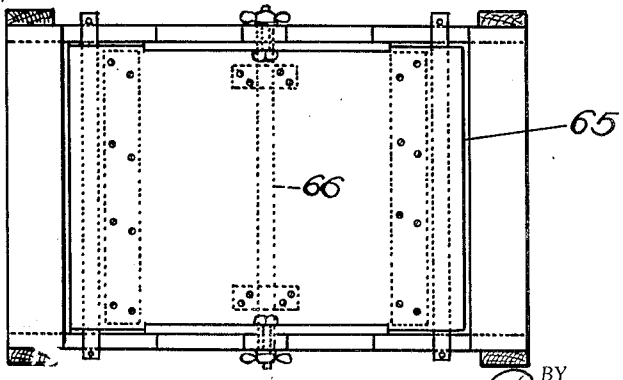


FIG. 13

INVENTOR.
DANIEL J. McQUAID SR.

BY Rollandet, McGrew & Campbell
ATTORNEYS.

Jan. 11, 1944. D. J. McQUAID, SR 2,338,729

DRAWING MACHINE

Filed Feb. 8, 1941 9 Sheets-Sheet 4

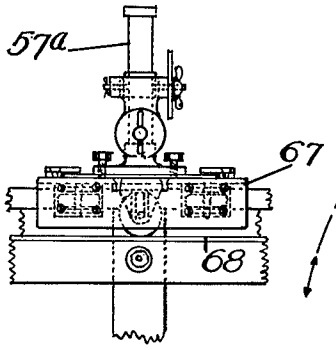


FIG. 18

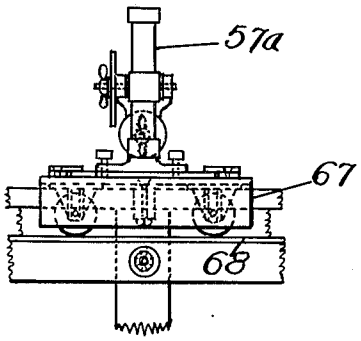


FIG. 19

FIG. 16

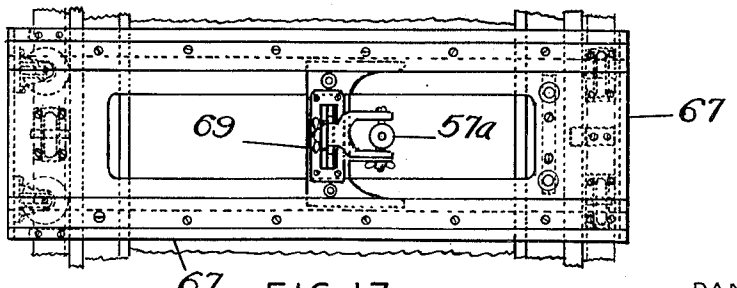


FIG. 17

INVENTOR.
DANIEL J. McQUAID SR.

BY Rollandet, McGrew & Campbell
ATTORNEYS.

Jan. 11, 1944. D. J. McQUAID, SR 2,338,729

DRAWING MACHINE

Filed Feb. 8, 1941 9 Sheets-Sheet 5

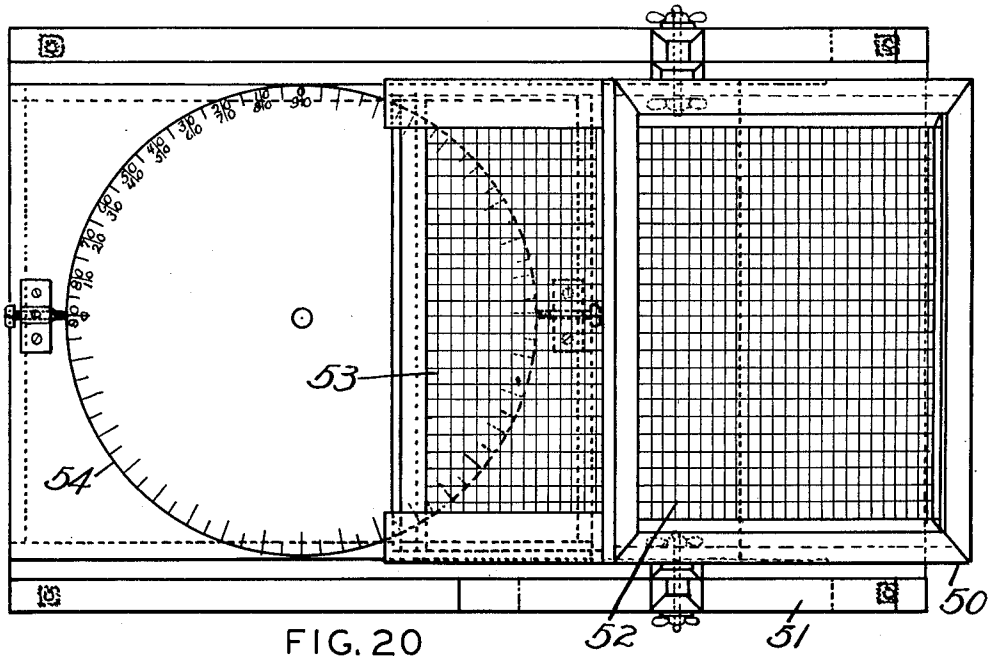


FIG. 20

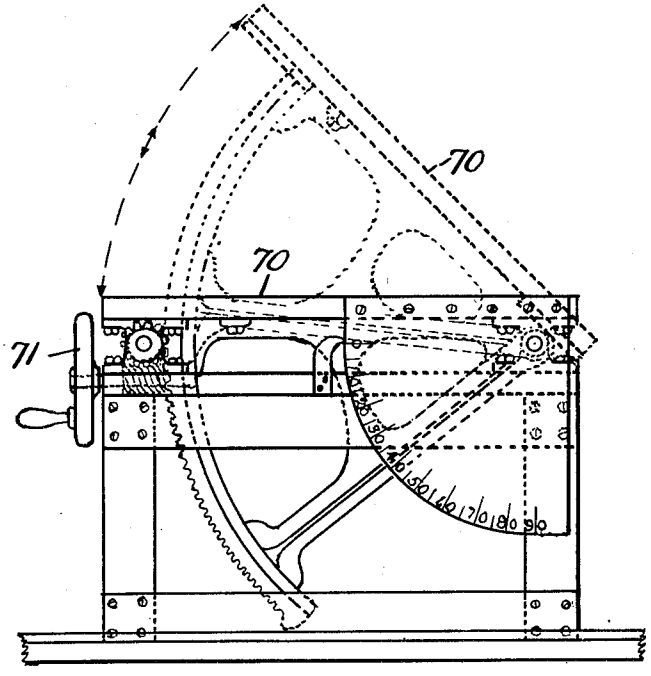


FIG. 21

INVENTOR.
DANIEL J. McQUAID SR.

