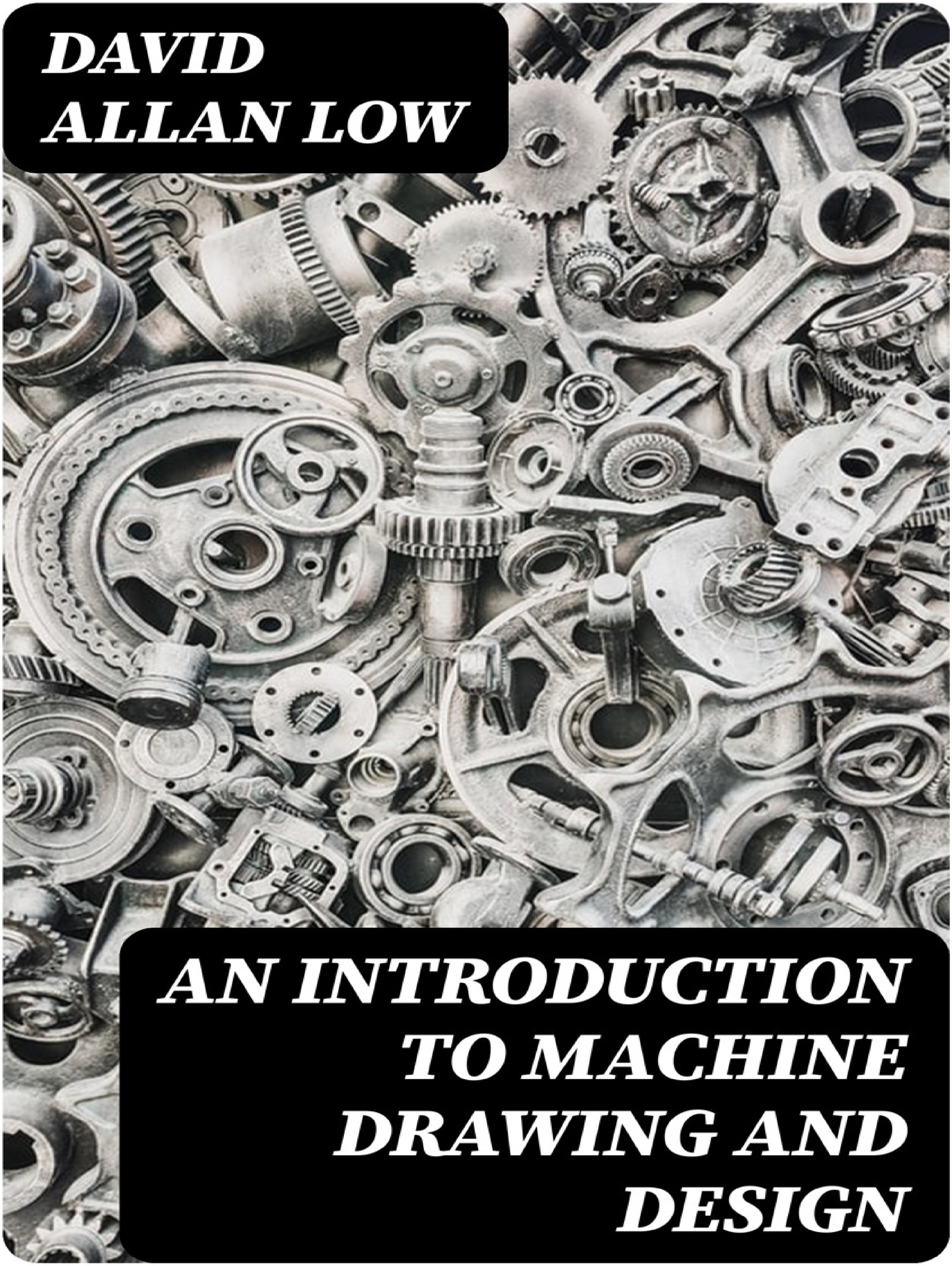
