Oct. 18, 1966 D. J. McQUAID, SR 3,279,074

ISOMETRIC DRAFTING INSTRUMENTS

Filed Nov. 29, 1963 6 Sheets-Sheet 1

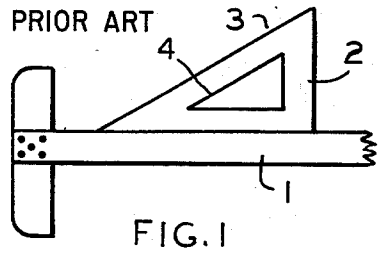


FIG. 1

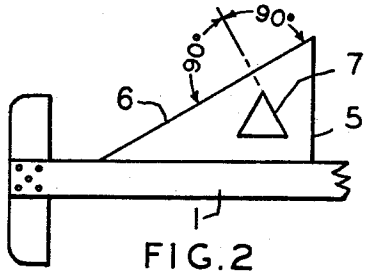


FIG. 2

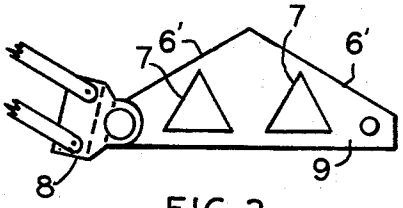


FIG. 3

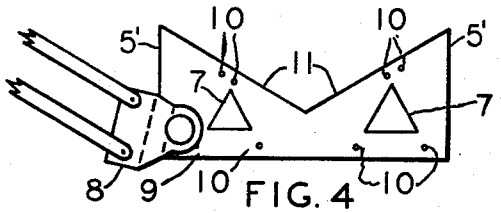


FIG. 4

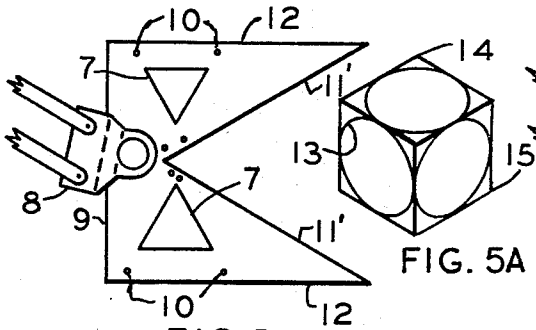


FIG. 5

FIG. 5A

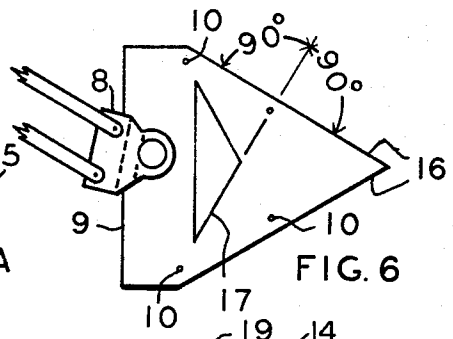


FIG. 6

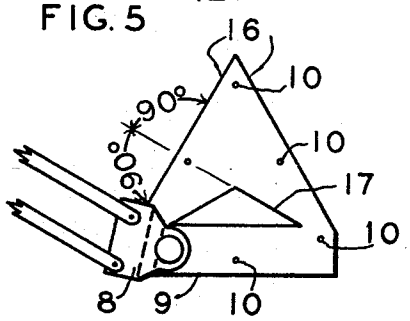


FIG. 7

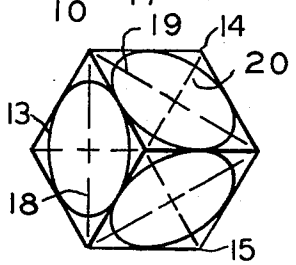


FIG. 8

WITNESS

Lloyd Allen Tetzpon

Richard E. Miller

INVENTOR.

DANIEL J. McQUAID SR.

BY Daniel J. McQuaid Sr.