BY Rollandet, McGrew & Campbell
ATTORNEYS.

Jan. 11, 1944. D. J. McQUAID, SR 2,338,729

DRAWING MACHINE

Filed Feb. 8, 1941 9 Sheets-Sheet 6

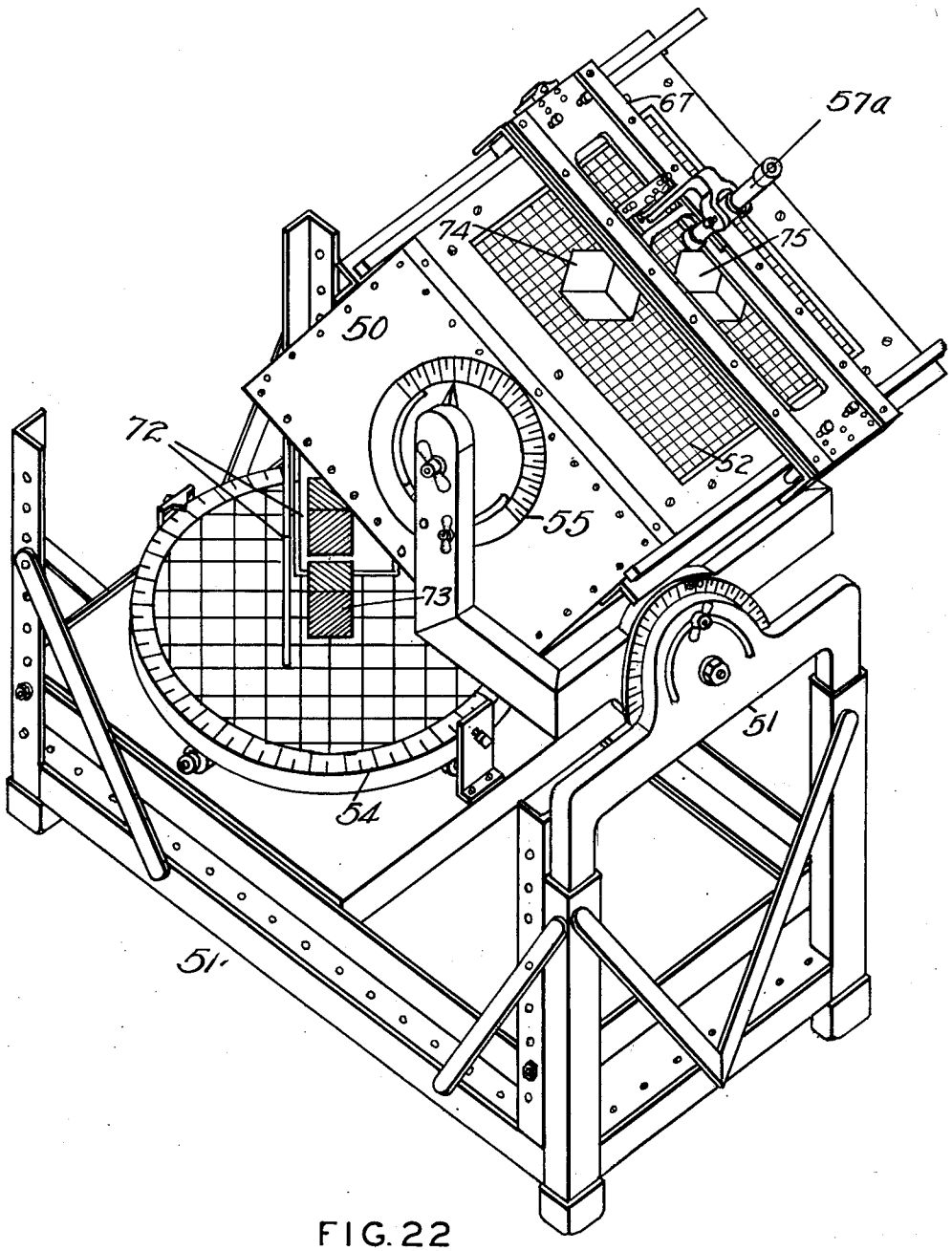


FIG. 22

INVENTOR.
DANIEL J. McQUAID SR.

BY Rolland & McGrew & Campbell
ATTORNEYS.

Jan. 11, 1944. D. J. McQUAID, SR 2,338,729

DRAWING MACHINE

Filed Feb. 8, 1941 9 Sheets-Sheet 7

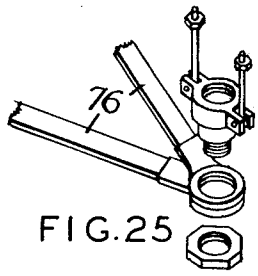


FIG. 25

FIG. 23.

