PART II

TERMS AND DEFINITIONS

IN the study and practice of this, as in any branch of science, one of the first demands upon the student is that he have a thorough knowledge of the exact meaning of the terms employed therein. To be able to say either in writing or in ordinary conversation exactly what is meant, is to eliminate all possibility of misunderstanding or error. Especially is this true in geometrical science with which the student has necessarily to deal in making a study of sheet metal pattern developments.

1. *Geometry* is the science which has for its object the measurement of extension or space.

Space is described as having three dimensions; length, breadth and thickness. These three dimensions cover all the extension or enlargement which any form or figure can possibly have in whatever direction.

In applying these dimensions to a concrete object, the term thickness is sometimes equivalent to hight or depth. These dimensions are understood to be taken at right angles to each other, that is width or breadth is measured at right angles to length, both being measured horizontally, and thickness is measured at right angles to both width and length, that is vertically.

2. A *Point* has position but no magnitude, that is neither length, breadth nor thickness. A point is represented on the drawing by a dot.

It should be understood that a point, having no dimensions is therefore invisible, but may be represented upon the paper by a dot. Likewise a line having no breadth or thickness is necessarily invisible, but is represented upon the paper by a mark. A mark cannot be a line because one cannot be made which has no breadth. The mark is however always spoken of as a line. Points and lines are supposed to exist everywhere or wherever wanted.

Lines

3. A *Line* has one dimension only, length. It may be either straight or curved, and is supposed to consist of a succession of points.

4. A *Straight Line* is the shortest distance between two points, or one which does not change its direction throughout its course. It is also termed a *right line*. Straight lines are used to form the sides of geometrical figures, known as polygons, and are usually designated in demonstrations by a reference letter or figure placed at each end. Fig. 19 shows a straight line with reference letters.

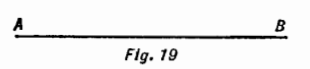


Fig. 19
Straight Line

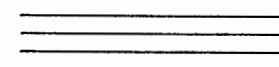


Fig. 20
Parallel Straight Lines

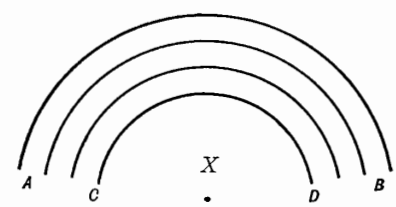


Fig. 21. Parallel Curved Lines

5. A *Broken Line* is geometrically speaking said to be made up of straight lines not lying in the same direction. In general practice however the term broken line is applied to any irregular line used to show that some part of an object represented in a drawing is incomplete, as though the part not shown had been broken away.

6. A *Curved Line* is one which changes its direction at every point. A curved line is usually designated by a reference letter or figure at each end and one or more along its course.

7. *Parallel Straight Lines* lie in the same plane and are everywhere equidistant, and being extended ever so far both ways, do not meet. In Fig. 20, parallel straight lines are shown.

8. *Parallel Curved Lines* are arcs of circles drawn from a common center. In Fig. 21, A B and C D are parallel curved lines both being drawn from the common point X as a center.

9. A *Horizontal Line* is parallel with the horizon or with the surface of a body of water at rest, that is level. In mechanical drawing horizontal lines are drawn from side to side across the paper, but a line drawn at any angle may be assumed to be

horizontal when it is used as the base of an oblique section or other view.

10. *Vertical Lines* are parallel to a plumb line suspended in a still atmosphere, being fastened at its upper end and having a weight attached to its lower end. In other words it is perpendicular to the horizon.

11. *Inclined or Oblique Lines* occupy an intermediate position between vertical and horizontal lines. In Fig. 22, A B represents a horizontal line, C D a vertical line and C E an oblique line.

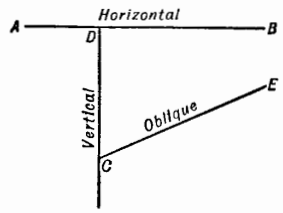


Fig. 22
Horizontal, Vertical and Oblique Lines

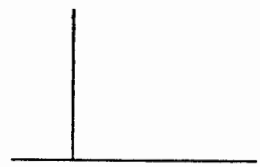


Fig. 23
Perpendicular Lines

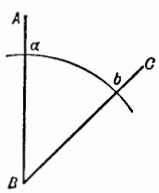


Fig. 24
Angle

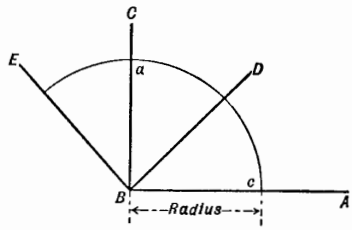


Fig. 25
Right, Acute and Obtuse Angles

12. *Perpendicular Lines* are at right angles to each other; thus, a vertical line is perpendicular to a horizontal line but perpendicular lines are not necessarily vertical and horizontal. In Fig. 23 the lines are perpendicular to each other.

Angles

13. An *Angle* is the amount of divergence between two straight lines which meet at a common point. The lines are called the sides of the angles and the point of meeting is called the *vertex* of the angle. Angles are usually designed by three letters, the middle letter being that at the vertex, as the angles A B C of Fig. 24. The magnitude of an angle is measured upon the arc of a circle of which the vertex is the center, as *a b*.

14. A *Right Angle* is one in which the measuring arc is a quarter of a circle. When two straight lines cross each other so as to make the four angles equal, the angles are all right angles.

15. An *Acute Angle* is less than a right angle, or one which is measured by an arc which is less than a quarter circle.

16. An *Obtuse Angle* is greater than a right angle and is measured by an arc which is more than a quarter circle. To make a comparison therefore between a number of angles, they must all be measured upon arcs having the same radius. In Fig. 25 A B C is a right angle, being measured by the quarter circle *a c;* A B D is an acute angle and A B E is an obtuse angle.