Oct. 18, 1966 D. J. McQUAID, SR 3,279,074

ISOMETRIC DRAFTING INSTRUMENTS

Filed Nov. 29, 1963 6 Sheets-Sheet 2

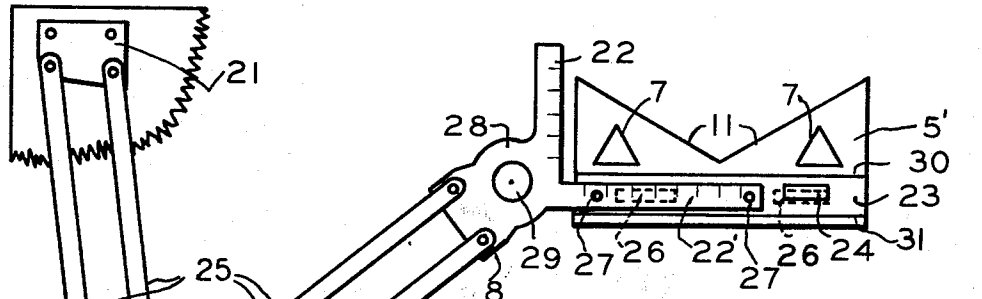


FIG. 9

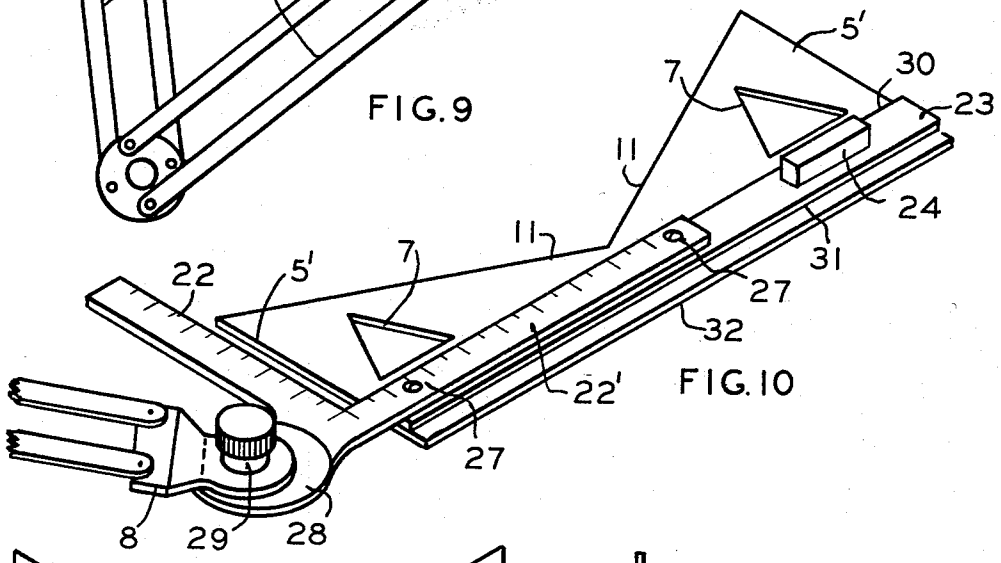


FIG. 10

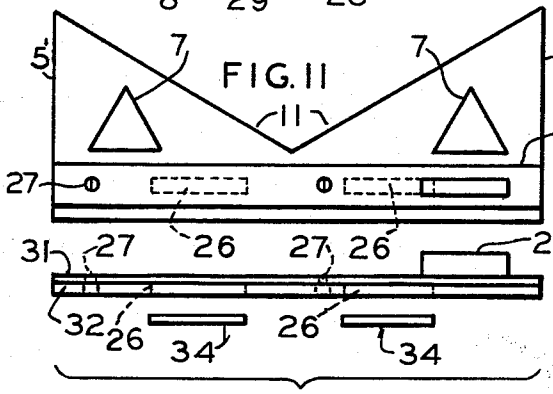


FIG. 11

FIG. 12

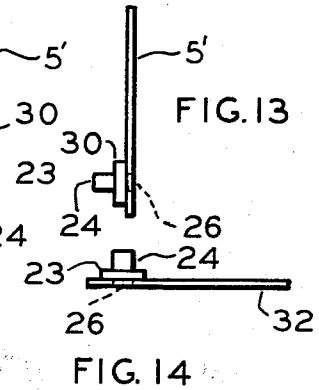


FIG. 13

FIG. 14

WITNESS
Floyd Allen Tetzner
Richard E. Miller

INVENTOR.
DANIEL J. McQUAID SR.
BY Daniel J. McQuaid Sr.

Oct. 18, 1966 D. J. McQUAID, SR 3,279,074

ISOMETRIC DRAFTING INSTRUMENTS

Filed Nov. 29, 1963 6 Sheets-Sheet 3

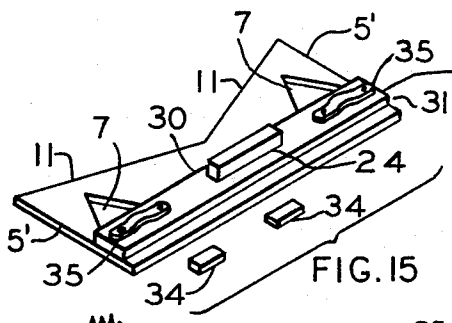


FIG. 15

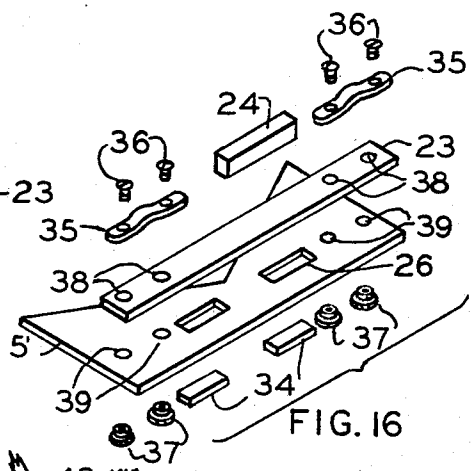


FIG. 16

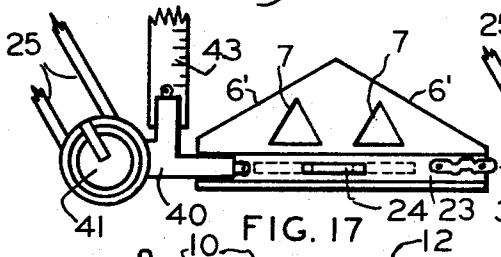


FIG. 17

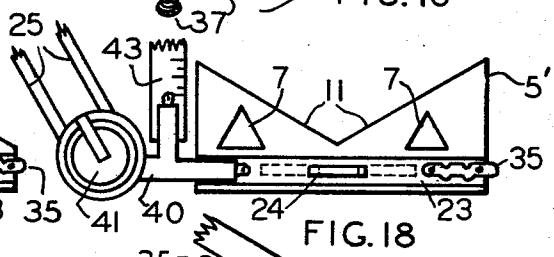


FIG. 18

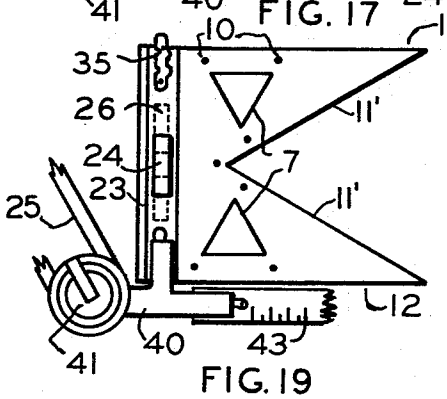


FIG. 19

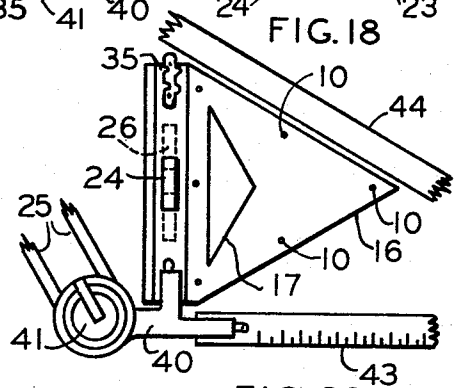


FIG. 20

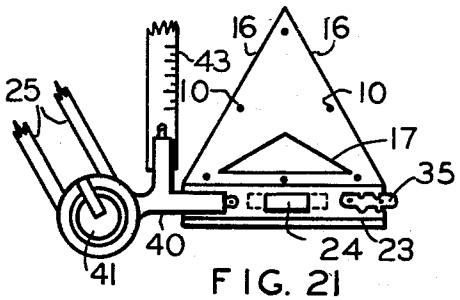


FIG. 21

WITNESS

Lloyd Allen Tetzpon

Richard E. Miller

INVENTOR.

DANIEL J. McQUAID SR.