FIG. 24

INVENTOR.
DANIEL J. McQUAID Sr

BY Rollandet, McGrew & Campbell
ATTORNEYS

Jan. 11, 1944. D. J. McQUAID, SR 2,338,729

DRAWING MACHINE

Filed Feb. 8, 1941 9 Sheets-Sheet 8

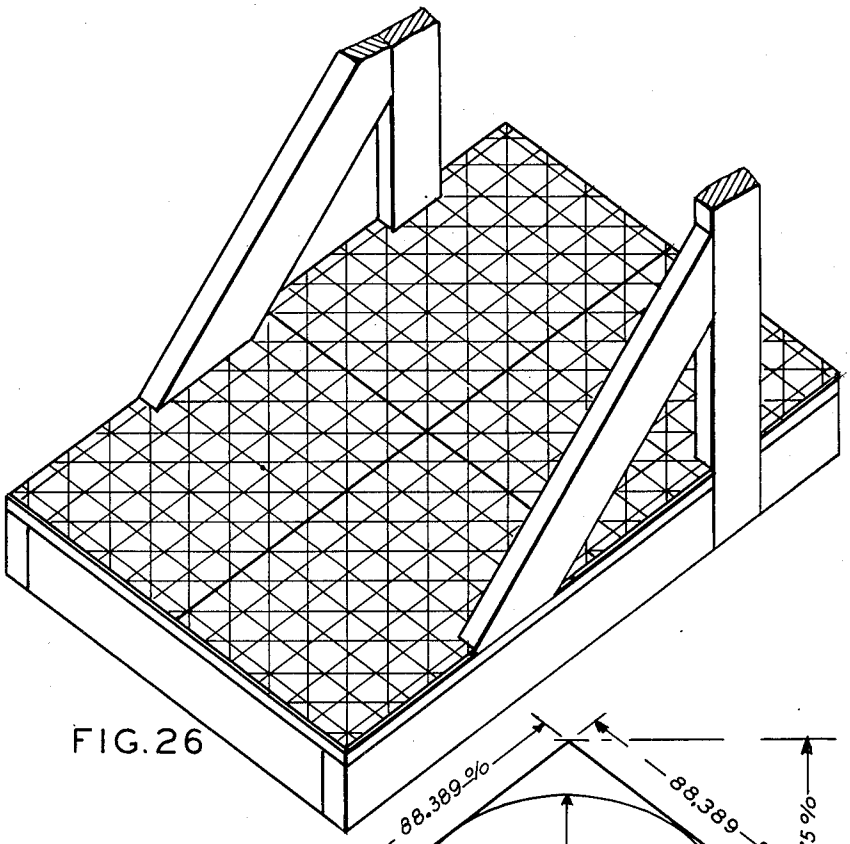


FIG. 26

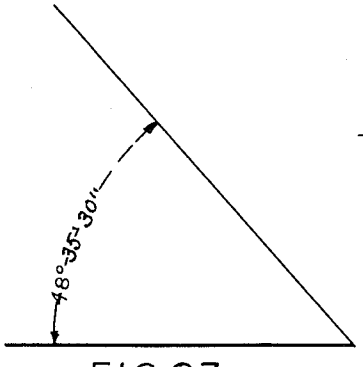


FIG. 27

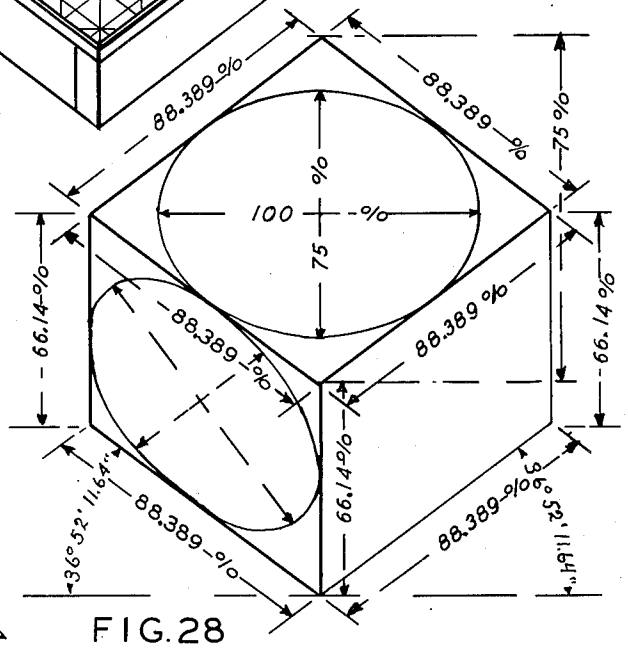


FIG. 28

INVENTOR.
DANIEL J. McQUAID SR.

BY Rollandet, McGrew & Campbell
ATTORNEYS

Jan. 11, 1944. D. J. McQUAID, SR 2,338,729

DRAWING MACHINE

Filed Feb. 8, 1941 9 Sheets-Sheet 9

Fig. 30

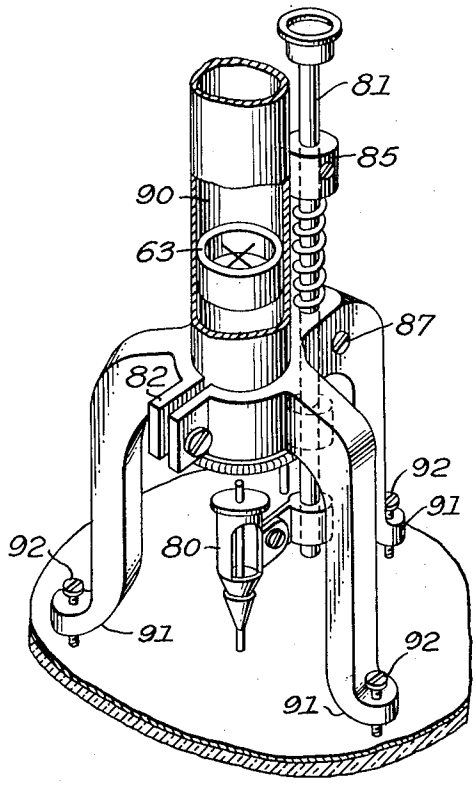


Fig. 29

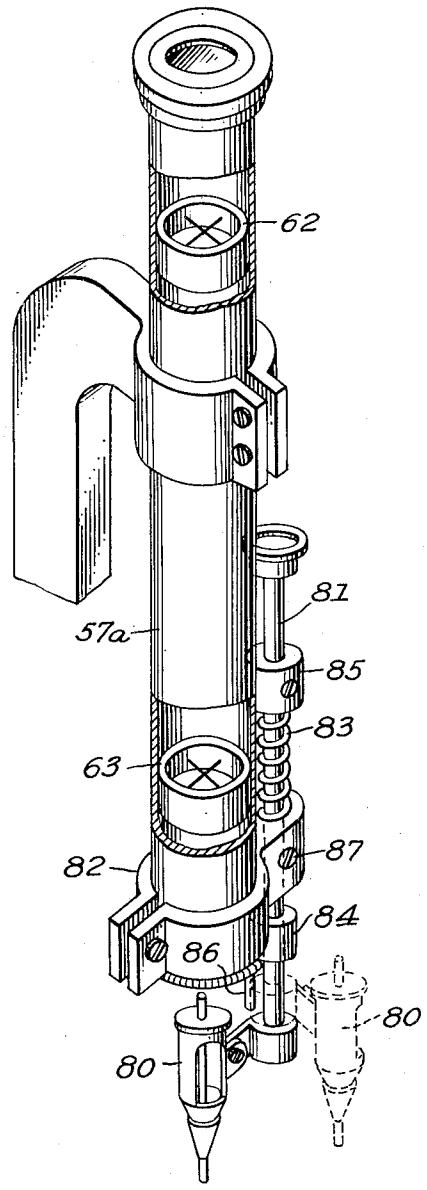
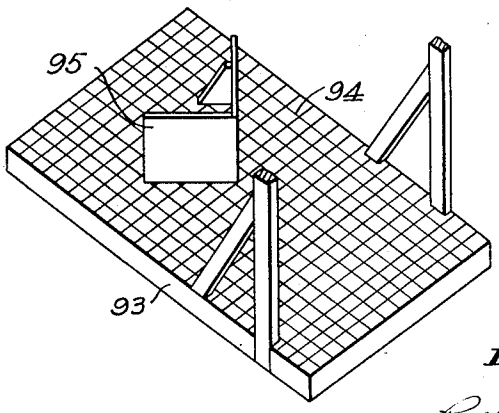


Fig. 31



Inventor.