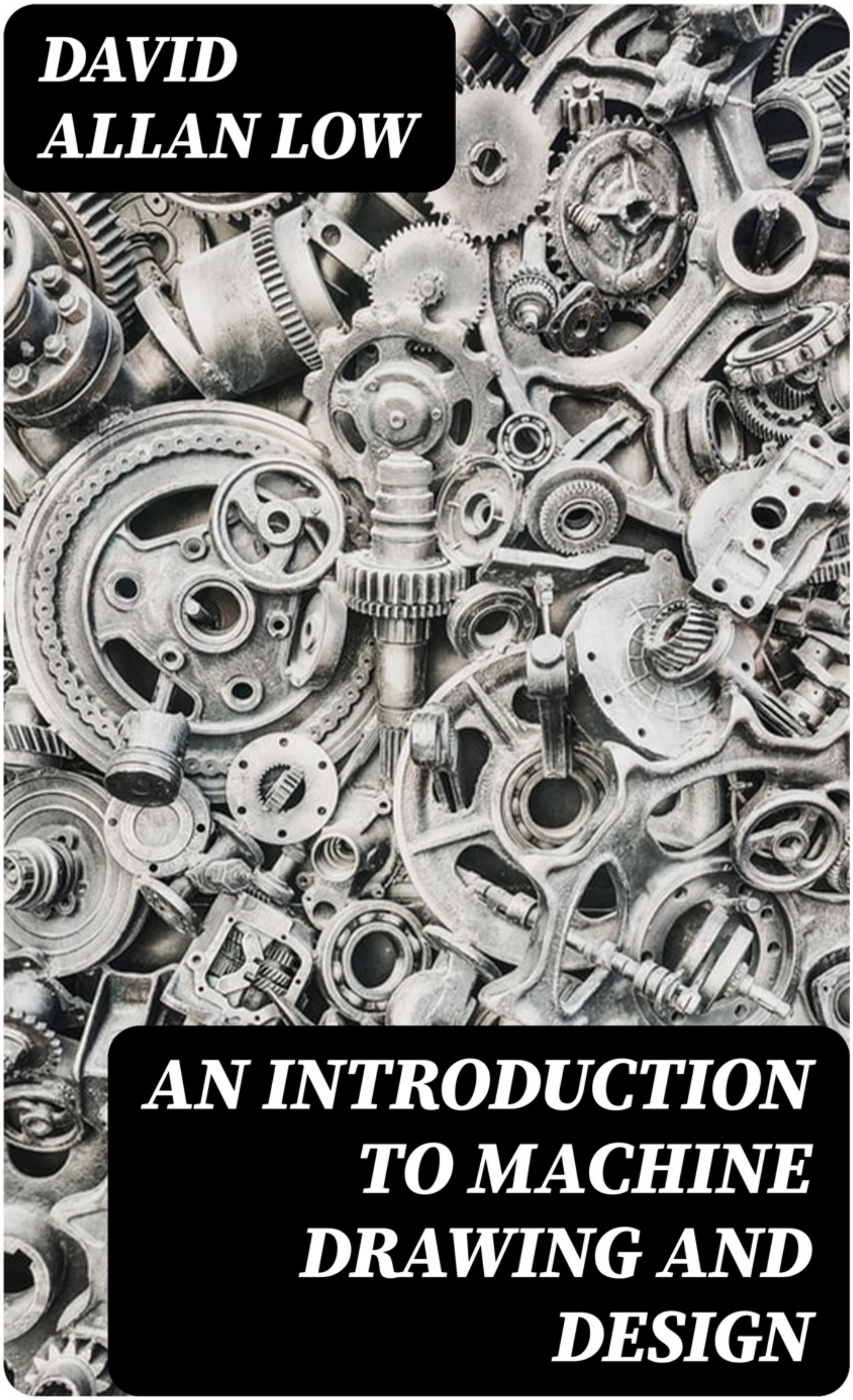
DAVID
ALLAN LOW



