PRACTICAL PROBLEMS

FOR

VEHICLE

DRAFTSMEN AND MECHANICS

R. B. BIRGE and HUGH M. SARGENT, Authors

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WARE BROS. COMPANY, Publishers
1010 Arch Street, Philadelphia, Pa.

CONTENTS

INTRODUCTION

k is the outgrowth of practical experience in ss room. The authors, while intimately con- with the vehicle industry, in 1909 conducted ning school in carriage drafting, the pupils of about twenty-five in number, were all employes nent. The results of the first year were so nuch benefit was experienced by the students ntinued through another year with an equally

instruction proceeded, many problems came up tion in relation to the highly technical work of ly maker. These problems were exactly such l any day in actual practice in any vehicle ch the student finds himself employed. Notes e practical problems, and their solutions, and e basis or foundation for the present volume. ions that had been answered and elucidated in thors have incorporated in this book a number problems, and the whole is now offered to all anics in the vehicle trade who are seeking to l education in order to advance themselves in altogether with the object of aiding aspiring ok was compiled and placed on the market

of elementary plane geometry is indispensably nderstand the principles upon which the art of rests. For the benefit of those who have not this preliminary training the subject has been introduced in the first section of the book. A careful perusal of this section will give the student an insight into the principles of plane geometry, and enable him to more clearly understand the technical terms necessarily employed later on. These principles are in fact very simple and easy to understand, but because they are so important and so constantly referred to in practical drafting, it is necessary for the student to have a clear working knowledge of them.

It is the purpose of this book to teach not only the practical applications of each problem, but also to convey a familiarity with the principles underlying each problem. Therefore, in preparing each illustration, those parts have been selected which are as simple as the case may permit, although they are not always in the best proportion. In a number of instances it was necessary to exaggerate the relations of the lines in order to explain the problem to the best advantage.

Great care has been taken to have the drawings and text accurate as the authors could make them, but as most of the work was done by busy men in their evening hours, it is possible that a few errors may have escaped their notice. Should any one discover discrepancies or mistakes of any description in the book the authors and publishers will consider it a favor if the information is brought to their attention.

There has been an insistent demand for a book of this character from the actual workers in the vehicle trades, and if this book meets that demand, or serves in any manner toward elevating the standard of technical education among the vehicle mechanics for whose benefit it was compiled, the authors will feel more than gratified with such a reward for their labor.

R. B. BIRGE,
HUGH M. SARGENT.

Geometrical Terms and Definitions

A LINE is that which has length merely, and may be straight or curved.

A STRAIGHT LINE, or, as it is sometimes called, a right line, is the shortest line that can be drawn between two given points. Straight lines are generally designated by letters or figures at their extremities, as A B, Fig. 1.

A CURVED LINE is one which changes its direction at every point, or one of which no portion, however small, is straight. It is therefore longer than a straight line connecting the same points. Curved lines are designated by letters or figures at their extremities and at intermediate points, as A B C or D E F, Fig. 2.

PARALLEL LINES are those which have no inclination to each other, being everywhere equidistant. A B and A′ B′ in Fig. 3 are parallel straight lines, and can never meet, though produced to infinity. C D and C′ D′ are parallel curved lines, being arcs of circles which have a common center.

HORIZONTAL LINES are lines parallel to the horizon, or level. A Horizontal Line in a drawing is indicated by a line drawn from left to right across the paper, as A B in Fig. 4.

VERTICAL LINES are lines parallel to a plumb line suspended freely in a still atmosphere. A Vertical Line in a drawing is represented by a line drawn up and down the paper, or at right angles to a horizontal line, as E C in Fig. 4.

INCLINED OR OBLIQUE LINES occupy an intermediate between horizontal and vertical lines, as C D, Fig. 4.

Two lines which converge toward
produced, would meet or intersect, a
other.

PERPENDICULAR LINE
ular to each other when the angles
of meeting are equal. Vertical and
perpendicular to each other, but pe
always vertical and horizontal, but
to the horizon, provided that the an
point of intersection are equal. In F
are said to be perpendicular to A B.
E F are perpendicular to A B. L
same line are parallel to each other,
which are perpendicular to A B.

An ANGLE is the opening b
which meet one another. An angle
by three letters, the letter designati
straight lines containing the angle
other two letters, as the angle E C

A RIGHT ANGLE.—Whe
another straight line so as to make th
each other, each angle is a right angl
said to be perpendicular to each othe
Fig. 7.)

An ACUTE ANGLE is an an
as A B D or A B C, Fig. 7.

An OBTUSE ANGLE is an
angle, as A B E, Fig. 7.

GEOMETRICAL TERMS AND DEFINITIONS—Continued

GHT-SIDED FIGURES.

is that which has length and breadth

surface such that if any two of its points ght line, such line will be wholly in the rface which is not a plane surface, or urfaces, is a curved surface.

URVED SURFACE is one in which ay be joined by straight lines which shall ace. The rounded surface of a cylinder curved surface.

CURVED SURFACE is one in which e joined by a straight line lying wholly surface of spheres, for example, is a e.

ENUSE is the longest side in a right- the side opposite the right angle. A C,

a triangle is its upper extremity, as B, alled vertex.

a triangle is the line at the bottom. B C 9.

a triangle are the including lines. A C, 8 and 9.

is the point in any figure opposite to and se. The vertex of an angle is the point the angle meet. B, Fig. 9.

The ALTITUDE of a triangle is the length of a perpendicular let fall from its vertex to its base, as B D, Fig. 9.