BY Daniel J. McQuaid Sr

Oct. 18, 1966 D. J. McQUAID, SR 3,279,074

ISOMETRIC DRAFTING INSTRUMENTS

Filed Nov. 29, 1963 6 Sheets-Sheet 4

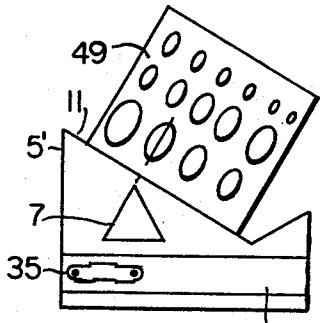


FIG. 22

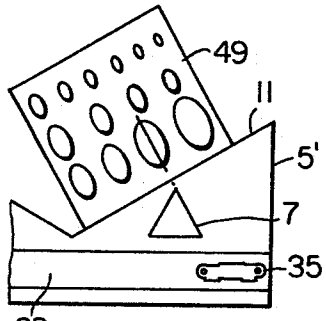


FIG. 23

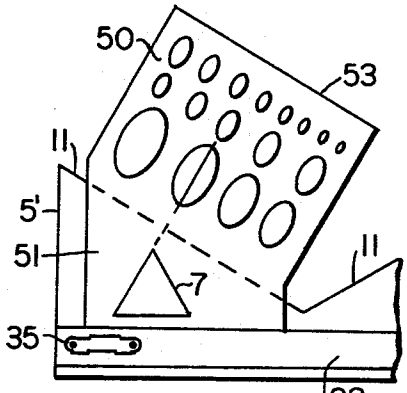


FIG. 24

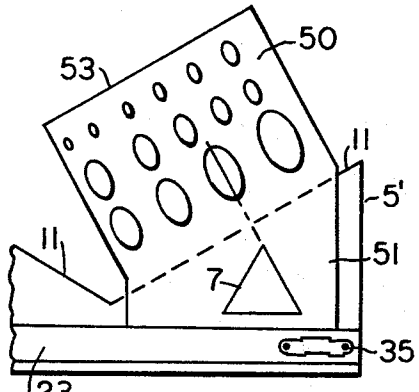


FIG. 25

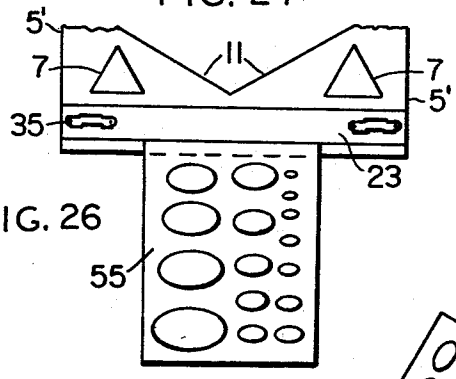


FIG. 26

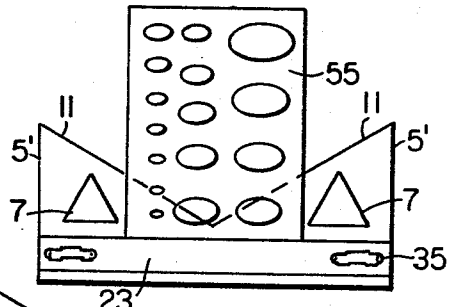


FIG. 27

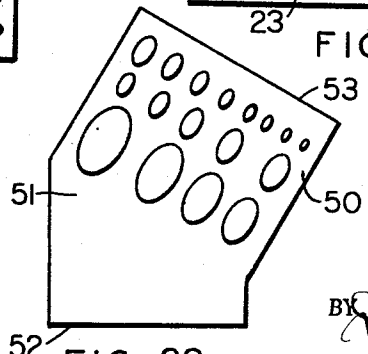


FIG. 28

WITNESS
Floyd Allen Tatpon
Richard E. Miller

INVENTOR.
DANIEL J. McQUAID SR.
BY Daniel J. McQuaid Sr

Oct. 18, 1966 D. J. McQUAID, SR 3,279,074

ISOMETRIC DRAFTING INSTRUMENTS

Filed Nov. 29, 1963 6 Sheets-Sheet 5

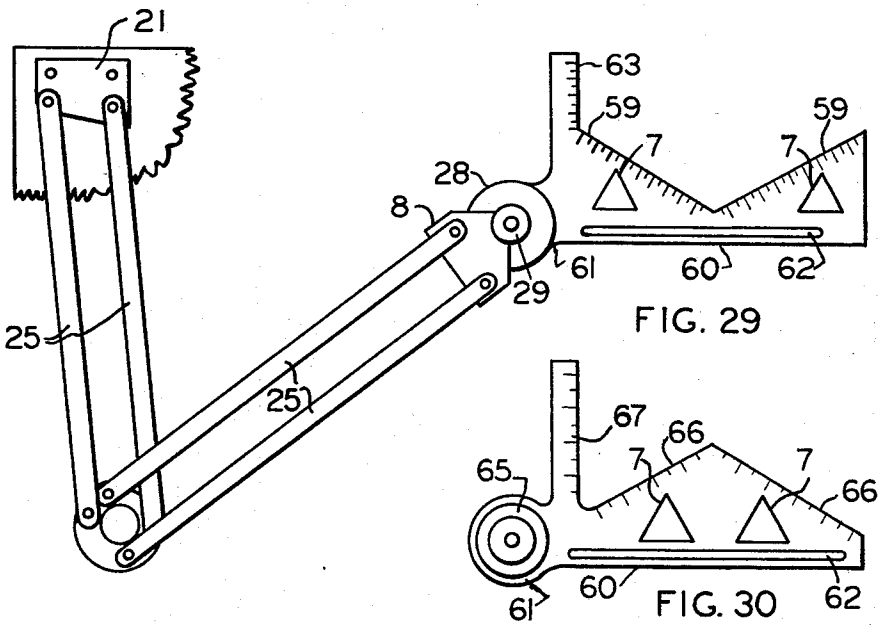


FIG. 29

FIG. 30

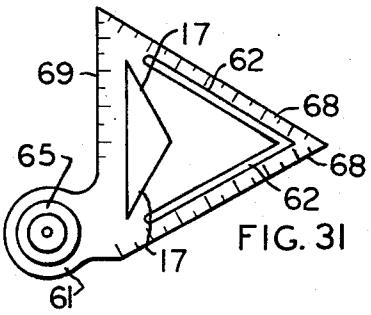


FIG. 31

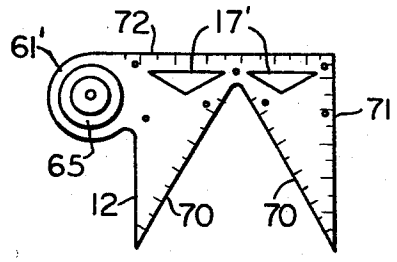


FIG. 33

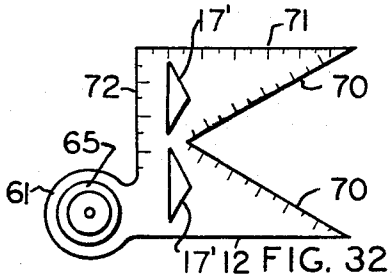


FIG. 32

WITNESS
Floyd Allen Tatpon
Richard E. Miller

INVENTOR.
DANIEL J. McQUAID SR.
BY Daniel J. McQuaid SR.