AN INTRODUCTION TO MACHINE DRAWING AND DESIGN



DAVID ALLAN LOW

AN INTRODUCTION TO MACHINE DRAWING AND DESIGN

David Allan Low

An Introduction to Machine Drawing and Design

EAN 8596547130864

DigiCat, 2022
Contact: DigiCat@okpublishing.info

Table of Contents

AN INTRODUCTION

Table of Contents

TO

MACHINE DRAWING

Table of Contents

AND

DESIGN

Table of Contents

BY

DAVID ALLAN LOW

Table of Contents

(WHITWORTH SCHOLAR), M. INST. M.E.

HEAD MASTER OF THE PEOPLE'S PALACE TECHNICAL SCHOOLS, LONDON
AUTHOR OF 'A TEXT-BOOK ON PRACTICAL SOLID OR DESCRIPTIVE GEOMETRY'
'AN ELEMENTARY TEXT-BOOK OF APPLIED MECHANICS' ETC.

FOURTH EDITION

LONDON
LONGMANS, GREEN, AND CO.
AND NEW YORK: 15 EAST 16th STREET
1890

PRINTED BY
SPOTTISWOODE AND CO., NEW-STREET SQUARE
LONDON

PREFACE.

Table of Contents

It is now generally recognised that the old-fashioned method of teaching machine drawing is very unsatisfactory. In teaching by this method an undimensioned scale drawing, often of a very elaborate description, is placed before the student, who is required to *copy* it. Very often the student succeeds in making a good copy of the drawing placed before him without learning very much about the object represented by it, and this state of matters is sometimes not much improved by the presence of the teacher, who is often simply an art master, knowing nothing about machine design. It is related of one school that a pupil, after making a copy of a particular drawing, had a discussion with his teacher as to whether the object represented was a sewing machine or an electrical machine. Evidently the publisher of the drawing example in this case did not adopt the precaution which a backward student used at an examination in machine design: he put on a full title above his drawing, for the information of his examiner.

Now, if machine drawing is to be of practical use to any one, he must be able to understand the form and arrangement of the parts of a machine from an inspection of suitable drawings of them without seeing the parts themselves. Also he ought to be able to make suitable drawings of a machine or parts of a machine from the machine or the parts themselves.

In producing this work the author has aimed at placing before young engineers and others, who wish to acquire the skill and knowledge necessary for making the simpler *working drawings* such as are produced in engineers' drawing offices, a number of good exercises in drawing, sufficient for one session's work, and at the same time a corresponding amount of information on the design of machine details generally.

The exercises set are of various kinds. In the first and simplest certain views of some machine detail are given, generally drawn to a small scale, which the student is asked to reproduce *to dimensions marked on these views*, and he is expected to keep to these dimensions, and not to measure anything from the given illustrations. In the second kind of exercise the student is asked to reproduce certain views shown *to dimensions given in words or in tabular form*. In the third kind of exercise the student is required to make, in addition to certain views shown to given dimensions, others which he can only draw correctly if he thoroughly understands the design before him. In the fourth kind of exercise the student is asked to make the necessary working drawings for some part of a machine which has been previously described and illustrated, *the dimensions to be calculated by rules given in the text*.

The illustrations for this work are all new, and have been specially prepared by the author from *working drawings*, and he believes that they will be found to represent the best modern practice.

As exercises in drawing, those given in this book are not numbered exactly in their order of difficulty, but unless on the recommendation of a teacher, the student should take them up in the order given, omitting the following:—26, 27, 28, 35, 40, 42, 43, 45, 49, 50, 54, 60, 61, as he comes to them, until he has been right through the book; afterwards he should work out those which he omitted on first going over the book.

In addition to the exercises given in this work the student should practise making freehand sketches of machine details from actual machines or good models of them. Upon these sketches he should put the proper dimensions, got by direct measurement from the machine or model by himself. These sketches should be made in a note-book kept for the purpose, and no opportunity should be lost of inserting a sketch of any design which may be new to the student, always putting on the dimensions if possible. These sketches form excellent examples from which to make working drawings. The student should also note any rules which he may meet with for proportioning machines, taking care, however, in each case to state the source of such information for his future guidance and reference.

As machine drawing is simply the application of the principles of descriptive geometry to the representation of machines, the student of the former subject, if he is not already acquainted with the latter, should commence to study it at once.

D. A. L.

GLASGOW: *March* 1887.

PREFACE TO THE THIRD EDITION.

Table of Contents

To this edition another chapter has been added, containing a number of miscellaneous exercises, which it is hoped will add to the usefulness of the work as a text-book in science classes. The latest examination paper in machine drawing by the Science and Art Department has also been added to the Appendix.

D. A. L.

London: *August* 1888.

AN INTRODUCTION

Table of Contents

TO

MACHINE DRAWING AND DESIGN.