A QUADRILATERAL figure is a surface bounded by four straight lines. There are three kinds of Quadrilaterals: The Trapezium, the Trapezoid, and the Parallelogram.

CIRCLES AND THEIR PROPERTIES

A CIRCLE is a plane figure bounded by a curved line, everywhere equidistant from its center. (Fig. 10.) (See also Circumference.)

The CIRCUMFERENCE of a circle is the boundary line of the figure. (Fig. 10.)

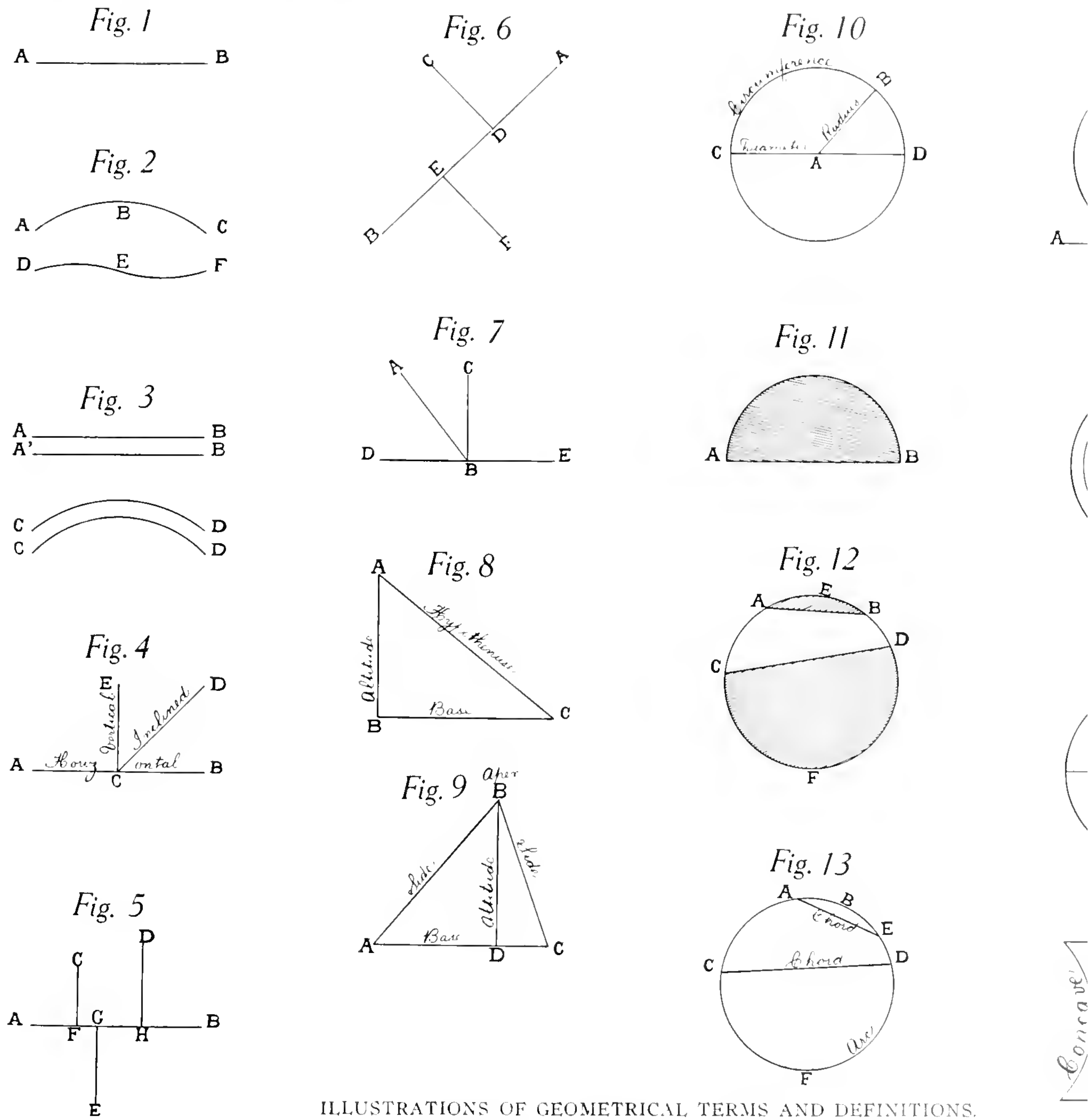
The CENTER of a circle is a point within the circumference equally distant from every point in its circumference, as A, Fig. 10.

The RADIUS of a circle is a line drawn from the center to any point in the circumference, as A B, Fig. 10, that is, half the diameter. The plural of radius is radii.