17. *Adjacent Angles.*— When two straight lines intersect (cross) each other, four angles are formed. Those two which lie on the same side of one of the

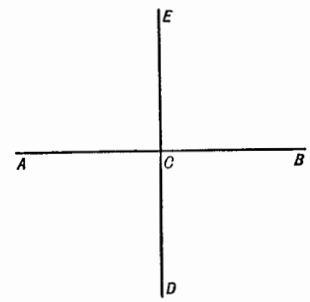


Fig. 26
Adjacent and Opposite Angles

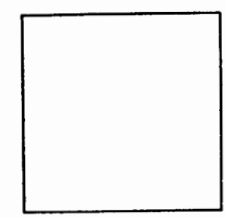


Fig. 27
A Rectilinear Figure

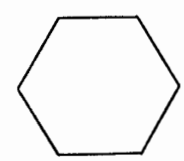


Fig. 28
Hexagon

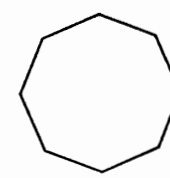


Fig. 29
Octagon

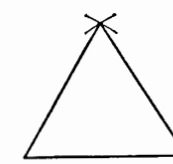


Fig. 30
Equilateral Triangle

lines are said to be *adjacent angles;* those two which lie on opposite sides of both lines are said to be *opposite angles.* Thus in Fig. 26 A C E and E C B are adjacent angles and A C E and D C B are opposite angles.

Plane Figures

18. A *Surface* has two dimensions only, length and breadth. A surface may be either plane or curved.

19. A *Plane Surface* is such that if any two points within it are connected by a right or straight line, the line will be wholly within the surface. Such a surface is usually termed a plane. For the definition of curved surface see cylinder, Defs. 73 and 74.

20. A *Plane Figure* is a portion of a plane terminated on all sides by lines either straight or curved.

21. A *Rectilinear Figure* is a portion of a plane bounded by straight (right) lines. Any rectilineal figure may be termed a polygon. Fig. 27.

22. A *Regular Polygon* is one in which all sides, and also all angles are equal. It is thus equilateral

and equiangular. These conditions are satisfied only when the polygon be inscribed within or circumscribed about a circle. The term is usually applied to figures having more than four sides. Figs. 28 and 29 show two types.

Fig. 31
Isosceles Triangle

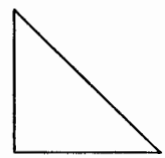


Fig. 32
Right Angled Triangle

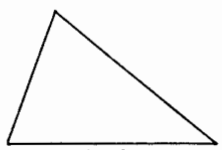


Fig. 33
Acute Angled Triangle

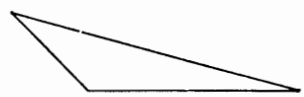


Fig. 34
Obtuse Angled Triangle

Triangles

Of all plane straight sided figures, the triangle is beyond all doubt the most important, the most used and the most useful. It is the means or basis of the great computations of surveyors, engineers and astronomers. Its area is easily computed, and therefore that of any figure which can be cut into triangles. The solution of its problems is discussed in that branch of mathematical science called Trigonometry. It is of especial importance to pattern draftsmen inasmuch as it furnishes him with the means of measuring, and thereby of developing, the shapes of irregular surfaces, the employment of which is termed *Triangulation*.

23. A *Triangle* is a rectilinear figure, or polygon, bounded by three straight lines. Triangles may be equilateral, isosceles, scalene, right angled, acute angled or obtuse angled.

24. An *Equilateral Triangle* is one in which the three sides are equal that is, of the same length. Fig. 30.

25. An *Isosceles Triangle* is one which has two of its sides equal. Fig. 31.

26. A *Right-Angled Triangle* is one in which one of its angles is a right angle. Fig. 32. No triangle can have more than one right angle.

27. An *Acute-Angled Triangle* is one which has all of its angles acute. Fig. 33.

28. An *Obtuse-Angled Triangle* is one which has one of its angles obtuse. Fig. 34.

29. A *Scalene Triangle* has all of its sides unequal.

30. The *Hypothenuse* of a right-angled triangle is the longest side or the side opposite the right angle. Fig. 35.

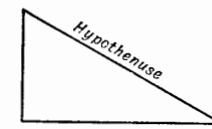


Fig. 35
The Hypothenuse of a Triangle

31. The *Vertex* of a triangle is its upper angle, sometimes called the apex, as A of Fig. 36.

Fig. 36
The Vertex of a Triangle

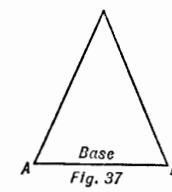


Fig. 37
The Base of a Triangle

Fig. 38
The Altitude of a Triangle

32. The *Base* of a triangle is the lower side or side upon which it may be supposed to stand, as A B of Fig. 37.

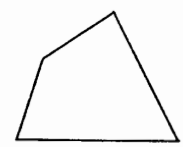


Fig. 39
Trapezium

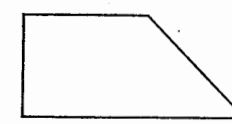


Fig. 40
Right Angled Trapezoid

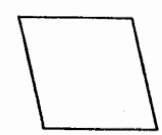


Fig. 41
Rhombus

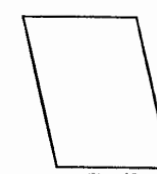


Fig. 42
Rhomboid

33. The *Altitude* of a triangle is the length of a line drawn perpendicularly to its base. Fig. 38.

Quadrilaterals

34. A *Quadrilateral* is a plane figure bounded by four straight lines. The square and the rectangle are quadrilateral figures, but those usually referred to are the Trapezium, the Trapezoid and the Parallelogram.