Table of Contents

I. INTRODUCTION.

Table of Contents

Drawing Instruments.—For working the exercises in this book the student should be provided with the following:—A well-seasoned yellow pine *drawing-board*, 24 inches long, 17 inches wide, and $^3/_8$ inch or $^1/_2$ inch thick, provided with cross-bars on the back to give it strength and to prevent warping. A **T** *square*, with a blade 24 inches long attached permanently to the stock, *but not sunk into it*. One 45° and one 60° *set square*. The short edges of the former may be about 6 inches and the short edge of the latter about 5 inches long. A *pair of compasses* with pen and pencil attachments, and having legs from 5 inches to 6 inches long. A *pair of dividers*, with screw adjustment if possible. A *pair of small steel spring pencil bows* for drawing small circles, and a *pair of small steel spring pen bows* for inking in the same. A *drawing pen* for inking in straight lines. All compasses should have *round points*, and if possible *needle* points. A piece of india-rubber will also be required, besides two pencils, one marked H or HH and one marked HB or F; the latter to be used for lining in a drawing which is not to be inked in, or for freehand work.

Pencils for mechanical drawing should be sharpened with a *chisel point*, and those for freehand work with a *round point*. *Do not wet the pencil*, as the lines afterwards made with it are very difficult to rub out.

Drawing-paper for working drawings may be secured to the board by *drawing-pins*, but the paper for finished drawings or drawings upon which there is to be a large amount of colouring should be *stretched* upon the board.

The student should get the best instruments he can afford to buy, and he should rather have a few good instruments than a large box of inferior ones.

Drawing-paper.—The names and sizes of the sheets of drawing paper are given in the following table:—

	Inches
Demy	20 × 15
Medium	22 × 17
Royal	24 × 19
Imperial	30 × 22
Atlas	34 × 26
Double Elephant	40 × 27
Antiquarian	52 × 31

The above sizes must not be taken as exact. In practice they will be found to vary in some cases as much as an inch.

Cartridge-paper is made in sheets of various sizes, and also in rolls.

Hand-made paper is the best, but it is expensive. Good cartridge-paper is quite suitable for ordinary drawings.

Centre Lines.—Drawings of most parts of machines will be found to be symmetrical about certain lines called *centre lines*. These lines should be drawn first with great care. On a pencil drawing centre lines should be thin continuous lines; in this book they are shown thus — - — - —.

After drawing the centre line of any part the dimensions of that part must be marked off from the centre line, so as to insure that it really is the centre line of that part: thus in making a drawing of a rivet, such as is shown at (*a*) fig. 1, after drawing the centre line, half the diameter of the rivet would be marked off on each side of that line, in order to determine the lines for the sides of the rivet.

Inking.—For inking in drawings the best Indian ink should be used, and not common writing ink. Common ink does not dry quick enough, and rapidly corrodes the drawing pens. The pen should be filled by means of a brush or a narrow strip of paper, and not by dipping the pen into the ink.

In cases where there are straight lines and arcs of circles touching one another *ink in the arcs first*, then the straight lines; in this way it is easier to hide the joints.

Colouring.—Camel's-hair or sable brushes should be used; the latter are the best, but are much more expensive than the former. The colour should be rubbed down in a dish, and the tint should be light. The mistake which a beginner invariably makes is in having the colour of too dark a tint.

First go over the part to be coloured with the brush and *clean* water for the purpose of damping it. Next dry with clean blotting-paper to take off any superfluous water. Then take another brush with the colour, and beginning at the top, work from left to right and downwards. If it is necessary to recolour any part let the first coating dry before beginning.

Engineers have adopted certain colours to represent particular materials; these are given in the following table:—

Table showing Colours used to represent Different Materials.

Material	Colour
Cast iron	Payne's grey or neutral tint.
Wrought iron	Prussian blue.
Steel	Purple (mixture of Prussian blue and crimson lake).
Brass	Gamboge with a little sienna or a very little red added.
Copper	A mixture of crimson lake and gamboge, the former colour predominating.
Lead	Light Indian ink with a very little indigo added.
Brickwork	Crimson lake and burnt sienna.
Firebrick	Yellow and Vandyke brown.
Greystones	Light sepia or pale Indian ink, with a little Prussian blue added.
Brown freestone	Mixture of pale Indian ink, burnt sienna, and carmine.
Soft woods	For ground work, pale tint of sienna.

Hard woods	For ground work, pale tint of sienna with a little red added.
	For graining woods use darker tint with a greater proportion of red.

Printing.—A good drawing should have its title printed, a plain style of letter being used for this purpose, such as the following:—

A B C D E F G H I J K L M N O P Q R S T
U V W X Y Z
1 2 3 4 5 6 7 8 9 0

A B C D E F G H I J K L M N O P Q R
S T U V W X Y Z
1 2 3 4 5 6 7 8 9 0

The following letters look well *if they are well made*, but they are much more difficult to draw.