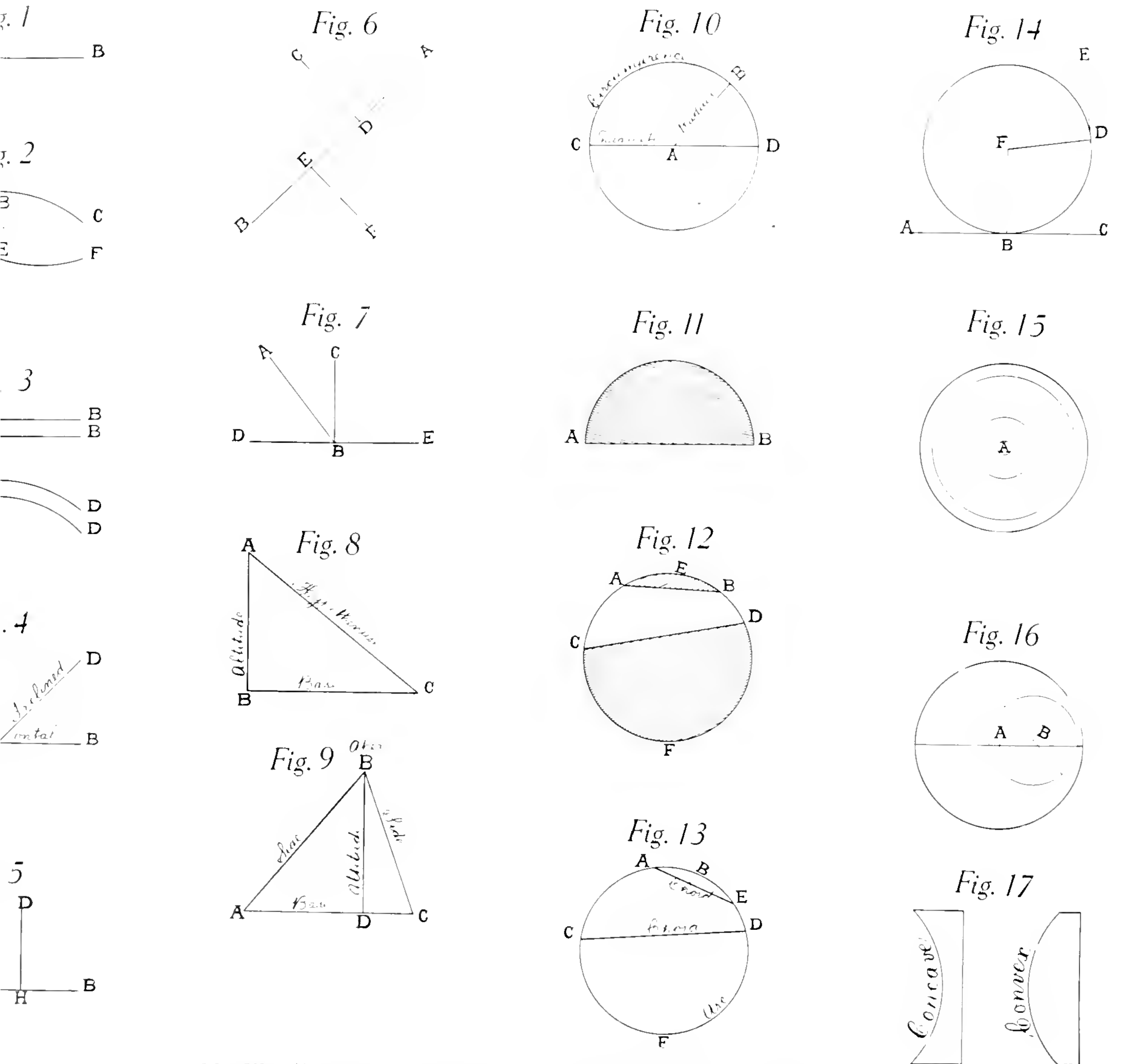
The DIAMETER of a circle is any straight line drawn through the center to opposite points of the circumference, as C D, Fig. 10.

A SEMICIRCLE is the half of a circle, and is bounded by half the circumference and a diameter. (Fig. 11.)

A SEGMENT of a circle is any part of its surface cut off by a straight line, as A E B and C F D, Fig. 12.



ILLUSTRATIONS OF GEOMETRICAL TERMS AND DEFINITIONS.



ILLUSTRATIONS OF GEOMETRICAL TERMS AND DEFINITIONS.

GEOMETRICAL TERMS AND DEFINITIONS—Continued

An ARC of a circle is any part of the circumference, as A B E and C F D, Fig. 13.

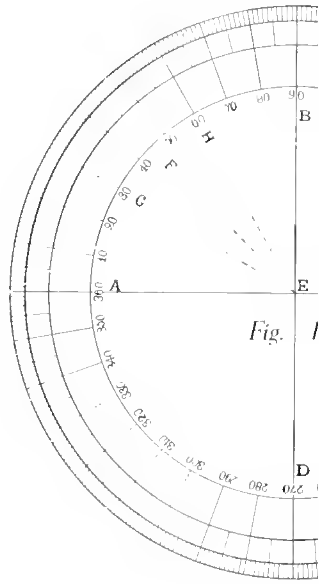
A CHORD is a straight line joining the extremities of an arc, as A E and C D, Fig. 13.

A TANGENT to a circle or other curve is a straight line which touches it at only one point, as E D and A C, Fig. 14. Every tangent to a circle is perpendicular to the radius drawn to the point of tangency. Thus E D is perpendicular to F D, and A C to F B.

CONCENTRIC circles are those which are described about the same center. (Fig. 15.)

ECCENTRIC circles are those which are described about different centers. (Fig. 16.)