35. A *Trapezium* has no two of its sides parallel, Fig. 39.

36. A *Trapezoid* has only two of its sides parallel, Fig. 40.

37. A *Parallelogram* has its opposite sides parallel. The square and the rectangle are parallelograms, as are also two other figures called the *Rhombus* or *Diamond* in which all sides are equal and the *Rhomboid* which has only its opposite sides equal. Figs. 41 and 42.

38. A *Rectangle* is a polygon having four right

angles and four sides not necessarily equal. Fig. 43.

39. A *Square* is a regular polygon of four sides, or in other words an equilateral rectangle. Fig. 44.

Polygons

Of the polygons of more than four sides we shall consider only those called "regular." Any regular polygon can therefore be *inscribed* within a circle, each angle of the polygon being in the circumferance of the circle as in Fig. 45. The polygon can also be drawn outside the circle having the middle of each side tangent to the circle, in which case it is said to be *circumscribed* about the *circle*. Fig. 46.

Fig. 43
Rectangle

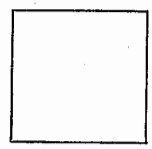


Fig. 44
Square

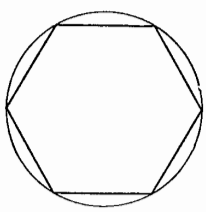


Fig. 45
Inscribed Polygon

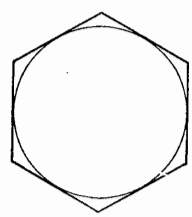


Fig. 46
Circumscribed Polygon

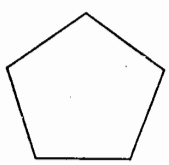


Fig. 47 Pentagon

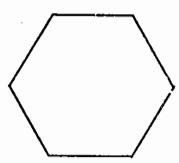


Fig. 48 Hexagon

Fig. 49 Heptagon

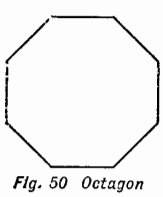


Fig. 50 Octagon

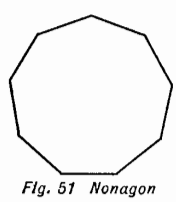


Fig. 51 Nonagon

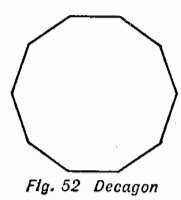


Fig. 52 Decagon

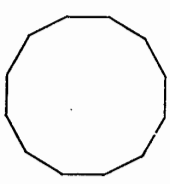


Fig. 53 Dodecagon

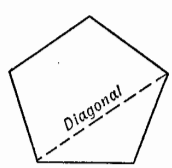


Fig. 54 Diagonal Line

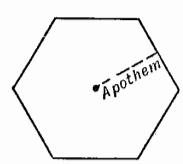


Fig. 55 The Apothem

40. A *Regular Pentagon* has five equal sides and five equal angles. Fig. 47.

41. A *Hexagon* has six sides. Fig. 48.

42. A *Heptagon* has seven sides. Fig. 49.

43. An *Octagon* has eight sides. Fig. 50.

44. A *Nonagon* has nine sides. Fig. 51.

45. A *Decagon* has ten sides. Fig. 52.

46. A *Dodecagon* has twelve sides. Fig. 53.

47. The *Perimeter* is the sum of all the sides bounding any polygon. It is sometimes applied to the circumference of a circle. The circle is thus considered as a polygon with an infinite number of sides.

48. A *Diagonal* is a straight line joining the opposite angles, or angles not adjacent, of any polygon. Fig. 54.

49. The *Apothem* of a regular polygon is a line drawn from center to the middle of a side or in other words the radius of the inscribed circle. Fig. 55.

Curvilinear Figures

The greater the number of sides a polygon has the more nearly does it approach a circle. A circle is therefore sometimes geometrically considered as a polygon having an infinite number of sides.

50. A *Circle* is a plane figure bounded by a curved line every point of which is equidistant from a point within called the *center*. The term is also applied to the line itself which is also called the *Circumference*. Fig. 56.

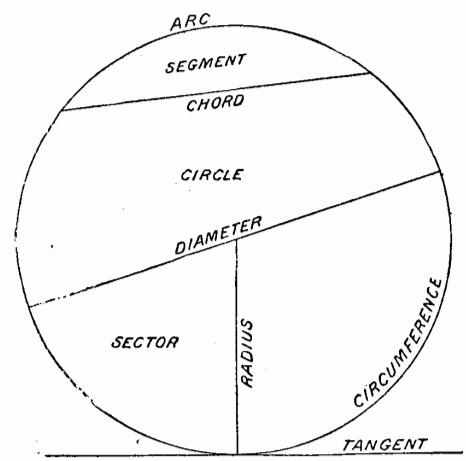


Fig. 56.— Parts of a Circle

51. The *Diameter* of a circle is any straight line drawn through the center to opposite points on the circumference. Fig. 56.

52. The *Radius* (plural radii) of a circle is a straight line drawn from the center of a circle to any point on the circumference, in other words it is half the diameter. Fig. 56.

53. A *Semicircle* is half a circle and is included between a diameter and half the circumference.

54. An *Arc* of a circle is any portion of the circumference. Fig. 56.

55. A *Chord* is a straight line joining the two ends of an arc. Fig. 56.

56. A *Segment* is that part of a circle (the space) included between any arc and its chord. Fig. 56.

57. A *Sector* is that part of a circle included between any two radii and the arc between. Fig. 56.

58. A *Quadrant* is a sector in which the two radii are at right angles or one whose area is one quarter of a circle. When a sector includes just one sixth of a circle, it is called a *Sextant*.