A B C D E F G H I J K L M N O P
Q R S T U V W X Y Z
1 2 3 4 5 6 7 8 9 0

For remarks on a drawing the following style is most suitable:—

abcdefghijklmnopqrstuvwxyz

All printing should be done by freehand.

Border lines are seldom put on engineering drawings.

Working Drawings.—A good working drawing should be prepared in the following manner. It must first be carefully outlined in pencil and then inked in. After this all parts cut by planes of section should be coloured, the colours used indicating the materials of which the parts are made. Parts which are round may also be lightly shaded with the brush and colours to suit the materials. The centre lines are now inked in with *red* or *blue ink*. The red ink may be prepared by rubbing down the cake of crimson lake, and the blue ink in like manner from the cake of Prussian blue. Next come the *distance* or *dimension* lines, which should be put in with *blue* or *red ink*, depending on which colour was used for the centre lines. Dimension lines and centre lines are best put in of different colour. The arrow-heads at the ends of the dimension lines are now put in with *black ink*, and so are the figures for the dimensions. The arrow-heads and the figures should be made with a common writing pen. The dimensions should be put on neatly. Many a good drawing has its appearance spoiled through being slovenly dimensioned.

We may here point out the importance of putting the dimensions on a working drawing. If the drawing is not dimensioned, the workman must get his sizes from the drawing by applying his rule or a suitable scale. Now this operation takes time, and is very liable to result in error. Time is therefore saved, and the chance of error reduced, by marking the sizes in figures.

In practice it is not usual to send original drawings from the drawing office to the workshop, but copies only. The copies may be produced by various 'processes,' or they may be tracings drawn by hand. Many engineers do not ink in their original drawings, but leave them in pencil; especially is this the case if the drawings are not likely to be much used.

Scales.—The best scales are made of ivory, and are twelve inches long. Boxwood scales are much cheaper, although not so durable as those made of ivory. If the student does not care to go to the expense of ivory or boxwood scales, he can get paper ones very cheap, which will be quite sufficient for his purpose. The divisions of the scale should be marked down to its edge, so that measurements may be made by applying the scale directly to the drawing. For working such exercises as are in this book the student should be provided with the following scales:—

A scale of	1,	or	12	inches to a foot.
”	$\frac{1}{2}$	”	6	”
”	$\frac{1}{3}$	”	4	”
”	$\frac{1}{4}$	”	3	”
”	$\frac{1}{6}$	”	2	”

A scale of 1 is spoken of as 'full size,' and a scale of $\frac{1}{2}$ as 'half size.'

Engineers in this country state dimensions of machines in feet, inches, and fractions of an inch, the latter being the 1/2, 1/4, 1/8, 1/16, &c. In making calculations it is generally more convenient to use decimal fractions, and then substitute for the results the equivalent fractions in eighths, sixteenths, &c. The following table will be found useful for this purpose:—

Decimal Equivalents of Fractions of an Inch.

Fraction	Decimal Equivalent	Fraction	Decimal Equivalent
1/32	·03125	17/32	·53125
1/16	·0625	9/16	·5625
3/32	·09375	19/32	·59375
1/8	·125	5/8	·625
5/32	·15625	21/32	·65625
3/16	·1875	11/16	·6875
7/32	·21875	23/32	·71875
1/4	·25	3/4	·75
9/32	·28125	25/32	·78125
5/16	·3125	13/16	·8125
11/32	·34375	27/32	·84375
3/8	·375	7/8	·875
13/32	·40625	29/32	·90625
7/16	·4375	15/16	·9375
15/32	·46875	31/32	·96875
1/2	·5	1	1·0

Engineers use a single accent (´) to denote *feet*, and a double accent (´´) to denote *inches*. Thus 2´ 9´´ reads two feet nine inches.

II. RIVETED JOINTS.

Table of Contents

Two plates or pieces to be riveted together have holes punched or drilled in them in such a manner that one may be made to overlap the other so that the holes in the one may be opposite the holes in the other. The rivets, which are round bars of iron, or steel, or other metal, are heated to redness and inserted in the holes; the head already formed on the rivet, and called the tail, is then held up, and the point is hammered or pressed so as to form another head. This process of forming the second head on the rivet is known as riveting, and may be done by hand-hammering or by a machine.