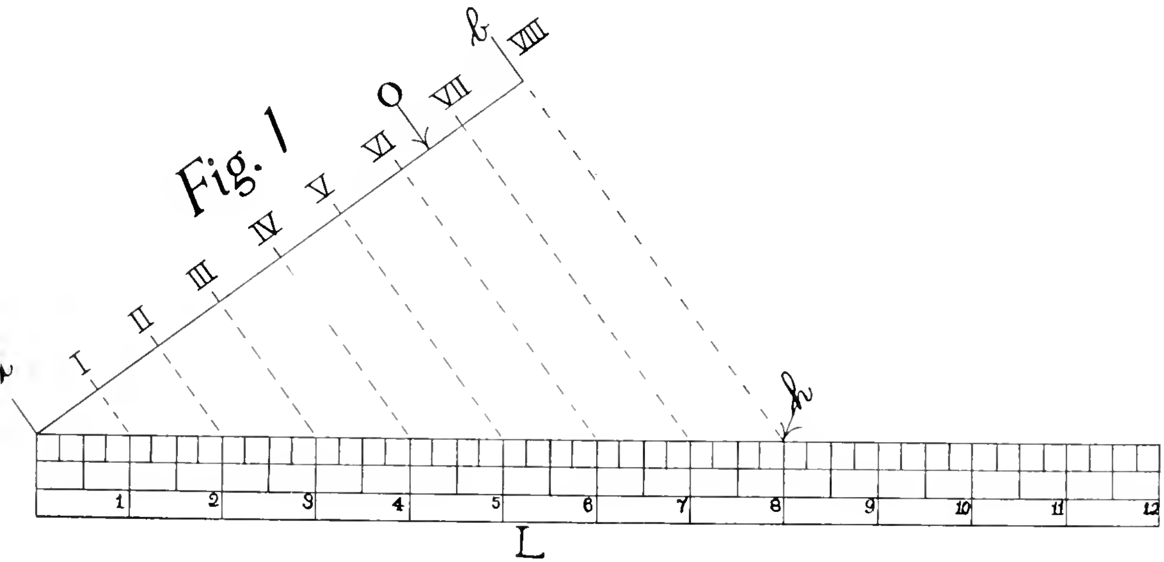
A DEGREE.—The circumference of a circle is considered as divided into 360 equal parts, called degrees (marked °). Each degree is divided into 60 minutes (marked ′); and each minute into 60 seconds (marked ″). Thus if the circle be large or small the number of divisions is always the same, a degree being equal to 1/360 part of the whole circumference; the semicircle is equal to 180, and the quadrant to 90. The radii drawn from the center of a circle to the extremities of a quadrant are always at right angles with each other; a right angle is therefore called an angle of 90 (A E B, Fig. 18). If a right angle be bisected by a straight line, it divides the arc of the quadrant also into two equal parts, each being equal to one-eighth of the whole circumference, or 45° (A E F and F E B, Fig. 18); if the right angles were divided into three equal parts by straight lines, it would divide the arc
containing 30 (A E G, G E I
the degrees of the circle are used
by an angle of any number of de
a circle with any length of rad
of the compasses in its vertex,
intercept a portion of the circle co
given. Thus the angle A E H,



CONCAVE means hollowe
the interior of an arched surface
to convex. (Fig. 17.)

A CONVEX surface is one
is regularly protuberant or bulgin
The opposite of convex is conca

e Off Equally a Number of Parts on a Line, the Length of Which is Given



s to divide a line $6\frac{1}{2}$ inches long into s. The easiest and quickest method is

Fig. 1. Draw a perpendicular line scale L from a until 8 inches strike the perpendicular line drawn from line O at h. Mark each inch from the scale on to the drawing, and project on to line O, establishing points I, II, III, IV, V, VI and VII, which are equally spaced on line O.

The Laying Out of True Sweeps or Curves when th
Amount of Sweep or Curve is Giver

Fig. 2

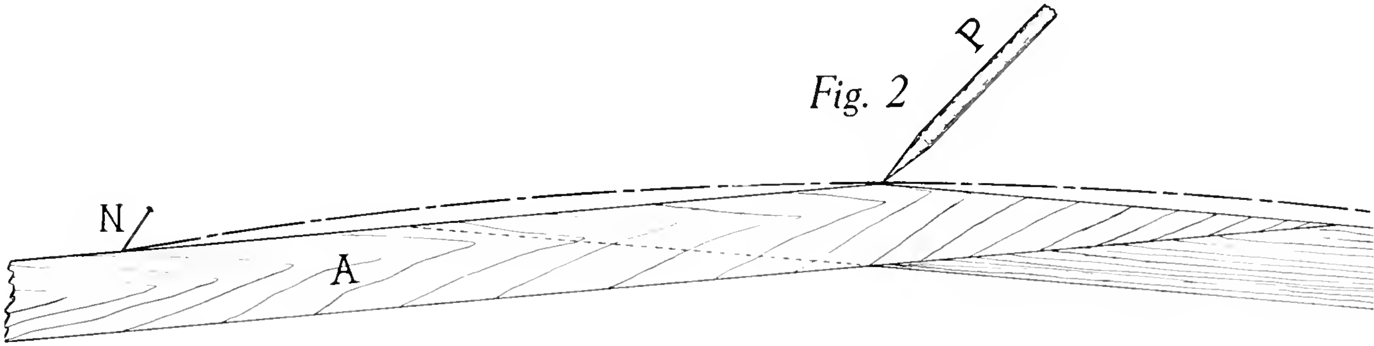
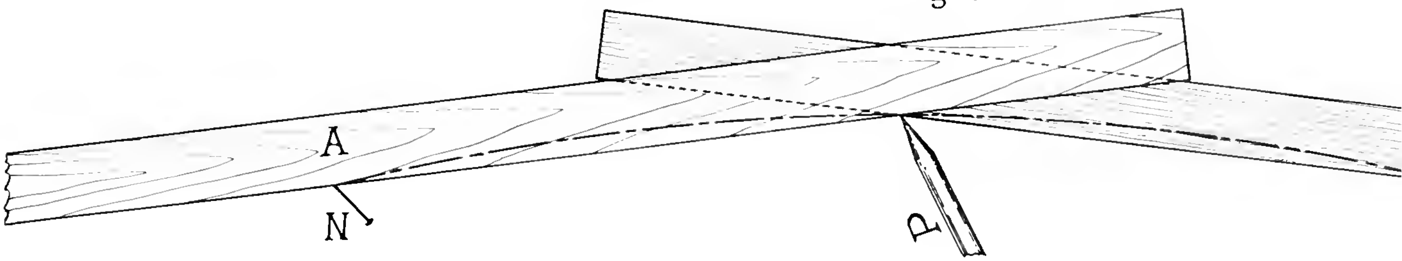


Fig. 1



FOR laying out true sweeps or curves where it is impractical to strike the radius with the compasses or trammel points, we illustrate the following example, and although the principle has long been in use, it is unknown to a great many mechanics.