Oct. 18, 1966 D. J. McQUAID, SR 3,279,074

ISOMETRIC DRAFTING INSTRUMENTS

Filed Nov. 29, 1963 6 Sheets-Sheet 6

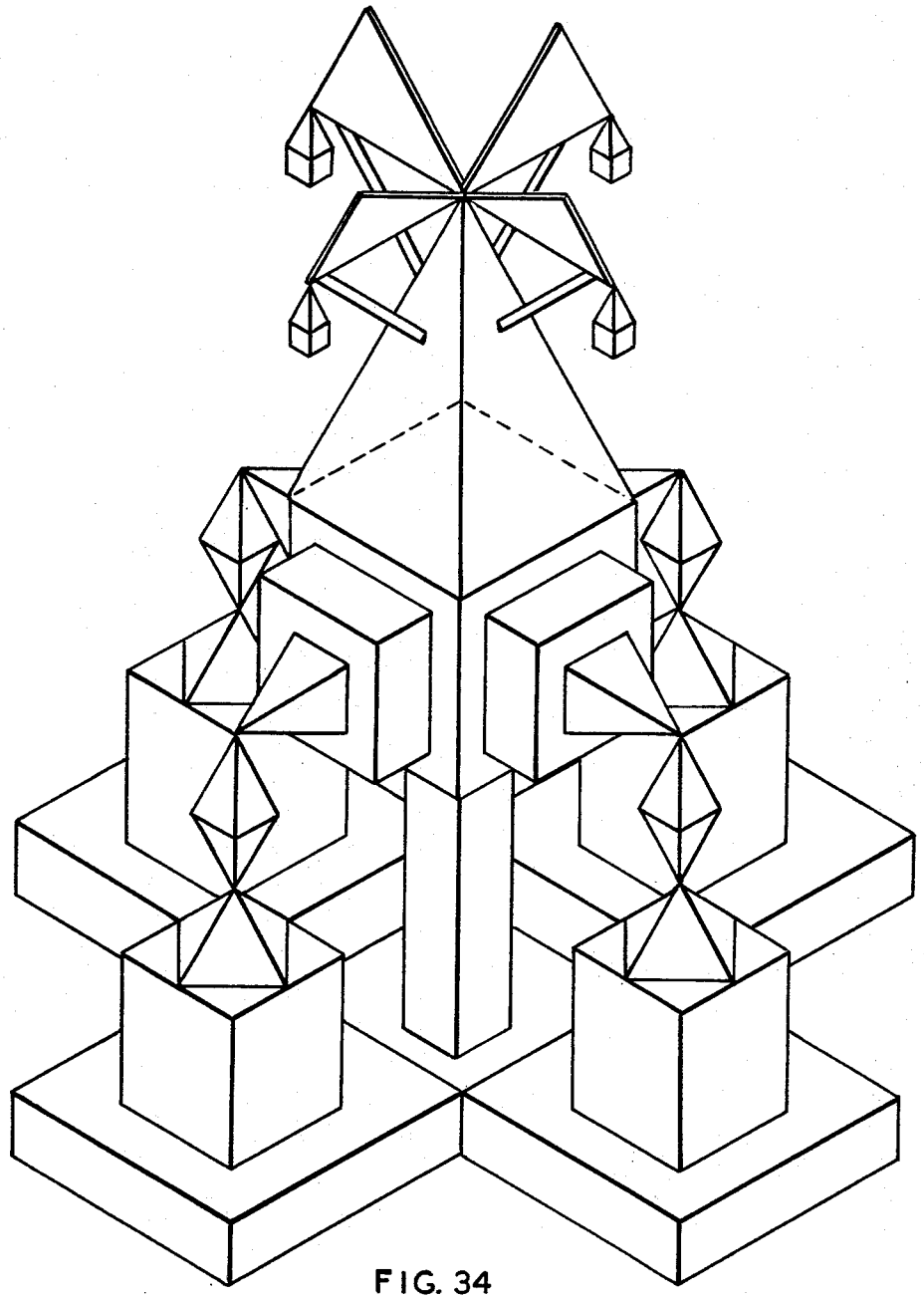


FIG. 34

WITNESS
Lloyd Allen Tetzon
Richard E. Miller

INVENTOR.
DANIEL J. McQUAID SR.
BY Daniel J. McQuaid Sr.

United States Patent Office 3,279,074
Patented Oct. 18, 1966

3,279,074

ISOMETRIC DRAFTING INSTRUMENTS

Daniel Joseph McQuaid, Sr., 530 Kalamath, Denver, Colo.

Filed Nov. 29, 1963, Ser. No. 326,788
12 Claims. (Cl. 33—104)

This invention relates to drafting or drawing instruments, and more particularly to drafting instruments which are particularly useful in making isometric drawings.

An isometric drawing is a representation of an object, theoretically enclosed within a cube whose axes are inclined at the same angle to the picture plane and each point of which is projected onto the picture plane by a projection line which extends perpendicularly to the picture plane. Such a representation, using such projection lines, is actually a projection, i.e. the distance along each of the axes is foreshortened, but since the scale for each axis is the same, hence the term "isometric," meaning one scale, the scale can be increased, so that each dimension along any axis of the cube can be made equal to the actual dimension of the object, so that the result is a drawing, rather than a true projection. In both an isometric projection and an isometric drawing, the axes of the cube are spaced 120° apart, so that one axis of the cube normally extends at 90° to a horizontal line and the other two axes at 30° upwardly from a horizontal line, but in opposite directions. The concept of isometric projections and drawings is generally credited to Professor William Farish, of the University of Cambridge, England, who prepared and read a paper relating to the same on February 21 and March 6, 1820, before the Cambridge Philosophical Society. Of the three existing copies of this paper, one is available at the Library of the University of Illinois, Urbana, Illinois.

Notwithstanding the fact that isometric drawing has been known since 1820, the only drafting instruments heretofore commonly available have been the conventional 30–60 triangle, used in association with a T square. The conventional 30–60 triangle has angles of 30°, 60° and 90° at the corners, with the hypotenuse edge thus extending at an angle of 30° to the longer opposite edge and the other two edges being at 90° to each other. Such a conventional 30–60 triangle is provided with a cutout or aperture, used primarily for shifting the triangle or for picking it up, whose inside edges are each parallel to the adjacent outer edge of the triangle. In making isometric drawings, one of the perpendicular edges of the 30–60 triangle is used to make lines corresponding to the vertical axis of the cube, or lines parallel thereto, while the triangle is turned in one direction and placed on the T square in making lines corresponding to one of the inclined axes of the cube or lines parallel thereto, with the triangle being turned over, placed against the T square and the hypotenuse edge used in making lines corresponding to, or parallel to, the other inclined axis of the cube. However, there is no edge, either interior or exterior, of the conventional 30–60 triangle which can be used in making lines representing an axis of an ellipse, either major or minor, which causes the making of isometric drawings with a T square and a conventional 30–60 triangle not only laborious and clumsy, but also time consuming and therefore uneconomical. Also, considerable practical experience, including observation and visualization, is necessary to determine which way to turn the conventional 30–60 triangle, so that it will be in proper position to draw a desired line in an isometric drawing, and this becomes confusing and distracting, when the draftsman is attempting to concentrate on the object being drawn at the same time.

Isometric drawings are used, in many instances, as illustrations or visual aids and also for industrial and commercial illustration purposes. An isometric drawing to scale is particularly valuable, since it enables the parts of an object to be scaled directly on the isometric drawing. Isometric drawings are also quite valuable in piping diagrams, as for plumbing or heating and ventilating purposes, as well as conveying the appearance of an object in three dimensions, through a drawing which may also be used to scale the dimensions of the object, which is not true of perspective drawings.

Among the objects of this invention are to provide a novel drafting instrument which is particularly adapted for use in making isometric drawings; to provide such an instrument which is particularly adapted to be utilized in drawing the principal axes of an isometric cube and also the major and minor axes of an ellipse representing a circle inscribed in any face of the cube; to provide such a drafting instrument which may exist in several different foms; to provide such drafting instruments which may be attached to a conventional parallel arm drafting machine; to provide such drafting instruments which may be modified to include scales for measuring directly the length of a line of the drawing; to provide such drafting instruments which are also adapted to be utilized in teaching isometric drawing; and to provide such drafting instruments which are simple in construction but effective and efficient in use.