Forms of Rivet Heads.—In fig. 1 are shown four different forms of rivet heads: (*a*) is a *snap head*, (*b*) a *conical head* (*c*) a *pan head*, and (*d*) *a countersunk head*.

Proportions of Rivet Heads.—The diameter of the snap head is about 1·7 times the diameter of the rivet, and its height about ·6 of the diameter of the rivet. The conical head has a diameter twice and a height three quarters of the rivet diameter. The greatest diameter of the pan head is about 1·6, and its height ·7 of the rivet diameter. The greatest diameter of the countersunk head may be one and a half, and its depth a half of the diameter of the rivet.

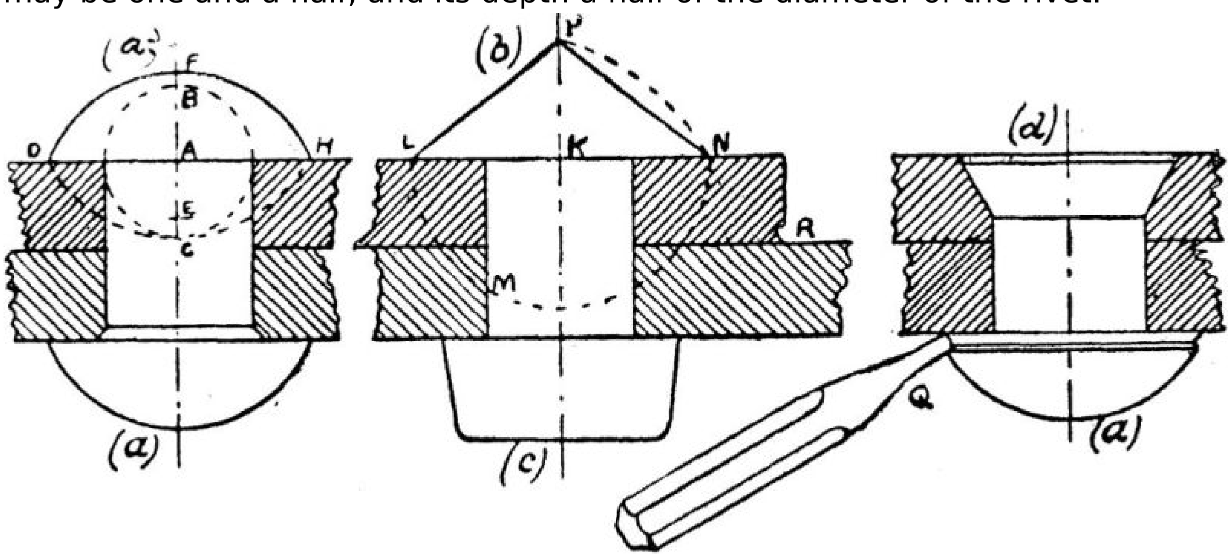


Fig. 1.

In fig. 1 at (*a*) and (*b*) are shown geometrical constructions devised by the author for drawing the snap and conical head for any size of rivet, the proportions being nearly the same as those given above.

Geometrical Construction for Proportioning Snap Heads.—With centre A, and radius equal to half diameter of rivet, describe a circle cutting the centre line of the rivet at B and C. With centre B and radius BC describe the arc CD. Make BE equal to AD. With centre E and radius ED describe the arc DFH.

Construction for Conical Head.—With centre K, and radius equal to diameter of rivet, describe the semicircle LMN, cutting the side of the rivet at M. With centre M and radius MN describe the arc NP to cut the centre line of rivet at P. Join PL and PN.

When a number of rivets of the same diameter have to be shown on the same drawing the above constructions need only be performed on one rivet. After the point E has been discovered the distance AE may be measured off on all the other rivets, and the arcs corresponding to DFH drawn with radii equal to ED. In like manner the height KP of the conical head may be marked off on all rivets of the same diameter with conical heads.

Caulking.—In order to make riveted joints steam- or water-tight the edges of the plates and the edges of the heads of the rivets are burred down by a blunt chisel or caulking tool as shown at Q and R.