For the example let us say
of 4 inches in a length of 40 in
line two points 40 inches apart.
nail as illustrated in Fig. 1. Hal
lay out on a perpendicular line a

` OF TRUE SWEEPS OR CURVES WHEN THE LENGTH AND AMOUNT OF SWEEP OR CURVE IS GIVEN—Continued

nt another nail. Next take two sticks, in the length of the sweep, and secure on the nails and forming a triangle, in Fig. 1 represent the sticks, and N

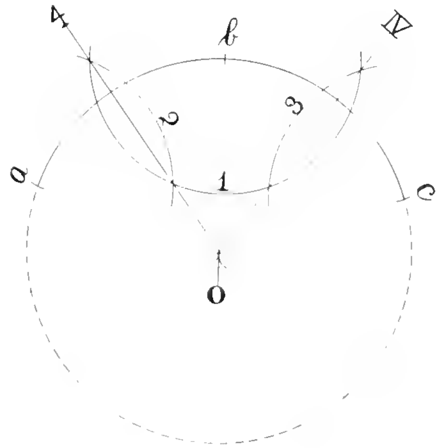
re placed tight up against the nails and that they cannot change their angle, nd notch out the sticks at this point so nay be placed therein.

eep, work the sticks back and forth in Fig. 1, being sure to have the sticks In this way a sweep of any length is system will be found very convenient in cases where the radius is too great to be reached by the compasses or trammel points.

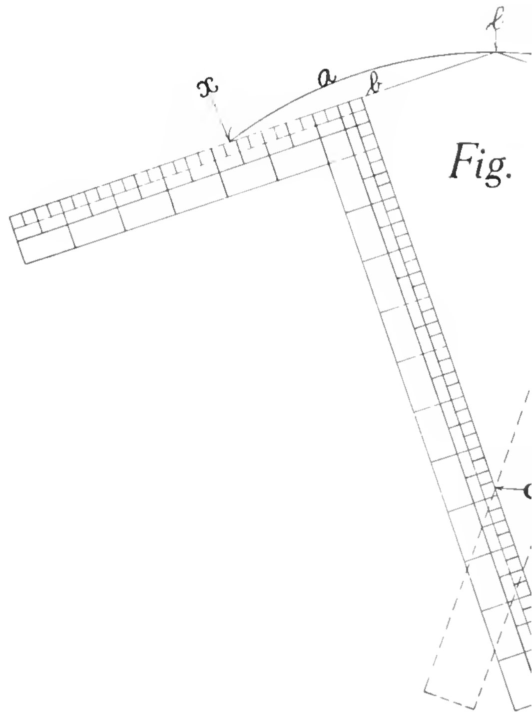
It is usually customary to form the sticks as shown in Fig. 1, and place the pencil on the inside of the sticks as shown, but in some cases it is desirable to construct the sweep as shown in Fig. 2, with the outside of the sticks bearing against the edge of the nails, and the pencil being placed in the notch on the outside of the sticks. Although this is sometimes desirable, we believe it will be found more convenient to lay a sweep out as illustrated in Fig. 1, inasmuch as one need not be particular in fastening the sticks together, except that they must be fastened securely so that they will not change their position in relation to the nails.

To Find the Radius of an Arc

Fig. 2



AN ARC FOR WHICH WE WISH TO FIND THE CENTER OR THE RADIUS



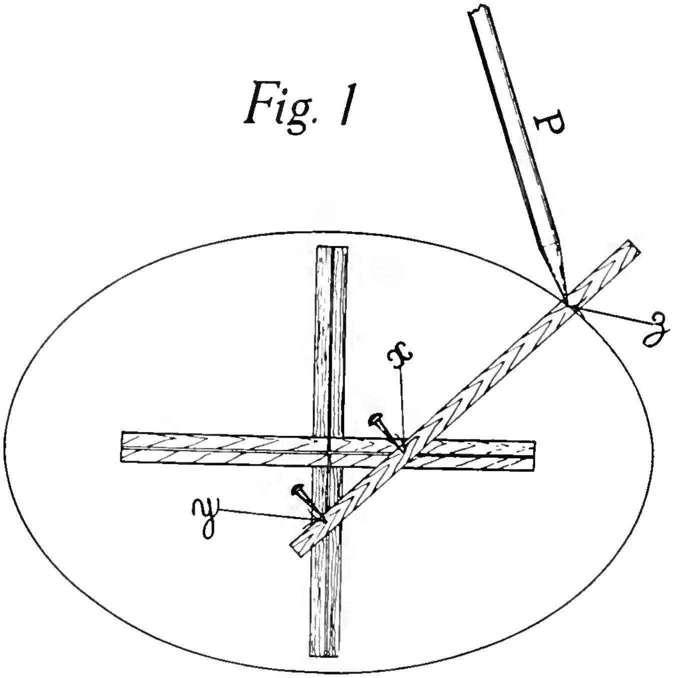
ANOTHER METHOD OF FIND

REFER to a-c in Fig. 2, an arc for which we wish to find the center or the radius that described same. Take point b, which is midway between a and c, and describe arc 1 therefrom, the radius of which is greater than half the distance from a to b, or from b to c. With the same radius centered at a and c describe arcs 2 and 3, passing through arc 1 described from b. Draw the lines 4 and IV through intersection of arcs, and where these lines intersect at O we will have established the center from which the large arc a-c was described.