The foregoing and additional objects of this invention will become apparent from the description which follows, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a top plan view of a conventional 30°–60° triangle placed against a conventional draftsman's T square in making orthographic drawings in the manner of the prior art;

FIG. 2 is a top plan view of a 30°–60° triangle of this invention placed against a draftsman's T square for making isometric drawings in accordance with this invention;

FIG. 3 is a top plan view of a double end or combination drafting instrument of this invention attached to a conventional drafting machine, with the latter shown fragmentarily;

FIG. 4 is a top plan view of a double end, inverted drafting instrument of this invention, similarly attached to a drafting machine;

FIG. 5 is a top plan view of a double end, inverted V-shaped drafting instrument of this invention similarly attached to a drafting machine;

FIG. 5A is an isometric view of a cube having an ellipse inscribed in each of the visible faces, which is particularly adapted to be drawn by the drafting instruments of this invention;

FIG. 6 is a top plan view of a single end, V-shaped drafting instrument of this invention, with its base attached to a drafting machine;

FIG. 7 is a top plan view of the drafting instrument of FIG. 6, with one side attached to the drafting machine;

FIG. 8 is an oblique isometric drawing of a cube having an ellipse inscribed in each visible face, with construction lines indicating the manner in which the ellipses are drawn through use of the drafting instruments of this invention;

FIG. 9 is a top plan view of the drafting instrument of FIG. 4 removably attached to another conventional type of drafting machine, with the drawing board shown fragmentarily for clarity of illustration;

FIG. 10 is an isometric view of the drafting instrument of this invention and a portion of the drafting machine of FIG. 9;

FIG. 11 is a top plan view, on an enlarged scale, of the drafting instrument of this invention of FIG. 9;

FIG. 12 is an exploded, bottom view of the drafting instrument of FIG. 11;

FIG. 13 is a side elevation of the drafting instrument of FIG. 11;

FIG. 14 is a side elevation of the drafting instrument as shown in FIG. 12;

FIG. 15 is a partially exploded isometric view of a molded drafting instrument of this invention, particularly adapted for use in making heating and ventilating drawings or diagrams;

FIG. 16 is a further exploded, isometric view of a laminated drafting instrument, otherwise similar to that of FIG. 15;

FIG. 17 is a top plan view of the drafting instrument of FIG. 3 modified for attachment to a drafting machine having a vertical scale blade;

FIG. 18 is a top plan view of the drafting instrument of FIG. 4, modified for attachment to the drafting machine of FIG. 17;

FIG. 19 is a top plan view of the drafting instrument of FIG. 5, modified for attachment to the drafting machine of FIG. 17;

FIG. 20 is a top plan view of the drafting instrument of FIGS. 6 and 7, modified for attachment to the drafting machine of FIG. 17;

FIG. 21 is a top plan view of the drafting instrument and machine of FIG. 20, shifted to a different position;

FIG. 22 is a fragmentary, top plan view of the drafting instrument of FIG. 15 and an ellipse template placed against one of the hypotenuse edges;

FIG. 23 is a fragmentary, top plan view, showing an ellipse template placed against the opposite hypotenuse edge shown in FIG. 22;

FIG. 24 is a fragmentary, top plan view of the drafting instrument of FIG. 15 and a special ellipse template whose base is placed against a straight edge thereof;

FIG. 25 is similar to FIG. 24, but showing the special ellipse template reversed in position and overlying the opposite hypotenuse edge;

FIG. 26 is a fragmentary, top plan view of the drafting instrument of FIG. 15 and an ellipse template placed against the underside of a straight edge thereof;

FIG. 27 is a top plan view of the drafting instrument of FIG. 15 and an ellipse template placed on the upper straight edge thereof;

FIG. 28 is a top plan view of the special ellipse template of FIGS. 24 and 25;

FIG. 29 is a top plan view of a drafting instrument similar to that of FIG. 4, modified for attachment to the drafting machine having an angular adjustment and also having an integral vertical scale and hypotenuse scales;

FIG. 30 is a top plan view of the drafting instrument of FIG. 3, modified in a manner similar to that shown in FIG. 29;

FIG. 31 is a top plan view of a drafting instrument similar to that of FIG. 6 and provided with vertical and hypotenuse scales, as well as for attachment to the drafting machine of FIG. 29;

FIG. 32 is a top plan view of a drafting instrument similar to that of FIG. 5 but modified to have various scales and for machine attachment, as well as having the cutouts or apertures similar to the cutout of FIG. 31, the instrument being shown in a position particularly adapted to produce an isometric cube, as in FIG. 5A, or drawings requiring the same type of lines;

FIG. 33 is a top plan view of the drafting instrument of FIG. 32, shown in a position particularly adapted to produce an oblique isometric cube, as in FIG. 8, or drawings requiring the same type of lines; and

FIG. 34 is an isometric drawing of a hypothetical object, illustrating the type of lines and configurations which can be drawn with a drafting instrument of this invention.

Referring to the drawings, FIG. 1 shows the prior art conventional 30–60 triangle having a base placed against a T square **1** and provided with a shorter edge **2**, which

is perpendicular to the base, and a hypotenuse edge **3** which extends at 30° to the base. This triangle is provided with a cutout or aperture **4** whose edges are parallel to the adjacent outer edges of the triangle and are therefore useless for drawing any line, except a line parallel to one of the outer edges, the outer edges, of course, being more convenient for drawing a line. As will be evident, the edge **2** of the prior art triangle shown in FIG. 1 may be used to draw a vertical line, while the hypotenuse edge **3**, in the position shown, may be used to draw one of the inclined axes of an isometric cube, extending from the lower left to the upper right. When the triangle of FIG. 1 is turned over, from right to left, the hypotenuse edge **3** may be used to draw the opposite inclined edge of the axis of an isometric cube or lines parallel thereto. However, for reasons pointed out above, the conventional 30–60 triangle is otherwise essentially useless for any other purpose in making isometric drawings.

A drafting instrument constructed in accordance with this invention is illustrated in FIG. 2, in association with a T square **1**, and comprises a triangle having a base edge which is placed against the T square, as shown, as well as a vertical edge **5** and a hypotenuse edge **6**, the exterior of this triangle thus being similar to the exterior of the conventional 30–60 triangle of FIG. 1. However, the cutout or aperture **7** has edges which form an equilateral triangle, with one of the edges being perpendicular to the hypotenuse edge **6**, as indicated by the construction line shown, which is disposed at 90° to the hypotenuse edge. The triangle of FIG. 2 is particularly useful in drawing the isometric cube of FIG. 5A, as will be explained hereinafter, as well as the axes of ellipses representing circles inscribed in a face of the cube.