DANIEL J. McQUAID SR.

By

Kallander, McAndrews & Campbell

Attorneys.

Patented Jan. 11, 1944 2,338,729

UNITED STATES PATENT OFFICE

2,338,729

DRAWING MACHINE

Daniel J. McQuaid, Sr., Denver, Colo.

Application February 8, 1941, Serial No. 377,993

22 Claims. (Cl. 33—20)

This invention relates to an improved drawing machine.

A principal object of the invention is to construct a drawing machine that has an unusually wide range of utility and yet is extremely easy to use in the rapid rendering of a drawing of almost any subject.

More specifically, an important object of the invention is to provide such a device with a transparent drawing surface that will enable the user to draw a subject at any angle according to axonometric projection or isometric style, to a predetermined scale or scales and with very unusual accuracy.

Another object is to provide a drawing machine that can be used to make a drawing on transparent material of a subject according to axonometric projection principles at any angle from a viewpoint ranging from a top plan view to a vertical elevation, or a combination of angles.

A further object is to provide a drawing machine that is particularly well adapted for teaching such subjects as solid geometry, mechanical drawing, art and the like.

A still further object is to provide a drawing machine using a transparent drawing material, that readily may be used for portrait work, and form the outlines for oil painting, murals, pastels, pen and ink, pencil or other such renderings.

Still another object is to construct a device of this character that is particularly well adapted to convert a map, architectural or engineering plan and elevation drawing or the like, into an axonometric projection drawing or isometric view, or conversely, to aid in converting a perspective such as a photograph taken from an airplane at any angle, into a relief or other type map.

A further object is to provide in a drawing machine of this character, means whereby a subject may be mounted on a movable stage of the machine and held at a predetermined angle with reference to the drawing surface while an axonometric projection is being drawn.

Another object is to provide a device whereby distant objects may be drawn accurately.

A further object is to provide a drawing machine that may be used for enlarging or reducing a subject drawn, to an accurate scale.

Another object is the provision in such a device whereby a plurality of different views of an object may be drawn at one setting without moving the position of the subject being drawn or changing the adjustment of the drawing machine.

Other objects and advantages reside in details of design and construction which will be more fully disclosed in the following description and in the drawings wherein like parts have been similarly designated and in which:

Figure 1 is a front elevation of a machine built according to this invention;

Figure 2 is a top plan view of a gun-sight type point finder that is well adapted to be used with the machine illustrated in Figure 1;

Figure 3 is a front elevation of the point finder shown in Figure 2;

Figure 4 is a side elevation of the point finder shown in Figures 2 and 3, illustrated in its operative relationship to a subject being drawn;

Figure 5 is a telescope type finder that is intended for use with the machine shown in Figure 1;

Figure 6 shows a telescope type point finder similar to that illustrated in Figure 5 and mounted on an adjustable stand to facilitate its use with the machine shown in Figure 1;

Figure 7 is a side elevation of a machine similar to that illustrated in Figure 1, illustrating a revolving stage;

Figure 8 is a plan view of the revolving stage portion of the machine illustrated in Figure 7;

Figure 9 is a detail shown on a large scale, of certain features shown in Figures 7 and 8;

Figure 10 is a fragmentary elevation of a portion of the machine shown in Figure 7;

Figure 11 is a plan view of the portion illustrated in Figure 10;

Figure 12 is a side elevation of a machine similar to that shown in Figure 7 but having modified features;

Figure 13 is a plan view of certain features embodied in the machine of Figure 12;

Figure 14 is a plan view of a component of the machine shown in Figure 12;

Figure 15 is an edge elevation of the component shown in Figure 14;

Figure 16 is a side elevation of a machine similar to that shown in Figure 12 and illustrated in a different operating position and shown with certain additional features;

Figure 17 is a fragmentary plan view of a portion of the machine illustrated in Figure 16;

Figures 18 and 19 show fragmentary details of the machine of Figure 16;

Figure 20 is a plan view of the drawing machine illustrated in Figure 7;

Figure 21 is a side elevation depicting a modification of certain features illustrated in Figure 12;

Figure 22 is an isometric perspective of a machine similar to that illustrated in Figures 1

and 7, and includes certain additional features;

Figure 23 is an isometric perspective view of a machine embodying the fundamental principles illustrated in Figures 1, 7, 12 and 16, together with certain additional features;

Figures 24 and 25 are fragmentary illustrations of certain details of Figure 23, and drawn to a larger scale;

Figure 26 is an isometric drawing showing a stage upon which objects to be drawn may be mounted, and is well adapted to be incorporated in any of the machines herein illustrated;

Figures 27 and 28 are diagrammatic illustrations setting forth typical calculations whereby the scale of a three dimensional drawing made with any of the machines herein disclosed, may accurately be predetermined;

Figures 29 and 30 illustrate marking means attached to point finders that are well adapted for use with this improved drawing machine; and

Figure 31 is an isometric view of a stage and a "prop" that can be used advantageously with this device.

In order to disclose an operative reduction to practice of the present inventive concept, the accompanying drawings will be described in some particularity; however, this disclosure merely sets forth typical examples and numerous changes may be made within the scope of the appended claims without departing from the spirit of the invention.

As the structural features herein illustrated, which embody this invention, are described and explained, it will become manifest that drawing machines made according to this invention have a wide range of utility.

Some of the objects and advantages of the invention are included in the formal statement of objects and it will be apparent that the machine, which is the subject of this application, has so many uses that it would be impractical, if not impossible, to describe them all.

The structural features herein set forth are capable of fulfilling the stated objects and more. Such features will be set forth in broad fundamentals and it will be understood that sizes, proportions and arrangements are subject to variation according to circumstances.

In Figure 1, reference character 50 denotes a hollow cube-like frame structure which is mounted upon a support 51. The frame structure 50 is mounted for angular movement about a horizontal axis as shown in Figure 7, and it may be moved up and down manually or mechanically to a selected elevation to suit conditions.

Incorporated in the cube-like frame structure 50 are two sets of cross-lines 52 and 53 which are in parallel planes that are spaced apart.

These cross-lines 52 and 53 may be provided in a number of ways, i. e., they may be hairs, threads, wires, rubber bands or the like, strung across upon frames such as illustrated in Figures 10 and 11, or they may be lines superimposed by any means upon pieces of glass or other transparent media.

If the lines are provided by means of strung threads or the like, as illustrated in Figures 10 and 11, then they are preferably made of different colors as indicated by the letters coinciding with the cross-lines of Figure 11, which, reading from left to right, for instance, red, black, red, white, red, black, etc., for purposes of distinction, so that corresponding individual lines in the two planes may be brought together in the sight-line.