For convenience then in establishing a unit of measure by which all angles may be measured and compared, the circumference of the circle is supposed to be divided into 360 equal arcs or parts, each part being called a *degree*. A degree is also divided into 60 equal parts called *minutes*, and a minute is further divided into 60 equal parts called *seconds*. When the greatest accuracy is required a second may be divided into tenths and hundredths. Degrees minutes and seconds are denoted by the symbols, °, ′, ″, thus 23° 47′ 34″ is read 23 degrees, 47 minutes and 34 seconds, while tenths and hundredths of a second are expressed decimally, as 16.42″. This part of the subject is properly included under the head of trigonometry.

It must be borne in mind that the degree has no reference except fractionally to the size of a circle, thus a degree is 1/360th of any circle great or small. If from the vertex of an angle of 45° two arcs are drawn cutting the sides of the angle, the radius of one of them being twice that of the other, the arc drawn with the longer radius will be twice as long as the other but both will be arcs of 45° because each arc is 1/8 of the completed circle, 45 being 1/8 of 360.

If any arc as *a b* of Fig. 57 be subtracted from a quadrant (90°) what remains is called the *complement* of the first arc; if subtracted from a semicircle (180°) the remaining arc is called the *supplement*.

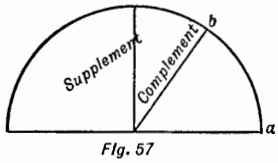


Fig. 57
The Complement and Supplement

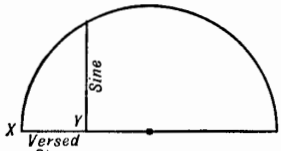


Fig. 58
Sine and Versed Sine of an Arc

59. A *Tangent* to a circle or any curve, is any straight line drawn as to touch the curve at one point only. Every tangent to a circle is perpendicular to a radius drawn to the point of tangency. Fig. 56.

60. The *Versed Sine* of an arc is the distance from the foot of a line drawn from one end of an arc, perpendicular to a radius drawn to the other end of the arc. A line drawn in continuation of the versed line would pass through the center of the circle. X Y in Fig. 58 shows the versed sine.

The various functions of a circle as above described have been shown and named. There are however other functions of a circle used in trigonometrical calculations which are not essential to the pattern draftsman's work and are not here shown.

61. *Concentric* circles are those which are described from the same center. Fig. 59.

62. *Excentric circles* are described from different centers but one circle is within the other. Fig. 60.

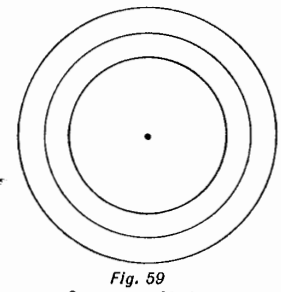


Fig. 59
Concentric Circles

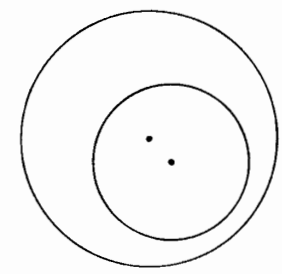


Fig. 60
Excentric Circles

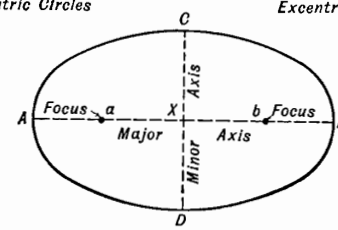


Fig. 61
An Ellipse

63. An *Ellipse* is a plane figure bounded by a curved line which is of such a nature that the sum of two lines drawn from any point upon it to two fixed points within, called the *foci*, is always the same. One of these points is called a *focus*. The figure has thus a long and a short diameter. Fig. 61 is an ellipse in which A B is the long diameter, called the *major axis*, and C D is the short diameter, called the *minor axis*. These axes cross each other at right angles at the point X which is the common center of both axes. The two foci are situated upon the major axis at points *a* and *b*.

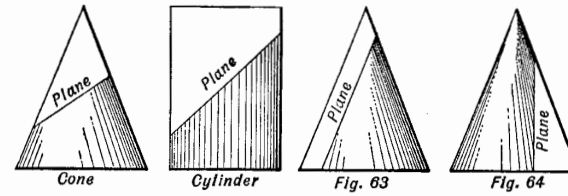


Fig. 62
Producing Elliptical Sections

Fig. 63
Producing
a Parabola

Fig. 64
Producing
a Hyperbola

An ellipse is also a section of a cylinder or of a cone made by a plane which passes through both sides of the cylinder and cone as in Fig. 62.

64. A *Parabola* is a section made by a plane passing through a cone parallel to one of its sides. Fig. 63.

65. A *Hyperbola* is a section made by a plane which passes through a cone vertically (parallel to and) at one side of its axis or at an angle with the base which is greater than that of the side. Fig. 64.

66. An *Involute* is a curve traced by the end of a string as it is wound upon another curve, as a circle, or unwound from it. Fig. 65.

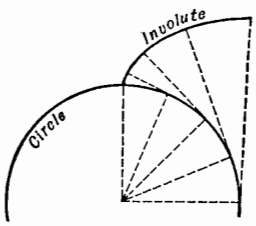


Fig. 65
Involute

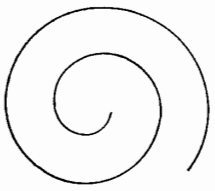


Fig. 66
Spiral

67. A *Spiral* is a curve similar to an involute the radius of which increases according to a mathematical law as the curve expands. Its use to the architectural or sheet metal draftsman is in the drawing of scrolls or volutes. Fig. 66.