Another drafting instrument of this invention, shown in FIG. 3, comprises a flat, planar member having a base edge **9** and a pair of oppositely disposed hypotenuse edges **6'**, each of which extends at 30° to the base edge **9**, but converge to form an obtuse point, as shown, at their intersection. The drafting instrument of FIG. 3 is conveniently attached to a bracket **8** of a parallel arm drafting machine, so that it may be moved to any desired number of parallel positions on the drafting board, thereby eliminating the T square **1** of FIG. 2. The drafting instrument of FIG. 3 is also provided with a pair of cutouts or apertures **7**, the inner edges of each of which form an equilateral triangle with one of the edges of the equilateral triangle being perpendicular to the adjacent hypotenuse edge **6'**. This drafting instrument is also adapted to be utilized in making an isometric drawing, such as the isometric cube shown in FIG. 5A, as will be explained hereinafter.

The drafting instrument of FIG. 4 is also attached to a bracket **8** of a flexible arm drafting machine, with its base edge **9** in horizontal position and side edges **5'** vertical. Small holes **10** are placed in line with the inside edges of the equilateral triangles of the cutouts or apertures **7**, one edge of each of which is perpendicular to an adjacent hypotenuse edge **11**. As before, each hypotenuse edge **11** extends at 30° to the base edge **9**, but the hypotenuse edges **11** converge toward each other and form a V-shaped valley therebetween, as shown.

The drafting instrument of FIG. 5 is also attached to a bracket **8** of a parallel arm drafting machine, but with the base edge **9** vertical and the hypotenuse edges **11'** opposite base edge **9** and converging together at an acute angle. It will be noted that hypotenuse edges **11'** of FIG. 5 are parallel to the hypotenuse edges **11** of FIG. 4, but since the base edge **9** of the former is perpendicular to the base edge **9** of the latter, the included angle between the hypotenuse edges **11'** of FIG. 5 is 60°, rather than 120°, as in FIG. 4, between edges **11**.

Each of the drafting instruments of FIGS. 2–5 is particularly adapted to be utilized in drawing the isometric cube of FIG. 5A, including the major and minor axes of ellipses **13** inscribed in the faces of the cube, as

well as the lines at the opposite upper corner **14** of the cube and lower remote corner **15** of the cube. Thus, the hypotenuse edge **6** of the triangle of FIG. 2 may be utilized in drawing the lower edge of the corner **15**, as well as lines parallel thereto, while the triangle of FIG. 2 may be turned over and the hypotenuse edge **6** utilized to draw the right edge of the corner **14** and lines parallel thereto. Also, the vertical edge **5** may be utilized in drawing the upper edge of the corner **15** and other lines parallel thereto. The edge of aperture **7**, perpendicular to hypotenuse edge **6**, is utilized in drawing the major axis of ellipse **13** opposite corner **15**, and when the triangle of FIG. 2 is reversed, the minor axis of the ellipse adjacent corner **15**. The left edge of the aperture **7** of FIG. 2 is also utilized in drawing the minor axis of the ellipse **13** opposite corner **15** and the major axis of the ellipse adjacent corner **15**. Of course, the edge **5** of FIG. 5 may be utilized in drawing the minor axis of the ellipse adjacent corner **14** and the T square is used in drawing the major axis of this ellipse. The drafting instruments of FIGS. 3, 4 and 5 are utilized similarly in drawing the edges of the cube of FIG. 5A, as well as the major and minor axes of the inscribed ellipses, it being noted that neither of these instruments need be turned over and therefore they may be attached to a drafting machine. Thus, the left hand hypotenuse edge **6'** of FIG. 3, the right hand hypotenuse edge **11** of FIG. 4 and the upper hypotenuse edge **11'** of FIG. 5 may be used to draw the same lines of the isometric cube of FIG. 5A as the hypotenuse edge **6** of the triangle of FIG. 2, when in the position shown. Similarly, the cutouts **7** adjacent to the above hypotenuse edges of FIGS. 3–5 may be utilized to draw the same lines as the cutout **7** of FIG. 2. Similarly, the right hypotenuse edge **6'** of FIG. 3, the left hypotenuse edge **11** of FIG. 4 and the lower hypotenuse edge **11'** of FIG. 5 may be utilized to draw the same line as the hypotenuse edge **6** of FIG. 2, when the triangle thereof is turned over. Also, the cutout **7** of FIGS. 3–5 adjacent the above hypotenuse edges may be utilized to draw the same major and minor ellipse axes as the cutout **7** of FIG. 2, when turned over. The holes **10** in the drafting instruments of FIGS. 4 and 5 are, as indicated above, in line with the angular edges of the cutout **7** and are utilized in locating extension points in drawing a longer line of an ellipse axis.

The drafting instruments illustrated in FIGS. 6 and 7 are identical, except the base edge **9** is vertical in FIG. 6 and horizontal in FIG. 7, each being attached to a bracket **8** of the drafting machine. This drafting instrument is provided with a pair of hypotenuse edges **16**, which converge together at an included angle of 60° opposite the base **9**, and a cutout **17** which is an isoceles triangle having two edges perpendicular, or at 90° to the opposite hypotenuse edge **16**. The drafting instrument of FIG. 6 is particularly adapted to be utilized in drawing the isometric cube and laying out the axes of the ellipse **13** of FIG. 5A, it being noted that the upper and lower hypotenuse edges **16** of FIG. 6 are respectively parallel to the lower and upper hypotenuse edges **11'** of FIG. 5, while the oblique edges of the cutout **17** are respectively parallel to the edges of the cutouts **7** which are perpendicular to the respective hypotenuse edges **11'**. Thus, the instrument of FIG. 6 may be used in the same manner as the instrument of FIG. 5.

When the instrument of FIG. 6 is turned 90° and attached to a drafting machine, as in FIG. 7, it is particularly adapted to draw the major and minor axes of the inscribed ellipses **13**, as well as the edges of the oblique isometric cube of FIG. 8. Of course, the major axis **18** of the left hand ellipse **13** is a vertical line, while the minor axis thereof is a horizontal line. However, the major axis **19** of the upper ellipse is drawn by the right oblique edge of cutout **17**, and the minor axis **20** is drawn by the left hypotenuse edge **16**. Similarly, the major axis of the ellipse adjacent corner **15** is drawn by the left oblique edge of the cutout **17**, and the minor axis by the right hypotenuse edge **16** of FIG. 7. The drafting instrument of FIG. 7, when attached to a parallel position drafting machine, is particularlly useful in making scalable exploded view drawings and laying out long scalable profiles of streets or highways and, at the same time, illustrating bridges, culverts, roads or streets, street intersections, overpasses, buildings, trees, street lights, stop signs and the like, all to scale and in three dimensions.