If the lines are made on glass or the like, they also may be distinguished by color or by reference characters, as illustrated in Figure 14.

A stage 54 is carried upon the supporting structure 51 and is horizontally slidable toward and away from the frame structure 50, as well illustrated in Figure 7, and is also rotatably mounted as shown in Figures 8 and 9, the latter figure being an enlarged detail of the central pivot.

An object to be drawn is placed upon the stage 54 and the operator by positioning the stage and the angle of the frame structure 50, may predetermine the view angle at which the object is to be rendered. An arcuate scale or protractor 55, Figure 7, is conveniently provided on the frame structure 50 so that the angle of said frame structure readily may be determined. A similar arcuate scale may be provided at the periphery of the stage 54 so that its rotary angular position also readily may be determined.

Immediately above the uppermost cross lines 52 is a piece of glass or the like, carried in the frame structure 50 to provide a transparent surface for supporting drawing material. If the uppermost cross lines 52 are carried directly upon a sheet of glass or the like, then that glass itself may provide the transparent drawing surface.

When the object is properly posed on the stage 54 and the machine is set for the desired angle, a sheet of transparent drawing material is placed upon the transparent drawing surface. The operator may then use a point finder such as the gun sight type finder 56 shown in Figures 2, 3 and 4, or the tubular or telescope-like point finder 57 illustrated in Figures 5 and 6, to assist in locating points on the drawing material corresponding to points on the object being drawn, or the cross-lines 52 and 53 alone may be used, particularly if they are arranged to form quite small squares.

It is manifest that by using the gun sight type finder of Figures 2, 3 and 4, and looking along the sights 58 and 59 thereof through the two planes of cross-lines 52 and 53, points may be located on the drawing material corresponding to points on the object being drawn. Thus the operator moves the point finder from place to place over the transparent drawing material to locate points representing the important features of the object being drawn, after which the points may be connected by lines.

Since the two sets of cross-lines 52 and 53 are in parallel planes and correspond with each other in spacing, the points thus located will be absolutely true and accurate with respect to the object being drawn. The use of the finder is well illustrated in Figure 4 where the sights 58 and 59 are being trained upon the corner point 60 of the object being drawn, and a pen 61 is being used to place the point in the sight-line.

The sets of cross-lines 52 and 53 may be used without the point finder of Figures 2, 3 and 4 to locate points on the drawing material if and when desired, but it is manifest that points coming in the spaces between the cross-lines can be located more accurately by the relatively movable finder 56 which has the general shape of a triangular pyramid and so constructed that the line of sight from 58 to 59 is perpendicular to the plane of the drawing surface.

Thus the cross-lines 52 and 53 cooperate with

the point finder 56 in the complete utility of the device.

As illustrated in Figures 14 and 15, the cross-lines 52 and 53 may be incorporated into removable frames which are slidable into prepared ways in the frame structure 50. By this arrangement, different sets of cross-lines may be inserted or removed. A special feature of this inventive concept is that by inserting sets of cross-lines corresponding to sets 52 and 53 but one set having larger or smaller squares than the other set, then true scale enlargements or reductions from the object being drawn may be rendered.

Instead of the gun sight type finder 56 of Figures 2, 3 and 4, the tubular or telescope-like finder 57 of Figures 5 and 6 may be used. This tubular finder 57 is provided within with two pairs of cross-hairs 62 and 63 which provide a sight-line therethrough to be used in cooperation with the cross-lines 52 and 53.

Structure 64, Figure 6, may be provided upon which to mount tubular sight 57, structure 64 having a flat bottom that is slidable over the surface of the drawing material, and also having angular adjustments whereby the angular relationship of the point finder 57 with reference to the drawing surface may be determined.

Referring next to Figures 12 and 13, a stage 65 corresponds to the stage 54 of Figures 1 and 7, but is mounted for angular movement about a a central axis 66 whereby an object to be drawn may be positioned at various angles above the horizontal. Other components of the drawing machine depicted in Figure 12 are entirely comparable to the features hereinbefore set forth in regard to Figures 1 and 2.

Figures 16, 17, 18 and 19 illustrate a drawing machine that includes the fundamental components hereinbefore set forth and, in addition, includes a slidable carriage 67 which is mounted for travel on ways 68 on the frame structure 50. This carriage 67 is provided with a slidable crosshead 69 upon which is mounted a tubular point finder 57*a* that is similar to finder 57 of Figures 5 and 6.

By thus mounting tubular sight finder 57*a*, it is manifest that it is capable of universal movement with reference to and immediately over the drawing surface carried upon the frame structure 50, which frame structure is angularly adjustable about a horizontal axis as hereinbefore set forth. This is a particularly convenient arrangement since the point finder 57*a* readily may be brought into position to locate any point on the object being drawn which is placed upon the stage 65 or any other type of stage herein set forth which may be used in combination with the other components of the machine.

As hereinbefore pointed out, the two sets of cross-lines 52 and 53 facilitate the location of points on the drawing surface and for more accurate location of points, particularly those that fall in the squares between the basic cross-lines 52 and 53, the finder 57*a* readily may be brought into use.

It is to be clearly understood that movable point finders positioned above the drawing surface may be omitted, and very rapid and reasonably accurate location of points may be done by the use of the two sets of cross-lines 52 and 53 which are incorporated in spaced-apart parallel planes in the frame structure 50.

Not only can the machines herein disclosed be used for accurately drawing objects such as machines, mechanical devices, parts thereof, geometric objects and the like, but it is manifest that a machine embodying this inventive concept and built of a suitable size, well may be used for artistic portrait work or for the drawing of persons or animals in scientific, medical or research work, as well as botanical research.

In drawing a live subject, arrangements would be made on the stage portion of the machine for holding or steadying the subject being drawn, and any desired angle from vertical to horizontal may be had by the angular adjustment of the frame structure 50 about its horizontal axis, which in turn determines the angular position of the transparent drawing surface above the cross-lines 52 upon which the transparent drawing material is placed. Whatever angle is used for such a drawing, the results of illustration will be entirely true and accurate without distortion, and the scale may be full size, an enlargement, or a reduction. Convenient lighting equipment may advantageously be arranged on the drawing machine or adjacent the stage for proper illumination of the subject.

By turning the frame structure 50 to a suitable angle, distant objects may be drawn, and if the object or scene to be drawn is remote, then telescopic lenses may be incorporated in the tubular finder 57, thus, in effect, bringing the distant subject matter within easy range of vision so that it can be drawn accurately upon the transparent drawing material, which is superimposed upon the transparent drawing surface that is carried in the frame structure 50.