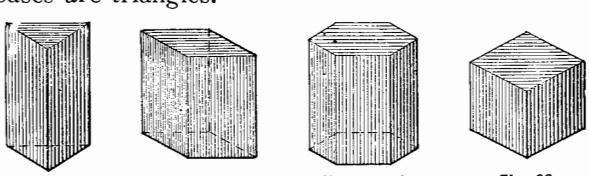
Solids

68. A *Solid* has length, breadth and thickness. The term "solid" in its geometrical sense does not indicate material substance, as though it were something supposed to be made of wood or stone, but a portion of space of certain dimensions and shape. It is sometimes referred to as volume. The geometrical solids include prisms, cylinders, pyramids, cones, the regular polyhedrons, conoids, spheroids, and the sphere.

69. A *Polyhedron* is a solid bounded entirely by planes or plane figures which are polygons either regular or irregular. The *edges* of a polyhedron are the intersections of its bounding planes. The name is applied to every solid bounded by plane faces.

70. A *Prism* is a solid or polyhedron of which the ends or bases are equal and parallel polygons, and the sides of parallelograms.

71. A *Triangular Prism* is a prism whose ends or bases are triangles.



Triangular Quadrangular Hexagonal
Fig. 67 Prisms

Fig. 68
Cube

The bases of a prism may be polygons of any number of sides, therefore we may have prisms designated as Triangular, Quadrangular, Hexagonal, etc., according as their bases have three, four, six or more sides. Fig. 67.

72. A *Cube* is a prism of which the bases and sides are squares. It therefore has six equal surfaces. Fig. 68.

73. A *Cylinder* (circular cylinder) may be described as a solid or prism having equal and parallel circles as its bases and an infinite number of sides. According to this definition a circle is a polygon having an infinite number of sides. The application of this definition to sheet metal work will be further explained in Part III.

74. A *Circular Cylinder* is sometimes spoken of as a solid of revolution. It is said to be generated by the revolution of a rectangle about one of its sides; the side which remains fixed becoming the axis of the cylinder while the side opposite is termed the generating line.

The bases of a cylinder may be any curvilinear figure, as an ellipse, oval or any irregular shape. Any cylinder not circular, is said to be generated by the movement of a straight line, which moves so as to constantly touch the base and to be constantly parallel to a fixed straight line. The generating line in any position is called an *element* of the surface.

75. A *Right Cylinder* is a cylinder in which the elements are at right angles to the bases.

76. An *Oblique Cylinder* is one in which the elements are oblique to the base.

77. A *Pyramid* is a solid having any straight sides figure (polygon) as a base and triangular sides which terminate in a point called the apex.

78. A *Right* or *Regular Pyramid* is one whose base is a regular polygon and in which a perpendicular let fall from its apex, passes through the center of its base. The perpendicular is called the *axis* of the pyramid. Fig. 69.

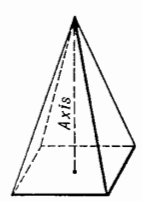


Fig. 69
Regular Pyramid

79. A *Cone* is a solid whose base is any curvi-linear figure and whose sides taper uniformly to its *apex;* in other words it is a pyramid having an infinite number of sides.

80. A *Right Cone* is one whose base is a circle and in which a perpendicular let fall from its apex, passes through the center of its base. This perpendicular, as in the case of the pyramid, is called the *axis* of the cone. As a solid of revolution, the cone is said to be generated by the revolution of a right angled triangle about one of the sides adjacent to the right angle. In this case the other side adjacent to the right angle generates the base, while the hypothenuse generates the conical surface. Scalene

cones and cones with any shape of base are said to be generated by a line one end of which remains fixed at the apex while the other extremity of the line is kept constantly in contact with the base. In this case the generating line at any position is an element of the surface. Fig. 70, shows right and scalene cones.

81. A *Truncated Cone* is one whose apex is cut away by a plane parallel to its base. The figure thus produced is more often spoken of as a *Frustum of a Cone*. Fig. 71.

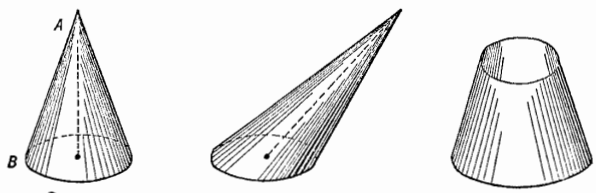


Fig. 70 Cones
Right and Scalene Cones

Fig. 71
Truncated Cone

A pyramid may be truncated as in the case of a cone, producing a *frustum of a pyramid.*

82. A *Scalene* or *Oblique Cone* is one whose axis is inclined to its base. Pyramids may also be scalene or oblique. Fig. 70.

83. The *Altitude* of a pyramid or cone either right or scalene, is the length a perpendicular let fall from the apex to the plane of its base. Fig. 69.

84. The *Slant Hight* of a right pyramid is the distance from its apex to the middle of one side at its base. The *Slant Hight* of a cone is the distance from its apex to any point on the circumference of its base; in other words the length of an element of its surface, as A-B in Fig. 70.

Regular Polyhedrons

There are five regular polyhedrons: —

85. A *Tetrahedron* is bounded by four equilateral triangles. It is thus also a triangular pyramid whose sides are equal to its base. Fig. 72.

86. A *Hexahedron* is bounded by six squares and is thus also known as a cube. Fig. 73.

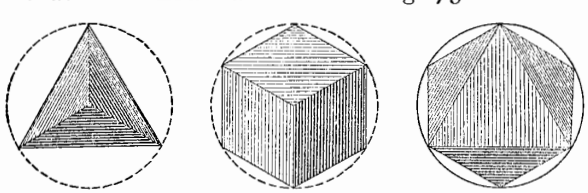


Fig. 72
Tetrahedron

Fig. 73
Hexahedron

Fig. 74
Octahedron

87. An *Octahedron* is bounded by eight equilateral triangles and is thus equivalent to two square pyramid set base to base. Fig. 74.