Fig. 3 illustrates another m
of an arc by the use of a squa
arc x-n which is at l. Draw s
x, l and n. Find the center of li
the square placed on line l-n,
from c. Then with the square pl
line perpendicularly from the cen
intersects that drawn from c a
the arc x-n.

Laying Out Ovals

Fig. 1



ONE SYSTEM FOR FINDING AN OVAL.

al systems for laying out a true oval, cle we will explain and illustrate three ular.

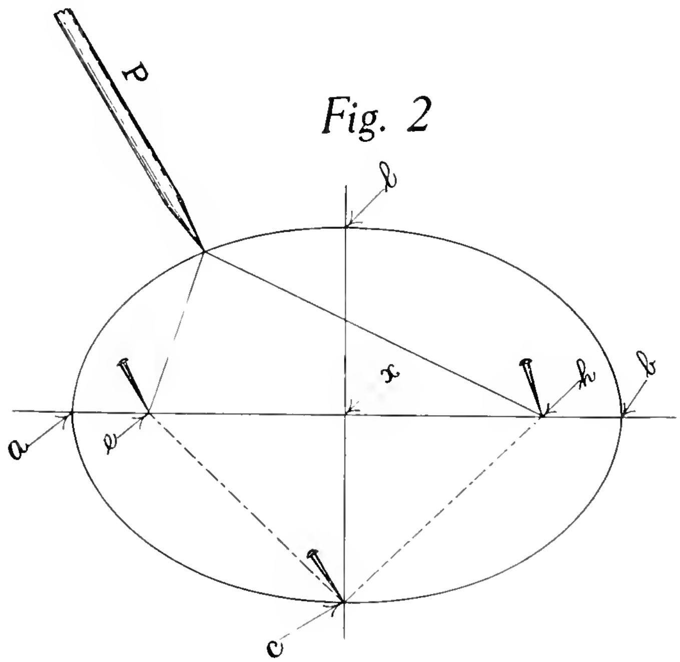
is illustrated in Figure 1. A square shape of a cross, and is grooved out as e two adjustable pins or studs secured y-x. Decide upon the length and width 18 inches long and 9 inches wide. Lay oint on the stick one-half the width of inches, from z to x. Locate one of the With one-half the length of the oval, which would be 9 inches, lay same off on the stick from z to y. Set the adjusted pins into the grooves in the cross frame and work the same up and down, and back and forward on the frame, having the pencil point bearing on the paper and describing a true oval around the cross frame.

Figure 2 illustrates another method for laying out an oval, and when there are no instruments at hand, same will be found very convenient. Lay out the horizontal and vertical center lines of the oval, and on same lay out the length and width desired. Take one-half the length of the oval from x to a and lay this distance out from c until same strikes the horizontal

LAYING OUT OVALS—Continued

center line of the oval at e and h, at which points locate two pins or tacks, as illustrated. At point c locate another pin or tack, and around these three pins or tacks tie a piece of string taut, forming a triangle e-h-c. Remove the pin or tack at c, and put the point of a pencil in its place. Keeping the

Fig. 2



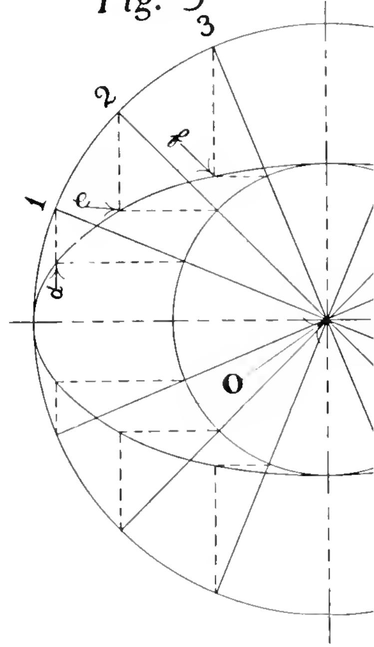
ANOTHER SYSTEM FOR FINDING AN OVAL.

string taut, with the pencil back of same, work the pencil P around the pins, which operation will produce a true oval.

Fig. 3 shows another handy system for laying out a true oval. Draw the horizontal and vertical center lines of the oval, and determine the length and width. From O, the center of the oval, draw a circle B, the diameter equal to the width

of the oval. Draw another circle
diameter of which will be equal
Space off a number of points 1,
A, and connect with the center o
lines drawn from 1, 2 and 3 inters

Fig. 3



LAYING OUT A TRUE

horizontal lines, outward, and fro
outer circle A, drop vertical proj
horizontal lines drawn from the i
The same operations apply for ob
required, and after same are foun
them with graceful sweeps which

.pplication of the Proportional Triangle for Laying Out Twisted or Winding Surfaces

l triangle will be used to a great extent
e following problems for laying out pro-
-unders of twisted or winding surfaces.
these advance problems will be found
ing the student for some of the more
taken up in some of the following

ain Fig. 1. The turn-under sweep B-Z
d from this line, providing we know the
turn-under, we may work proportional
r any part of the body. B-Z being the
sweep, we desire to find out the correct
ler sweep for another part of the body
ll amount of turn-under is equal to the
' on line O-O, Fig. 1.
ine Z-X be drawn through the horizontal
a triangle BCX below line O-O. Point
med turn-under sweep. Point C is fixed
-X as drawn from the top of the body
base line O-O, and, in completing the
nt we have to determine is X, and this
arily on the vertical line Z-X and to suit
have point A also fixed by the over-all
r sweep which we wish to proportion, so
another triangle ACX, X being the
th triangles.