As shown in FIGS. 9 to 14, the drafting instrument of FIG. 4 may be modified for attachment or adjustable attachment to a so-called universal or parallel arm drafting machine, which is attached by a bracket **21** to a drawing board, with the drafting instrument of FIG. 4 also being attached to an angular bracket having a vertical scale blade **22** and a horizontal scale blade **22'**, through a double edge, straight edge **23** formed integrally with or laminated to the drafting instrument, for purposes described later. A knob or handle **24** attached to straight edge **23** is utilized for lifting or maneuvering the drafting instrument into position, as to a plurality of parallel positions, permitted by the two sets **25** of parallel arms of the drafting machine, which extend between the mounting bracket **21** and the attachment bracket **8**. A series of slots or indentations **26** beneath the straight edge **23** may be utilized for a purpose described below, while the drafting instrument straight edge **23** may be attached to the scale blade **22'** by a series of screws **27**. In addition, the angular scale blades may be mounted on a separate bracket **28** which cooperates with a knob or lock nut **29**, as in FIG. 10, for adjustment of the position of the drafting instrument. The upper edge **30** of the straight edge provides a ledge, against which additional instruments, such as templates for drawing ellipses, may be placed, while the lower edge **31** of the straight edge is offset from the lower edge **32** of the drafting instrument, so that other drafting devices may be placed against edge **31** but will not slip under the drafting instrument, when in use.

The slots or indentations **26**, referred to above, on the underside of the drafting instrument, are adapted to receive magnets or magnetic tape **34**, for holding the drafting instrument against drafting paper placed on a metal covered surface of the drawing board, to prevent accidental dislodgement during use.

The drafting instrument of FIGS. 15 and 16 includes standard metal chucks **35** attached thereto by screws **36** extending through holes **38** in straight edge **23** and holes **39** in the drafting instrument, for engagement with threaded bushings or nuts **37**. In FIG. 16, the slots **26**, into which the magnets or magnetic tape **34** is inserted, are shown more clearly. The principal difference between the drafting instrument illustrated in FIGS. 9–14 and that illustrated in FIGS. 15 and 16 is that the former may be molded or formed from a single piece, while the parts of the latter are held together by the screws **36**. Of course, any suitable type of material, such as plastic or metal, may be utilized in making the drafting instruments of this invention which may be cast, molded, machined or formed in any other suitable manner.

The drafting instruments of FIGS. 3, 5, 6 and 7 may also be modified in a similar manner. Thus, in FIG. 17, a drafting instrument similar to that of FIG. 3 is provided with a straight edge **23**, a guide knob **24** and chucks **35**, for removable attachment at either end to a bracket **40** of a parallel arm drafting machine having an adjustable head **41**. A normally vertical scale blade **43** is removably attached to an upwardly extending leg of bracket **40**. In FIG. 18, a drafting instrument similar to that of FIG. 4 is provided with a straight edge **23**, a guide knob **24** and chucks **35**, for removable attachment at either end to one leg of bracket **40**, with normally vertical scale blade **43** removably attached to the other leg. In FIG. 19, a drafting instrument similar to that of FIG. 5 is again provided with a straight edge **23**, a guide knob **24** and chucks **35**, for mounting on a bracket **40** attached to an adjustable head **41**. In this instance, the drafting instru-

ment is mounted by a chuck **35** in the leg of bracket **40** opposite from that on which the drafting instruments of FIGS. 17 and 18 are mounted, with the scale blade **43** being transferred to the other leg, i.e. to a horizontal position. In FIG. 20, a drafting instrument similar to that of FIG. 6 is provided with a straight edge **23**, a knob **24** and chucks **35**, for attachment to either of the legs of bracket **40**, with scale blade **43** being mounted on the other leg. In FIG. 20, a straight edge **44** is also shown as being placed against one of the hypotenuse edges, for drawing a longer line than the size of the particular instrument shown will accommodate. In FIG. 21, a drafting instrument similar to that of FIG. 6 but modified as in FIG. 20, is mounted in a position corresponding to that of FIG. 7, i.e. on the opposite leg of bracket **40** from FIG. 20, and with the scale blade **43** in a vertical position.

As will be evident, the drafting instruments of FIGS. 9–14, FIGS. 15 and 16 and FIGS. 17, 18, 19 and 20 are particularly adapted to be utilized in drawing the isometric cube of FIG. 5A, particularly in laying out the major and minor axes of the ellipses inscribed in the faces of the cube, while the drafting instrument of FIG. 21 is particularly adapted to be utilized in drawing oblique isometric cubes, as shown in FIG. 8, together with the major and minor axes of inscribed ellipses.

In FIGS. 22 and 23, an ellipse template **49** is placed against one or the other of the hypotenuse edges **11** of a drafting instrument as shown in FIGS. 15 and 16, although preferably mounted on a drafting machine, as in FIG. 18. The ellipse cutouts in the template **49** are in line with or parallel to the edge of the cutout **7** which is perpendicular to the hypotenuse edge **11**, against which the edge of the ellipse template **49** is placed. Thus, FIG. 22 illustrates the ellipse template **49** in position to draw an ellipse corresponding to that adjacent corner **15** of the isometric cube of FIG. 5A, while FIG. 23 illustrates the ellipse template **49** in position to draw an ellipse corresponding to that opposite corner **15**. The ellipse adjacent corner **14** of FIG. 5A may be drawn by an ellipse template **55** of FIGS. 26 and 27, placed against either the lower edge of straight edge **23**, as in FIG. 26, or against the upper edge of the straight edge, as in FIG. 27.

In FIGS. 24 and 25, the use of a special ellipse template **50** of FIG. 28 is illustrated. The ellipse template **50** is provided with an angular base **51**, a lower edge **52** and an angular upper edge **53**. By placing the lower edge **52** against the upper edge of straight edge **23**, in the position of FIG. 24, or in the reverse position, as in FIG. 25, the ellipse template may be moved along the straight edge, rather than along the hypotenuse edge of the drafting instrument.

In further accordance with this invention, the drafting instruments thereof may be modified to provide scales, so that dimensions may be read directly. Thus, the drafting instrument of FIG. 29 is similar to the drafting instrument of FIG. 4, having similar equilateral cutouts **7**, but having hypotenuse edges **59** provided with measuring scales. This drafting instrument is provided with a base edge **60** and an extension **61**, for attachment to a bracket **8** of a drafting machine having two sets of parallel arms **25** extending to a mounting bracket **21** attached to the drawing board. The drafting instrument is reinforced by an upstanding rib **62**, which may also be utilized as a straight edge for ellipse templates and the like, while an integral scale blade **63** extends upwardly adjacent the hypotenuse edge **59** closest to the base extension **61**. Between extension **61** and the special head **28** of the drafting machine, a friction gasket **65**, as in FIG. 30, may be placed to hold the drafting instrument in any adjusted position, as for drawing oblique cubes and objects theoretically contained in such cubes. The drafting instrument of FIG. 30 is modified from that of FIG. 3 by the addition of scales to the hypotenuse edges **66** and a vertical scale blade **67**. The modified instrument of FIG. 30 is, of course, adapted to be attached to a drafting machine in the same manner as the instrument of FIG. 29. As shown in FIG. 31, the drafting instrument of FIG. 6 may be modified to include hypotenuse edges **68** having scales, as well as a vertical base edge **69** having a scale and an extension **61**, again permitting attachment to a drafting machine, in the same manner as in FIG. 29. As in both FIGS. 30 and 31, reinforcing rib or ribs **62** may be added.