88. A *Dodecahedron* is bounded by twelve pentagons. Fig. 75.

89. An *Icosahedron* is bounded by twenty equilateral triangles. Fig. 76.

90. The *Envelope* of a solid is its outer surface. The problem of the pattern draftsman is to obtain the shape of the envelope of any solid when it is spread out upon a plane or flat surface; thus the phrase, the envelope of a cone or cylinder, signifies its pattern. When thus laid out it is known as a development or pattern.

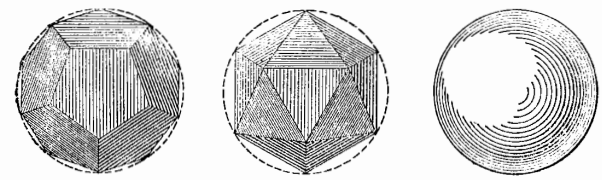


Fig. 75
Dodecahedron

Fig. 76
Icosahedron

Fig. 77
Sphere

91. The *Stretchout* of an envelope is its girth measured in short spaces, if of a cylindrical character set off on a straight line or if of a conical nature set off upon an arc of a circle, as in obtaining distance along the edge of a conical envelope as measured upon the circle of a plan or section.

92. An *Ordinate* as applied in pattern work, is the length of a straight line as measured from another straight line for the purpose of establishing a curve. It is more often spoken of as a *measuring line.*

93. *Normal.* Perpendicular. Original. That from which anything is derived.

94. A *Sphere* or *Globe* is a solid bounded by a curved surface every point of which is equidistant from a point within called the center. As a solid of revolution it is generated by the revolution of a circle or semicircle upon its diameter. Fig. 77.

95. A *Spheroid* is a solid generated by the revolution of an ellipse about one of its axes. If revolved upon its shorter or minor axis the spheroid is said to be *prolate*. If revolved about its longer or

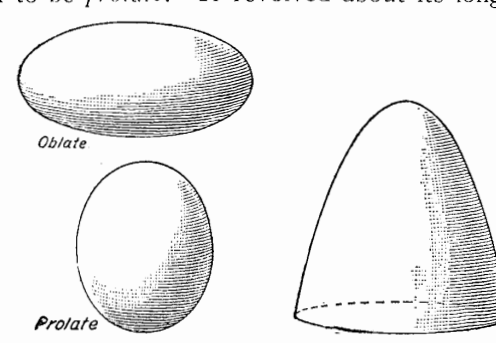


Fig. 78.—Spheroids

Fig. 79.—Conoid

major axis the resulting solid is called an *oblate spheroid.* Fig. 78.

96. A *Conoid* is a solid generated by the revolution of either of three conic sections about its axis. Such solid may also be termed an *ellipsoid,* a *para-*

baloid or a *hyperboloid* according as either half an ellipse, the parabola or the hyperbola is used in its generation. Fig. 79.

97. A *Convex* surface is one that curves outwardly. Fig. 80.

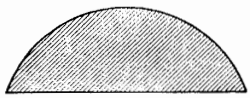


Fig. 80
Convex

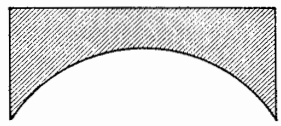


Fig. 81
Concave

98. A *Concave* surface is one that curves inwardly. Fig. 81.

Heating, Ventilation and Exhaust Piping

99. *Furnace Casing.* A sheet metal drum surrounding the upper part of a warm air furnace. A, Fig. 82.

100. *Furnace Bonnet.* A tapering hood placed over and connected to a furnace casing. B, Fig. 82.

101. *Deflector.* An inverted cone placed at the top of the Bonnet to direct the heated air to the Collars. C in Fig. 82.

102. *Bonnet Collar.* An outlet in a furnace casing placed at an angle, to provide means of connecting a warm air pipe or elbow. D in Fig. 82.

103. *Pieced Elbow.* An adjustable junction connecting two pipes set at angles and constructed so as to be turned to any required pitch.

104. *Oval Elbow "on the Sharp."* A pieced oval elbow mitered the long way of the oval. Fig. 83.

105. *Oval Elbow "on the Flat."* A pieced oval elbow mitered the short way of the oval. Fig. 84.

106. *Protractor.* A device for finding the rise of the miter line in developing the various forms of pieced elbows. Fig. 85.

107. *Tee Joint.* A junction of two sections of pipe, forming an angle.

108. *Compound Elbow.* Two elbows joined to make a double curve and form an offset both in plan and elevation.

108-a. *Peened Elbow.* An elbow whose cross-joints are seamed. Referring to Fig. 85-a, a single edge is turned on section A and a double edge on section B, then peened as shown at C.

109. *Reducing Elbow.* An elbow for connecting two pipes of unequal diameter. *Reducing Joint.* A junction between two pipes of unequal diameter.

110. *Leader* (in furnace work). A warm air pipe running from the furnace to the riser.

111. *Riser* (in furnace work). A stack or warm air pipe running vertically between the partitions and connecting to the register boxes.

112. *Register Box.* A sheet metal enclosure connected to heater pipe or riser for conducting warm air to register. Fig. 86. There are various styles of register box as, *Single Top, Double Top, Through Register Box, Top Register Box, Semi Circular,* and *Double Corner.*

113. *Duct.* A pipe of sheet metal, usually rectangular, for conducting warm or cold air for heating and ventilating buildings or cold air to warm air furnaces. Fig. 87. When the medium of air supply is round it is termed *cold air pipe.*

114. *Cold Air Shoe.* A fitting to connect at the bottom of a warm air furnace when cold air supply is taken from the inside of the building. Fig. 87.