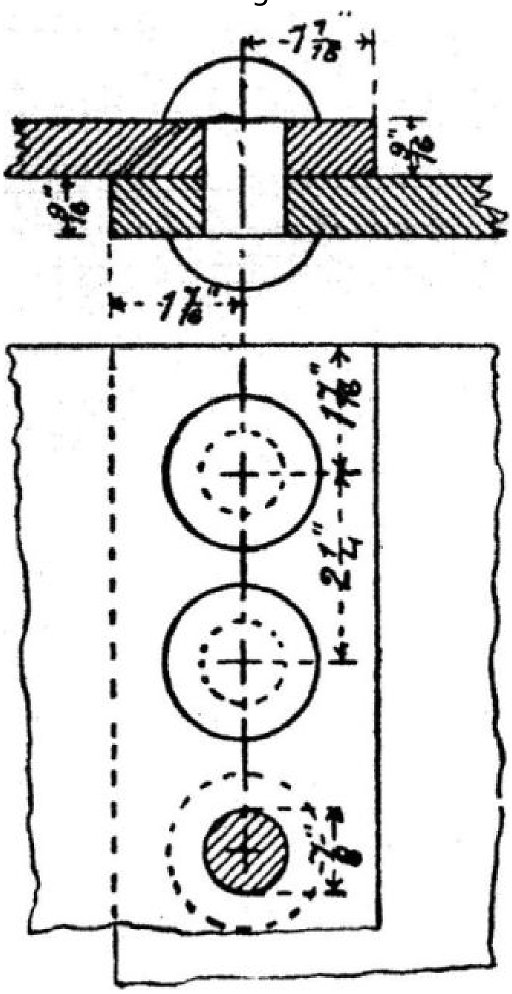


Fig. 2.

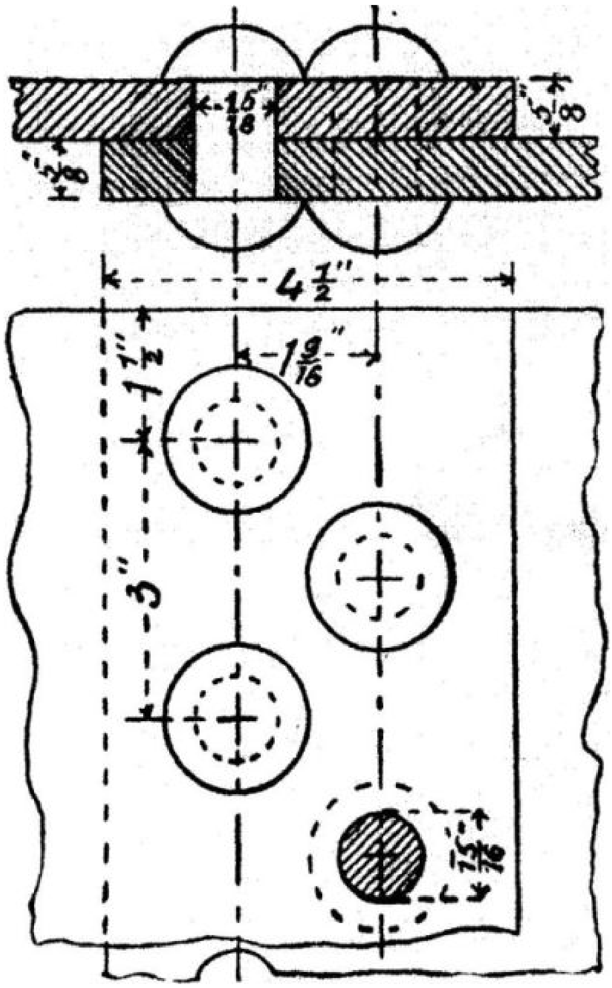


Fig. 3.

Exercise 1: *Forms of Rivets.*—Draw, full size, the rivets and rivet heads shown in fig. 1. The diameter of the rivet in each case to be 1⅛ inches, and the thickness of the plates ⅞ inch.

Exercise 2: *Single Riveted Lap Joint.*—Draw, full size, the plan and sectional elevation of the *single riveted lap joint* shown in fig. 2.

Table showing the Proportions of Single Riveted Lap Joints for various Thicknesses of Plates. (*Plates and Rivets Wrought Iron.*)

Thickness of plates	**¼**	**5/16**	**⅜**	**7/16**	**½**	**9/16**	**⅝**	**11/16**	**¾**
Diameter of rivets	9/16	⅝	11/16	¾	13/16	⅞	15/16	1	1 1/16
Pitch of rivets	1⅝	1¾	1⅞	2	2⅛	2¼	2 5/16	2⅜	2½
Width of lap	1¾	2	2¼	2½	2¾	2⅞	3	3⅛	3¼