Referring briefly to Figure 20, the plan view relationship of a typical machine built according to the fundamental principles of this inventive concept are well shown. The hollow frame structure 50 is positioned at a typical angle with reference to the stage 54 upon which the subject to be drawn is to be mounted. As is manifest, the vertical or view angle of the drawing is selectively determined by the angular position of the frame 50, and the horizontal angle of the subject being drawn may be selectively determined by the angular position of the rotary stage 54.

Figure 21 illustrates another stage arrangement wherein the stage 70 is angularly movable about a horizontal axis by means of handwheel 71 and suitable gearing.

Figure 22 illustrates a drawing machine that embodies the fundamental components and principles hereinbefore explained, and has additionally, means whereby the hollow frame structure 50 may be angularly adjusted about two axes of rotation which are positioned at right angles to each other.

Another special feature shown in Figure 22 is the right angular mirror assembly 72 which is placed adjacent the object 73 to be drawn. By placing the right angular mirror assembly 72 adjacent the object 73, the user may view the object 73 directly and also see side and rear views of the object 73 reflected in the mirror assembly 72 so that a plurality of views of the object 73 may be seen and drawn as indicated at 74 and 75, with one setting of the object and one setting of the drawing machine.

It is manifest that by using mirrors in selected positions, any reasonable number of views of the object on the stage can be seen and drawn at one setting with a great saving in time and a general coordination of the views, resulting in

a highly desirable and accurate rendering of the subject.

This particular phase of the present inventive concept is advantageous in teaching mechanics, mechanical drawing, solid geometry and kindred subjects. Obviously, by rotating the stage 54, various views of the object being drawn may be had, and the views reflected from the mirrors give a graphic and easily understandable representation of other sides of the subject.

Figures 23, 24 and 25 illustrate how a pantograph 76 may be incorporated into a machine built according to the fundamental principles herein disclosed. The pantograph is connected with the tubular type finder 57a by means of a swivel-like mechanism shown in Figures 24 and 25. It is manifest that as points are located through the finder, they may be drawn by means of a drawing instrument 77 on the pantograph, at the side of the finder.

This is a particularly advantageous arrangement because it removes the necessity of placing a drawing instrument in the exact sight-line, and it also eliminates the necessity of drawing upon transparent drawing material, because as points are located, they may be drawn on a piece of paper or the like at the side of the operator. Such paper or other drawing material conveniently could be placed upon the general transparent drawing surface of the machine or on a drawing board adjacent the machine.

In Figure 23, the object 78 is being directly viewed and points located through the tubular finder 57a, are being drawn as shown at 79, at the side of the finder. It will be understood that in drawing points directly in the sight-line either with or without the movable finder, a transparent drawing material is used from which prints, tracings or the like can be made. With the pantograph 76 of Figure 23, drawings can be made directly upon conventional drawing materials.

Again referring to Figures 6, 16, 17, 18 and 19, the mounting for the tubular or telescopic type finder 57 and 57a includes means for angular adjustment of the finder about two axes positioned at right angles to each other. These basic adjustments provide for accurately setting the finder perpendicularly to the plane of the drawing surface.

Another important advantage in such a mounting for the telescopic type finder is that it facilitates the conversion of an aerial photograph into a map. Some portions of almost any aerial photograph are taken at an angle other than perpendicular to the surface of the earth. Again, sometimes an entire photograph is taken at an angle other than perpendicular as, for instance, when the plane is banking on a turn, or shooting ahead of the plane or to the side thereof. When such a photograph is to be converted into a map, it is positioned on the stage of the machine and then the angle of the telescopic sight may be set to simulate the angle at which the photograph was taken with reference to the surface of the earth, thus to facilitate the drawing of the map from the photograph.

It is manifest from the foregoing disclosure that the present drawing machine is well suited for rendering almost any object in Air-Vu or axonometric projection at an almost infinite number of angles of the object being drawn with reference to the drawing surface. As above pointed out, it is possible to arrange this drawing machine and the object being drawn so that a vertical top plan view is seen and drawn, on the other hand, by adjusting the drawing surface and the stage upon which the object is supported to the other extreme, a front elevation may be drawn. Between these two extremes of top plan and front elevation lies the field of axonometric projection, which eliminates all converging lines such as are used in perspective drawings, and permits the rendering of such drawings in accurate predetermined scales. Thus, drawings produced on this machine can be made free from distorted appearance that is usually associated with the converging lines of common perspective.

When the object being drawn is positioned at an angle with reference to the drawing surface either by setting the stage at an angle of inclination or by setting the drawing surface carried in the frame structure 50 at an angle, or both, then it is manifest that the edges of the object being drawn are inclined with reference to the drawing surface and are thereby foreshortened.

In Figure 12, arcuate scales 55 and 55a are illustrated whereby an operator can predetermine and know the angular relationship between the object being drawn and the drawing surface, i. e., between the surface of the stage and the sheet of drawing material. With this angular relationship known, then the percentage of foreshortening of any line can be calculated according to a predetermined mathematical table.

A typical example of the percentage of foreshortening of the various lines on a cube, for instance, is well illustrated in Figures 27 and 28. This example is based upon the vertical angle of 48° 35′ 30″ between the drawing surface and the stage surface as illustrated in Figure 27. As a result of such angular relationship, the various edges of the cube shown in Figure 8, placed upon the stage, will have the percentage of foreshortening indicated.

Referring briefly to Figure 26, this illustrates one form of stage upon which an object to be drawn may be placed, which stage is intended to be combined as a relatively stationary part or slidably incorporated into any of the drawing machines herein illustrated. On the upper surface of the stage are positioned 90° crossed guide lines and 45° crossed guide lines, or other positioned lines, which serve the useful purpose of facilitating the placement of an object to be drawn at a predetermined angle with reference to the drawing surface carried in frame 50.

Figure 29 illustrates a further refinement wherein a marker such as a fountain pen 80, is mounted upon a slidable and rotatable shaft 81, which in turn is carried upon the tubular or telescopic type finder 57a by means of a bracket 82. The shaft 81 is urged upwardly by means of a compression spring 83, which upward movement may be selectively limited by the position of collar 84 on the shaft 81. Another and knurled collar 85 is carried upon the shaft 81 and provides an upper abutment for the spring 83. The marker or pen 80 is radially adjustable with reference to the shaft 81 so that when said shaft is rotated, the pen 80 will come into the axis of sight established by the cross-hairs in the point finder.

It is manifest that by depressing the shaft 81 with the forefinger and grasping the knurled collar 85 between the thumb and the second finger, the pen or other marker 80 may be depressed and rotated to establish a point on the drawing surface exactly in the axis of sight or sight-line, thus eliminating the human factor of possible

error in locating such a point by means of an extraneous pen such as 61, Figure 4.