115. *Round Header.* An intersection between a main riser and two horizontal branches. Fig. 88.

116. *Tapering Elbow.* An elbow with tapered pieces which if straightened would represent a frustum of a right cone.

117. *Tapering Y Joint.* Three sections of pipe of equal diameter which when joined form the approximate shape of the letter Y.

118. *Three Way Branch.* Three branches of pipe forming a transition from a main pipe. *Four Way Branch* or *Four Pronged Fork,* etc. A transition of four pipes of equal diameter from the main pipe.

119. *Double Offset.* A fitting in pipe work which offsets both in plan and elevation; that is, leans to the right or to the left, backward or forward.

120. *Straight Boot.* A fitting to connect a round leader to a vertical riser or stack. Fig. 89.

121. *Offset Boot.* A fitting of similar construction to a *straight boot* but forming an offset. Fig. 90.

122. *Stack Offset.* An offset fitting to provide a transition in a riser pipe for warm air heating. Fig. 91.

123. *Transition Piece* or *Transformer.* A fitting which makes a transition from one shape to another, without respect to the profile or section of pipes. Fig. 92 shows a transition from square to round.

124. *Irregular Prongs.*— A fitting composed of Y shaped branches issuing from a main pipe. The branches may be round, square or rectangular. Fig. 93.

125. *Trunk Line.*— A term employed in warm air heating where a single pipe feeds two or more smaller pipes, the feeder or large pipe having an area equal to the combined area of the pipes connected to it.

126. *Mixing Valve.*— A movable damper used to mingle the inside and outside air supply for warm air heating or for an indirect heating system. Fig.

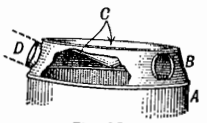


Fig. 82
Parts of Warm Air Furnace Casing

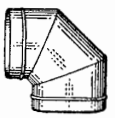


Fig. 83
Oval Elbow "on the Sharp"

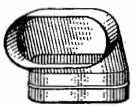


Fig. 84
Oval Elbow "on the Flat"

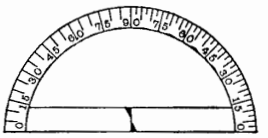


Fig. 85
Protractor

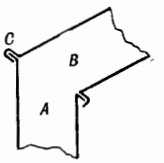


Fig. 85a
Peened Elbow

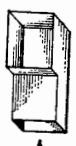


Fig. 86
Register Box

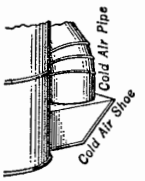


Fig. 87
Cold Air Shoe and Pipe

Fig. 88
Round Header

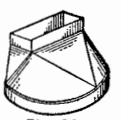


Fig. 89
Straight Boot

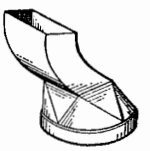


Fig. 90
Offset Boot

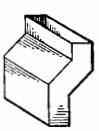


Fig. 91
Stack Offset

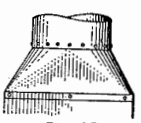


Fig. 92
Transition Square to Round

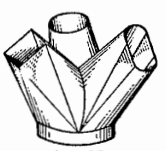


Fig. 93
Irregular 3 Way Branch or Prong

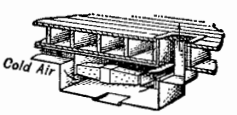


Fig. 94
Mixing Valve In Indirect Heating

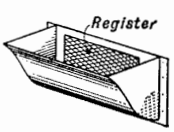


Fig. 95
Air Diffuser

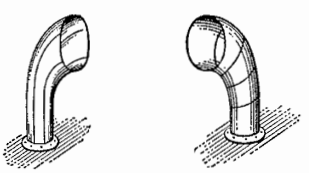


Fig. 96
Ship's Ventilators

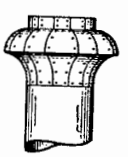


Fig. 97
Moulded Stack Cap

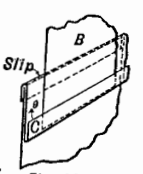


Fig. 98
S Slip

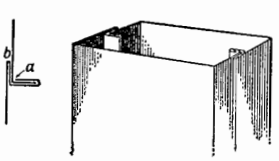


Fig. 99
Longitudinal Cup Joint In Duct Work

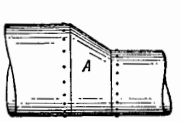


Fig. 100
Gusset

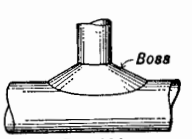


Fig. 101
Boss

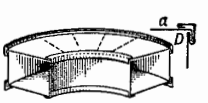


Fig. 102
Improved Pittsburgh Lock

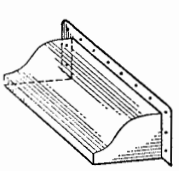


Fig. 103
Range Canopy

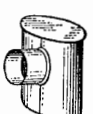


Fig. 104
Drum Elbow

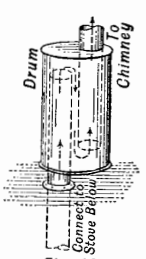


Fig. 105
Heating Drum

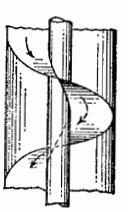


Fig. 106
Spiral Conveyer

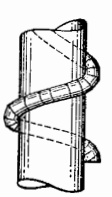


Fig. 107
Helical Elbows

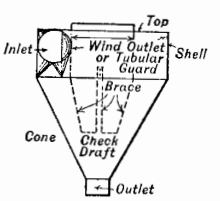


Fig. 108
A Separator and its Parts

94. The mixing damper in *indirect heating* is shown by D.

127. *Air Diffuser.*— A device to spread and direct the circulation of air within rooms. Fig. 95 — one type of air diffuser.