Now we have laid out a triangle for each turn-under, and it is by means of these triangles and the assumed turn-under sweep that we will develop the greater turn-under sweep A-Z. Passing through the assumed turn-under sweep B-Z and the vertical line Z-X, lay out a number of lines I, II and III at will above the horizontal line O-O. Where each one of these lines passes through the assumed turn-under sweep B-Z, take I for instance, drop a vertical line until we strike the hypothenuse for the proportional triangle of the assumed turn-under sweep. From this point draw a horizontal line passing through the triangles and number it 1. Where this line strikes the hypothenuse of the larger proportional triangle, erect a perpendicular line until line I is reached, thus establishing a point through which the correct proportional turn-under line A-Z must pass. Continue this operation with the remainder of the points, and connect with a graceful sweep, and we will have obtained a correct proportional turn-under, line A-Z, to the assumed turn-under, B-Z.

In Fig. 2 we illustrate another example which is equally important as that of Fig. 1. When a body is constructed with untwisted sides as far as the seat bottom, and in this illustration, Fig. 2, we will consider that the seat frame or the commencement of the twist is from line IV. B-Z is the assumed turn-under sweep. A-Y is the amount of turn-under at another part of the body for which we wish to proportion the turn-under sweep, having the same twist from the under

THE APPLICATION OF THE PROPORTIONAL TRIANGLE FOR LAYING OUT WINDING SURFACES—Continued

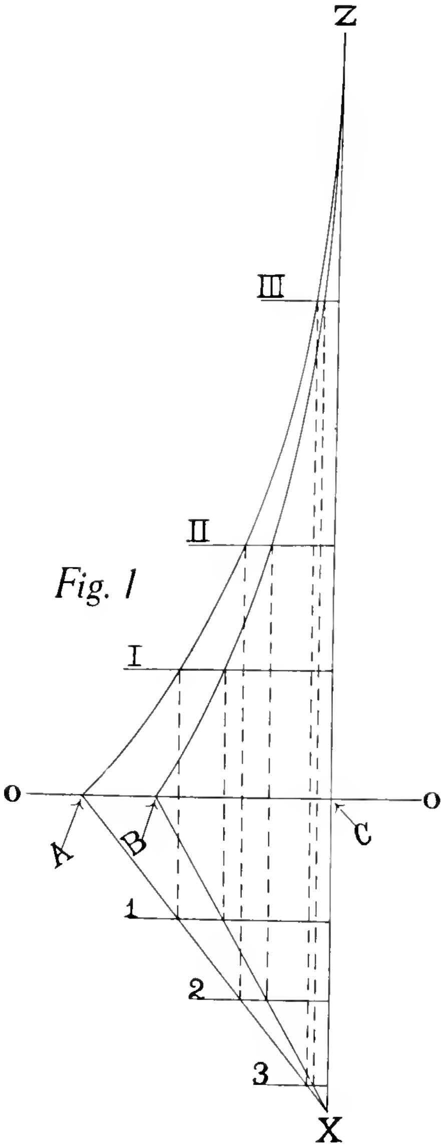
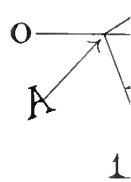


Fig. 1

side of the seat or line IV. Draw the straight line Z-X as a continuation of the body line before it commences to turn under at IV. It is on line Z-X that we locate the common apex X of our proportional triangles, which, as in Fig. 1, is determined at will. Lay out the proportional triangles BCX and ACX for the assumed turn-under sweep and the desired turn-under sweep, respectively. Space off a number of lines I, II, III and IV passing through the assumed turn-under sweep. Wherever these lines cut the assumed turn-under sweep, line B-Z, draw lines down on to the proportional triangle parallel with the outside line Z-X. Where these parallel lines strike line B-X of the triangle BXC, draw horizontal lines 1, 2 and 3 passing through the line A-X of the larger proportional triangle ACX. Project these points up and parallel to the outside line Z-X until lines I, II and III are intersected, thus establishing points through which the desired turn-under sweep will pass.

The only difference between this problem and that in Fig. 1 is that, instead of the usual vertical projections from the assumed turn-under sweep to the proportional triangles, the projections are parallel with the outside flared line Z-X. Fig. 2.



F

Construction of Joints

this subject as we would like would require
n this book than can be spared: therefore
in briefly the ordinary construction of the
in body-making, and we believe that the
found of great value to the beginner, and
ve for further study in this very important

ED OR LAPPED JOINTS

nt varies in shape and arrangement with
he pieces united. A full lap is used when
the other to its full thickness; a half lap
ted is cut away, whatever the shape of the
ommon expression, "half-lapped," does not
e united must be cut half away.

ne framing up of a toe bracket, each piece
nto the other. In the sill and angle piece
rabbet for the floor board, as shown by
In Fig. 2 is shown a batten or strainer
with a feather-edge lap joint. As this
has little work to do other than that of
n shape and supporting it, this kind of a
o one more complicated. Fig. 3 illustrates
oof bow into the head rail of an enclosed
pped joint. Fig. 4 illustrates a section of
the post half-lapped into the sill and top
rail. As an illustration of a full-lap joint we show the floor board let into a rabbet in the sill.