In order to provide a limit of angular movement or rotation of the shaft 81 and therefore the pen 80, a stop 86 may be provided which will automatically insure the angular positioning of the pen 80 in the sight-line or axis of sight, through the point finder.

It is manifest that normally the pen 80 is held up off the drawing surface and out of contact therewith, and rotated to the dotted line position of Figure 29 out of the axis of sight. However, under some circumstances, it may be desirable to hold the pen 80 down in contact with the drawing surface while the entire finder assembly 57a is moved about, in order to draw a continuous line or lines upon the drawing material. When this is desired, a set screw 87 in bracket 82 may be tightened to hold the shaft 81 and the pen 80 down so that the pen is in marking contact with the drawing surface.

For continuous marking, it is desirable to hold the pen 80 down onto the drawing surface at an angular or offset position out of the axis of sight or sight-line, to the side thereof so as not to interfere with the sight-line. Such an offset rendering would be exactly true to the subject being drawn.

The arrangement illustrated in Figure 29 speeds up the use of machines made according to this invention and greatly reduces the liability of error and thereby increases the accuracy and dependability of drawings produced with the aid of these machines.

The marker 80 may be a fountain pen, pencil or any other suitable marking instrument.

While it is preferred to mount the pen 80 on the telescopic type finder 57a, obviously, a similar mounting could be arranged for the pen 80 on the gun sight type finder such as 56, Figures 2, 3 and 4, or the tubular type finder 57, Figures 5 and 6, either with or without a base structure that is slidable over the drawing surface and bears directly thereon.

Figure 30 illustrates the components 81 to 87 inclusive, mounted upon a point finder 90 that is provided with feet 91 each of which has an adjusting screw 92 so that the entire finder assembly can be moved about upon the drawing surface and can be "leveled" or placed in perpendicular relationship to said drawing surface.

Figure 31 illustrates a stage 93 that is provided with right-angle guide lines 94 to facilitate the location of objects thereon that are to be drawn. A movable angular "prop" 95 is shown on the stage 93, which is for the purpose of helping to convert ordinary maps or plans into three dimensional isometric views.

What I claim is:

1. A drawing machine comprising a frame structure mounted for angular movement, two sets of cross-lines carried in the frame structure in parallel spaced planes, and a transparent drawing surface carried on said frame over the cross-lines in a plane parallel thereto and adjacent one set thereof.

2. A drawing machine comprising a supporting structure, a frame structure mounted for angular movement thereon, two sets of cross-lines carried on the frame structure in parallel spaced planes, a transparent drawing surface on said frame over the cross-lines and parallel thereto, and a stage slidably positioned on the supporting structure under the cross-lines for supporting an object to be viewed therethrough.

3. A drawing machine comprising a supporting structure, a frame structure mounted for angular movement thereon, two sets of cross-lines carried on the frame structure in parallel spaced planes, a transparent drawing surface on said frame over the cross-lines and parallel thereto, and a stage on the supporting structure, mounted for angular movement with reference thereto positioned under the cross-lines for the support of an object to be viewed therethrough.

4. A drawing machine comprising a supporting structure, a frame structure mounted for angular movement thereon, two sets of cross-lines carried on the frame structure in parallel spaced planes, a transparent drawing surface on said frame over the cross-lines and parallel thereto, and a rotary stage on the supporting structure positioned under the cross-lines for the support of an object to be viewed therethrough.

5. A drawing machine comprising a supporting structure, a frame structure mounted for angular movement thereon, two sets of cross-lines carried on the frame structure in parallel spaced planes, a transparent drawing surface on the frame over the cross-lines in a plane parallel thereto and adjacent one set thereof, a stage on the supporting structure under the cross-lines for support of an object to be viewed therethrough, a compound carriage mounted on said frame for universal movement over and adjacent said surface, and a point finder mounted on the carriage for conjoint movement therewith in fixed spaced and angular relationship to said surface.

6. A machine for making isometric reproductions of three-dimensional objects or the like, comprising a platform for the support of an object to be delineated, a transparent support positioned in overhanging relation to said platform, two sets of light-permeable cross lines disposed in the area between the platform and the transparent support in spaced parallel relation, delineating means mounted for two-dimensional movement on the transparent support into aligning relation with corresponding intersections of the respective sets and a point on the object to be reproduced, and a reproduction medium positioned and arranged to receive an impression from the delineating means coincident with each aligning adjustment of said delineating means.

7. A machine for making isometric reproductions of three-dimensional objects or the like, comprising a platform for the support of an object to be delineated, a transparent support positioned in overhanging relation to said platform, two sets of similarly-spaced light-permeable cross lines disposed in the area between the platform and the transparent support in spaced parallel relation, delineating means mounted for two-dimensional movement on the transparent support into aligning relation with corresponding intersections of the respective sets and a point on the object to be reproduced, and a reproduction medium positioned and arranged to receive an impression from the delineating means coincident with each aligning adjustment of said delineating means.

8. A machine for making isometric reproductions of three-dimensional objects or the like, comprising a platform for the support of an object to be delineated, a transparent support positioned in overhanging relation to said platform, two sets of differentially-spaced light-permeable cross lines disposed in the area between the platform and the transparent support in spaced

parallel relation, delineating means mounted for two-dimensional movement on the transparent support into aligning relation with corresponding intersections of the respective sets and a point on the object to be reproduced, and a reproduction medium positioned and arranged to receive an impression from the delineating means coincident with each aligning adjustment of said delineating means.

9. A machine for making isometric reproductions of three-dimensional objects or the like, comprising a platform for the support of an object to be delineated, a transparent support positioned in overhanging relation to said platform, two sets of light-permeable cross lines disposed in the area between the platform and the transparent support in spaced parallel relation, indicia for the identification of individual lines of each set, delineating means mounted for two-dimensional movement on the transparent support into aligning relation with corresponding intersections of the respective sets and a point on the object to be reproduced, and a reproduction medium positioned and arranged to receive an impression from the delineating means coincident with each aligning adjustment of said delineating means.

10. A machine for making isometric reproductions of three-dimensional objects or the like, comprising a platform for the support of an object to be delineated, a transparent support positioned in overhanging relation to said platform, two sets of light-permeable cross lines disposed in the area between the platform and the transparent support in spaced parallel relation, delineating means, inclusive of a point finder, mounted for two-dimensional movement on the transparent support into aligning relation with corresponding intersections of the respective sets and a point on the object to be reproduced, and a reproduction medium positioned and arranged to receive an impression from the delineating means coincident with each aligning adjustment of said delineating means.