128. *Ships Ventilator, or Cowl.*— A distinctive type of ventilator to provide the admission of air to the interior parts of ships. This type of ventilator is usually made oval at the mouth and round at the base, sometimes round to round, in either horizontal or longitudinal sections. Fig. 96 — two types of ships ventilator.

129. *Moulded Stack Cap.*— A metal finish made in a number of pieces, to surround the top of a heavy smoke stack. Fig. 97.

130. *Slip.*— (In duct construction.) An S shaped formation made of sheet metal to facilitate the slipping of one joint of pipe into another. There are various styles of slips in use. Fig. 98 shows a type most frequently employed.

131. *Cup Joint.*— (In duct construction.) A formation usually employed in making longitudinal seams, when ducts are set up in halves. The lock *a* in Fig. 99 slips into the lock *b* of the opposite half.

132. *Gusset.*— A connection joining two cylinders of unequal diameter, one side being of straight formation. Fig. 100.

133. *Boss.*— A reenforcement to strengthen the junction between two pipes. Fig. 101.

134. *Pittsburgh Lock.*— A form of construction employed in making large elbows. This lock is designed to save double seaming. Fig. 102 — an improved form of Pittsburgh Lock. Attached to the edge at *a* in D is a hem, which covers the unfinished edge of the metal and makes a close joint.

135. *Range Canopy.*— A sheet metal hood for placing over a kitchen range, to aid ventilation and conduct fumes from cooking. Fig. 103 — one of several types of Range Canopy made of various kinds of sheet metal.

136. *Drum Elbow.*— An elbow in the form of a T, making connection between ranges and chimney flues. Fig. 104.

137. *Heating Drum.*— A sheet metal cylinder made to utilize the heat from a smoke pipe for warming rooms. Fig. 105. Heat and smoke are diverted from the chimney flue, and led to the drum as indicated by the arrows. There are various designs of heating drums operated upon this principle.

138. *Chimney Base.*— A transition, forming a connection between the square flue of a chimney and a round smoke pipe.

139. *Ash Chute.*— A sheet metal duct for conveying ashes or refuse, usually placed in walls leading from kitchen to cellar.

140. *Spiral Conveyor.*— A sheet metal fitting of spiral construction, for conveying bundles or packages from upper stories by means of helical blanks or planes. Fig. 106.

141. *Helical Elbows.*— A series of elbows having the same rise at all angles, and revolving spirally around a cylinder. Fig. 107 — example of Helical Elbow used in grain elevators.

142. *Separator.*— A sheet metal structure with interior mechanism for receiving and separating material or waste discharged from machinery. The Separator is built to given proportions and operates in connection with the fan piping equipment of mills. Fig. 108.

143. *Hood.*— (In Exhaust and Blowpipe Work.) A contrivance in mill equipment for placing under saws and shapers, etc., to catch dust and shavings.

144. *Sweeper.*— (In Exhaust and Blowpipe Work.) An auxiliary to fan piping for mills, usually placed at the floor line and into which shavings and dust are swept.

Automobile Sheet Metal Work

145. Automobile parts are made of black sheets, aluminum coated sheets and in many cases from pure sheet aluminum. Fig. 109 illustrates an automobile with designations of its various sheet metal parts, as follows:

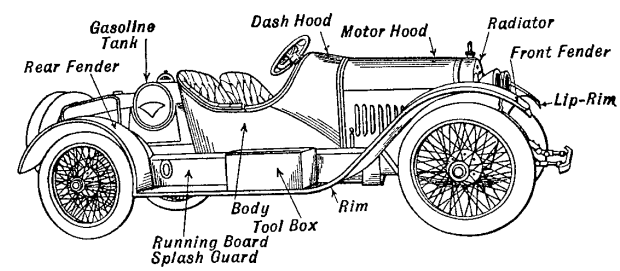


Fig. 109.— The Sheet Metal Parts of an Automobile

146. *Body.*— The main part of an automobile. made in one piece with dash hood attached, or divided into sections, with invisible riveted joints.

147. *Dash Hood.*— A hood or Bonnet which covers the dash board.

148. *Motor Hood.*— The part of the exterior structure of an automobile which covers and protects the motor. Hoods, sometimes called *Bonnets,* are made in various designs.

149. *Front* and *Rear Fenders.*— Splash guards covering the front and rear wheels, designed to arrest mud or flying matter.

150. *Rim.*— A narrow strip joined to and contributing finish and rigidity to the Fender.

151. *Lip Rim.*—A forward tapering section of the front *Fender.*

152. *Splash Guard.*—A shield placed against a Running Board for protection and for the exclusion of dirt.

153. *Tool Box.*—A receptacle attached to an automobile to accommodate tools for repair and upkeep.

154. *Gasoline Tank.*—A fuel container for automobiles, usually made of galvanized sheet iron or copper.

155. *Oil Tank.*—A container for fuel oil, usually constructed of tin plate.

156. *Splasher.*—A sheet metal partition on the inside of a gasoline tank, designed to prevent splashing.

157. *Fly Wheel Hood.*—A protective sheet metal bonnet or cover.

158. *Muffler.*—A sheet metal cylindrical tube employed to deaden the sound of escaping gases.

159. *Mud Pan.*—A sheet metal receptacle to protect the lower part of a motor from dust and flying matter.

160. *Funnels.*—Equipment made for conveying oil or gasoline to tanks.

Alphabetical List of Terms