As in FIGS. 32 and 33, the drafting instrument of FIG. 5 may be modified, so as to draw, respectively, an isometric cube, as in FIG. 5A, or an oblique isometric cube, as in FIG. 8, together with the major and minor axes of inscribed ellipses, as before. Thus, in FIG. 32, the hypotenuse edges **70** are provided with scales, while upper edge **71** and vertical edge **72** are also provided with scales. The lower edge **12** remains as before, while extension **61** at the lower left corner permits attachment to a drafting machine, as before. The cutouts **17'** are similar to the cutout **17** of FIGS. 6 and 7, rather than the cutouts **7** of FIG. 5, but have oblique edges inclined at the same angles. As in FIG. 33, the extension **61'** may be placed at a different angular position, so that the scale edge **72** may be horizontal and the scale edge **71** may be vertical, with the scale hypotenuse edges **70** diverging downwardly, rather than laterally.

FIG. 34 is an isometric drawing of a hypothetical object, drawn through use of any drafting instrument of this invention, and is particularly adapted to be copied by a student in learning to use the drafting instruments of this invention in making isometric drawings. It will be noted that a drafting instrument, as shown in FIG. 4, was used in drawing FIG. 34 and that the angular position of the instrument, at the outer end of the drafting machine, was not changed once during the drawing of FIG. 34.

From the foregoing, it will be evident that drafting instruments constructed in accordance with this invention fulfill to a marked degree the requirements and objects herein set forth, in particular the laying out of major and minor axes of ellipses, an important consideration in making isometric drawings. Certain embodiments of this invention are, of course, particularly useful for particular purposes. Thus the instruments of FIGS. 4, 9 and 18 are particularly useful in making heating, ventilating or piping diagrams or engineering drawings of a structural steel construction or block diagrams to scale, while the instruments of FIGS. 7, 21 and 33 are more particularly adapted to be utilized in making oblique isometric drawings. As will also be evident, the drafting instruments of this invention enable isometric drawings which are geometrically correct and mathematically accurate in a simple and easy manner, which also aids the designer or engineer in making an accurate three dimensional drawing of an object which is merely visualized, without the necessity of making orthographic drawings. This ability is also valuable in making drawings for catalogs, instruction manuals, advertising, transparent overlays, graphs for slides and projections, drawings for all types of text books and teaching material, and for the solution and illustration of problems in the graphic sciences. Particularly in the case of the double ended instruments, or those provided with two hypotenuse edges, the drafting instruments of this invention are useful in teaching the making of isometric drawings, since each edge of the instrument, both interior and exterior, is used in making the same slope of line in all drawings. The value of the instruments for the above purposes is enhanced when the instrument is attached to a parallel arm drafting machine.

Although several different embodiments of this invention have been illustrated and described, it will be understood that other embodiments may exist and that various changes and variations may be made, without departing from the spirit and scope of this invention.

What I claim is:

1. A drafting instrument for making isometric drawings, including the principal axes of an isometric cube and the major and minor axes of isometric ellipses representing circles inscribed in any face of said cube, comprising:
a planar, triangular member having angles of 30°, 60° and 90° at the corners and a hypotenuse outside edge opposite said 90° angle;
said member having a triangular aperture having equal sides and equal interior angles, with one of said aperture sides being perpendicular to said hypotenuse edge;
whereby said member may be placed against a straight edge or the like to enable the three axes of an isometric cube and lines parallel to any of said axes to be drawn and also to enable the major and minor axes of an ellipse contained in any of the three faces of said cube to be drawn with the outside edge intermediate in length engaging said straight edge and said 30° angle pointed in one direction or in the opposite direction.

2. A drafting instrument for making isometric drawings, including the principal axes of an isometric cube and the major and minor axes of isometric ellipses representing circles inscribed in any face of said cube merely by shifting said instrument to two or more parallel positions, comprising:
a planar member having a base edge and a pair of intersecting outer edges, each disposed at an angle of 30° to said base edge but extending in opposite directions;
said member having a spaced pair of triangular apertures, each adjacent one of said intersecting outer edges and each having equal sides and equal interior angles, with one side of each aperture being disposed at 90° to the adjacent outer edge.

3. A drafting instrument, as defined in claim 2, wherein the exterior angle between said intersecting edges is 240°.

4. A drafting instrument, as defined in claim 2, wherein the exterior angle between said intersecting edges is 120°.

5. A drafting instrument, as defined in claim 2, wherein the exterior angle between said intersecting edges is 60°.

6. A drafting instrument, as defined in claim 2, further including:
an element movable to a plurality of parallel positions; and
means for attaching said planar member to said element.

7. A drafting instrument, as defined in claim 6, including a handle for moving said member to different positions.

8. A drafting instrument for making isometric drawings, including the principal axes of an isometric cube and the major and minor axes of isometric ellipses representing circles inscribed in any face of said cube merely by shifting said instrument to two or more parallel positions, comprising:
a planar member having a base edge and a pair of intersecting outer edges, each disposed at an angle of 30° to said base edge but extending in opposite directions with an angle of 120° between said edges;

said member having at least one triangular aperture having equal sides and equal interior angles, with one side of said aperture being disposed at 90° to one intersecting outer edge and another side of said aperture being disposed at 90° to the other intersecting outer edge.

9. A drafting instrument for making isometric drawings, including the principal axes of an isometric cube and the major and minor axes of isometric ellipses representing circles inscribed in any face of said cube merely by shifting said instrument to two or more parallel positions, comprising:
a planar member having a base edge and a pair of intersecting outer edges, each disposed at an angle of 60° to said base edge but extending in opposite directions, and the angle between said intersecting outer edges being 60°;
said member having an aperture, two sides of which are perpendicular to the opposite intersecting edge.

10. A drafting instrument, as defined in claim 9, further including:
an element movable to a plurality of parallel positions; and
means for attaching said planar member to said element, with said base edge perpendicular to said parallel position.

11. A drafting instrument, as defined in claim 9, further including:
an element movable to a plurality of parallel positions; and
means for attaching said planar member to said element, with said base edge parallel to said parallel positions.

12. A drafting instrument, as defined in claim 9, wherein said aperture is triangular and the third side of which is parallel to said base edge.

References Cited by the Examiner

UNITED STATES PATENTS

1,002,734	9/1911	Morse	33—104
1,293,248	2/1919	Tintanne.	
1,584,507	5/1926	Bolling	33—104
1,778,481	10/1930	Boucher.	
2,033,715	3/1936	Jacob	33—79.1 X
2,137,004	11/1938	Langsner	33—79.1
2,610,407	9/1952	McQuaid	33—104
2,858,612	11/1958	Verrett	33—104 X
3,093,919	6/1963	Holtz.	

FOREIGN PATENTS

23,107	3/1949	Finland.
1,186,549	2/1959	France.
322,477	6/1920	Germany.
1,357	1893	Great Britain.
282,686	8/1928	Great Britain.
883,194	11/1961	Great Britain.

LEONARD FORMAN, *Primary Examiner.*

ISAAC LISANN, *Examiner.*

H. N. HAROIAN, *Assistant Examiner.*