11. A machine for making isometric reproductions of three-dimensional objects or the like, comprising a platform for the support of an object to be delineated, a transparent support positioned in overhanging relation to said platform, two sets of light-permeable cross lines disposed in the area between the platform and the transparent support in spaced parallel relation, delineating means, inclusive of a point finder of the gun-sight type, mounted for two-dimensional movement on the transparent support into aligning relation with corresponding intersections of the respective sets and a point on the object to be reproduced, and a reproduction medium positioned and arranged to receive an impression from the delineating means coincident with each aligning adjustment of said delineating means.

12. A machine for making isometric reproductions of three-dimensional objects or the like, comprising a platform for the support of an object to be delineated, a transparent support positioned in overhanging relation to said platform, two sets of light-permeable cross lines disposed in the area between the platform and the transparent support in spaced parallel relation, delineating means, inclusive of a telescopic point finder, mounted for two-dimensional movement on the transparent support into aligning relation with corresponding intersections of the respective sets and a point on the object to be reproduced, and a reproduction medium positioned and arranged to receive an impression from the delineating means coincident with each aligning adjustment of said delineating means.

13. A machine for making isometric reproductions of three-dimensional objects or the like, comprising a platform for the support of an object to be delineated, a transparent support positioned in overhanging relation to said platform, two sets of light-permeable cross lines disposed in the area between the platform and the transparent support in spaced parallel relation, delineating means including a point finder mounted for universal movement on the transparent support into aligning relation with corresponding intersections of the respective sets and a point on the object to be reproduced and a point marker carried by the point finder for coextensive universal movement therewith, and a reproduction medium positioned and arranged to receive an impression from the point marker coincident with each aligning adjustment of the point finder.

14. A machine for making isometric reproductions of three-dimensional objects or the like, comprising a platform for the support of an object to be delineated, a mirror background for said object, a transparent support positioned in overhanging relation to said platform, two sets of light-permeable cross lines disposed in the area between the platform and the transparent support in spaced parallel relation, delineating means mounted for universal movement on the transparent support into aligning relation with corresponding intersections of the respective sets and a point on the object to be reproduced or its reflected image, and a reproduction medium positioned and arranged to receive an impression from the point marker coincident with each aligning adjustment of the point finder.

15. A machine for making isometric reproductions of three-dimensional objects or the like, comprising a platform for the support of an object to be delineated, a plurality of mirrors disposed in different angular positions about said object to provide a background therefor, a transparent support positioned in overhanging relation to said platform, two sets of light permeable cross lines disposed in the area between the platform and the transparent support in spaced parallel relation, delineating means mounted for universal movement on the transparent support into aligning relation with corresponding intersections of the respective sets and a point on the object to be reproduced or its reflected image, and a reproduction medium positioned and arranged to receive an impression from the point marker coincident with each aligning adjustment of the point finder.

16. A machine for making isometric reproductions of three-dimensional objects or the like, comprising a tiltable platform for the support of an object to be delineated, means for holding said platform in selective angular positions, a transparent support positioned in overhanging relation to said platform, two sets of light-permeable cross lines disposed between the platform and the transparent support in spaced parallel relation, delineating means mounted for universal movement on the transparent support into aligning relation with corresponding intersections of the respective sets and a point on the object to be delineated, and a reproduction medium positioned and arranged to receive an impression from the delineating means coincident

with each aligning adjustment of said delineating means.

17. A machine for making isometric reproductions of three-dimensional objects or the like, comprising a platform for the support of an object to be delineated, a transparent support positioned in overhanging relation to said platform and movable from a substantially upright position to a substantially horizontal position, means for holding said support in selective angular positions, two sets of light-permeable cross lines disposed in parallel relation between the platform and the transparent support and parallel to said support, delineating means mounted for universal movement on the transparent support into aligning relation with corresponding intersections of the respective sets and a point on the object to be delineated, and a reproduction medium positioned and arranged to receive an impression from the delineating means coincident with each aligning adjustment of said delineating means.

18. A machine for making isometric reproductions of three-dimensional objects or the like, comprising a platform for the support of an object to be delineated, a light-permeable support positioned in overhanging relation to said platform, two sets of light-permeable cross lines disposed in the area between the platform and the light-permeable support in spaced parallel relation, delineating means comprising a compound carriage mounted for universal movement on the support, a point finder mounted for conjoint movement with the carriage, an arm mounted on the carriage for coextensive movement with the point finder, and a marking device fixed on said arm, and a reproduction medium positioned and arranged to receive an impression from the marking device coincident with each aligning adjustment of the point finder.

19. A machine for making isometric reproductions of three-dimensional objects or the like, comprising a platform for the support of an object to be delineated, a light-permeable support positioned in overhanging relation to said platform, two sets of light-permeable cross lines disposed in the area between the platform and the light-permeable support in spaced parallel relation, delineating means comprising a compound carriage mounted for universal movement on the support, a point finder mounted for conjoint movement with the carriage, an arm mounted on the carriage for coextensive movement with the point finder and a marking device mounted on said arm for movement in synchronism with the point finder, and a reproduction medium positioned and arranged to receive an impression from the marking device coincident with each aligning adjustment of the point finder.

20. A machine for making isometric reproductions of three-dimensional objects or the like, comprising a platform for the support of an object to be delineated, a light-permeable support positioned in overhanging relation to said platform, delineating means, inclusive of a point finder comprising a tube having at least one set of cross hairs intersecting on its lengthwise axis, said point finder being mounted for universal movement on the support into aligning relation between the cross hairs of the tube and a point on the object to be reproduced, and a reproduction medium positioned and arranged to receive an impression from the delineating means coincident with each aligning adjustment of the point finder.

21. A machine for making isometric reproductions of three-dimensional objects or the like, comprising a platform for the support of an object to be delineated, a light-permeable support positioned in overhanging relation to said platform, two sets of light-permeable cross lines disposed in the area between the platform and the support in spaced parallel relation, delineating means mounted for universal movement on the support into aligning relation with corresponding intersections of the respective sets and a succession of points on the object to be reproduced, and a reproduction medium positioned and arranged to receive an impression from the delineating means coincident with each aligning adjustment along the succession of points to thereby delineate the object as though viewed from infinity.

22. A machine for making isometric reproductions of three-dimensional objects or the like, comprising a platform for the support of an object to be delineated, a light-permeable support positioned in overhanging relation to said platform, delineating means, inclusive of a point finder comprising a tube having two sets of cross hairs intersecting at intervals on its lengthwise axis, said point finder being mounted for universal movement on the support into aligning relation between the cross hairs of the tube and a point on the object to be reproduced, and a reproduction medium positioned and arranged to receive an impression from the delineating means coincident with each aligning adjustment of the point finder.

DANIEL J. McQUAID, SR.