MORTISE AND TENON JOINT

Fig. 5 shows the two pieces to be united which form this joint. Note that they are both of the same thickness, and A is cut away equal on both sides for the tenon. The projecting part c on A, Fig. 5, is the tenon, and d in B is the mortise. e is the shoulder of the tenon, which is equal on both sides. f is usually one-third of the thickness of A and B.

BARE-FACED TENON AND MORTISE

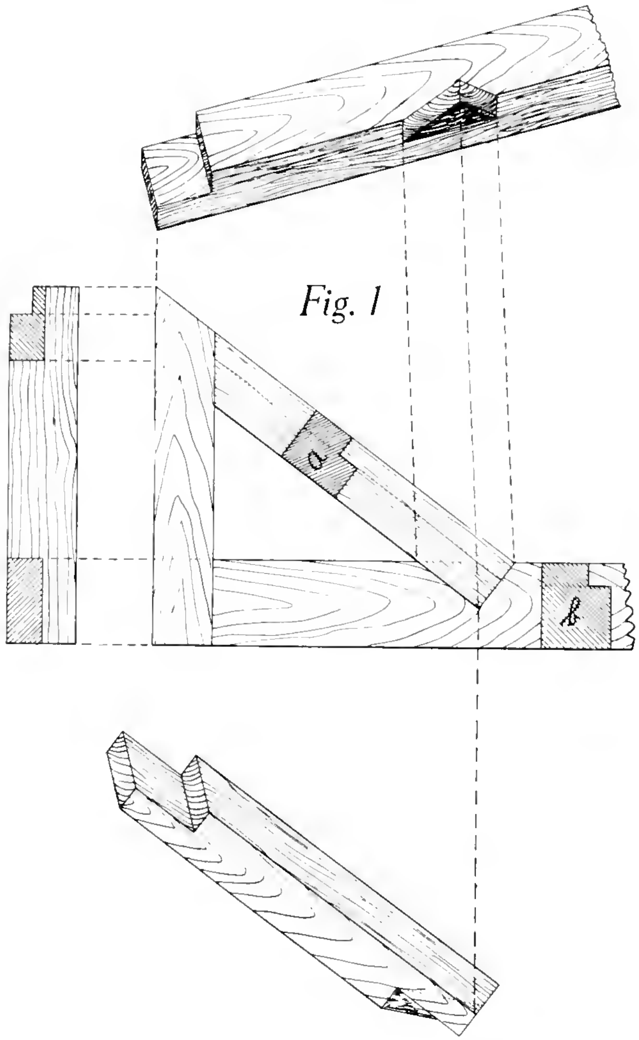
In Fig. 6 we illustrate a bare-faced tenon and mortise joint. This means that the face of the tenon, or both faces, are exposed. The bare-faced tenon and mortise is used when two pieces are joined endways in the same direction, or endways in different directions, as shown in Fig. 6.

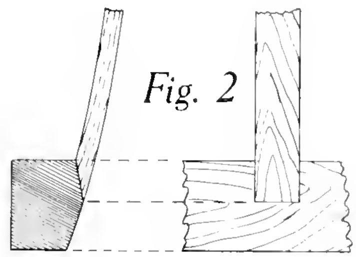
STUMP TENON.

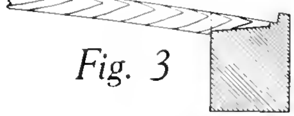
Fig. 7 shows a mortise, tenon and stump joint, and is frequently used in framing up parts where certain joints should not be exposed as they are in Fig. 6. The stump reinforces and prevents twisting.

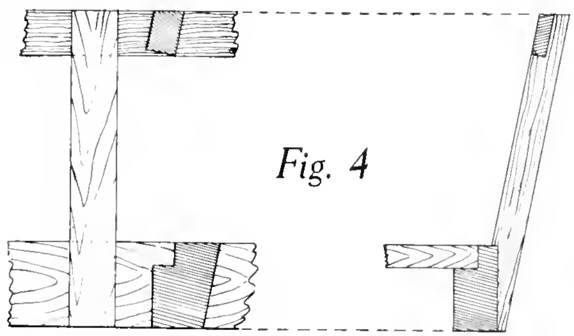
OPEN MORTISE, TENON AND MITER JOINT

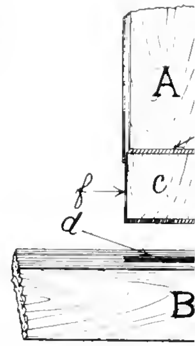
This joint is illustrated in Fig. 8, and is used in framing up parts where it is undesirable to have the joints exposed.











ILLUSTRATING THE CONSTRUCTION OF JOINTS

CONSTRUCTION OF JOINTS—Continued

E TENON AND MORTISE

on and mortise joint is illustrated in Fig. 9. ning the fence bar a into the door pillar b. ikes a stronger joint than with a single eases a single mortise and tenon joint is t is also illustrated in Fig. 9, the lock to the pillar b.

FALSE TENON

a false tenon for joining a frame, as case a false tenon is used on account of not as satisfactory as a bare-faced tenon In framing up parts with a false tenon, to have the grain of the tenon cross that parts united.

MITER JOINT.

a simple 45-degree miter joint. This is

TENON AND LAP JOINT.

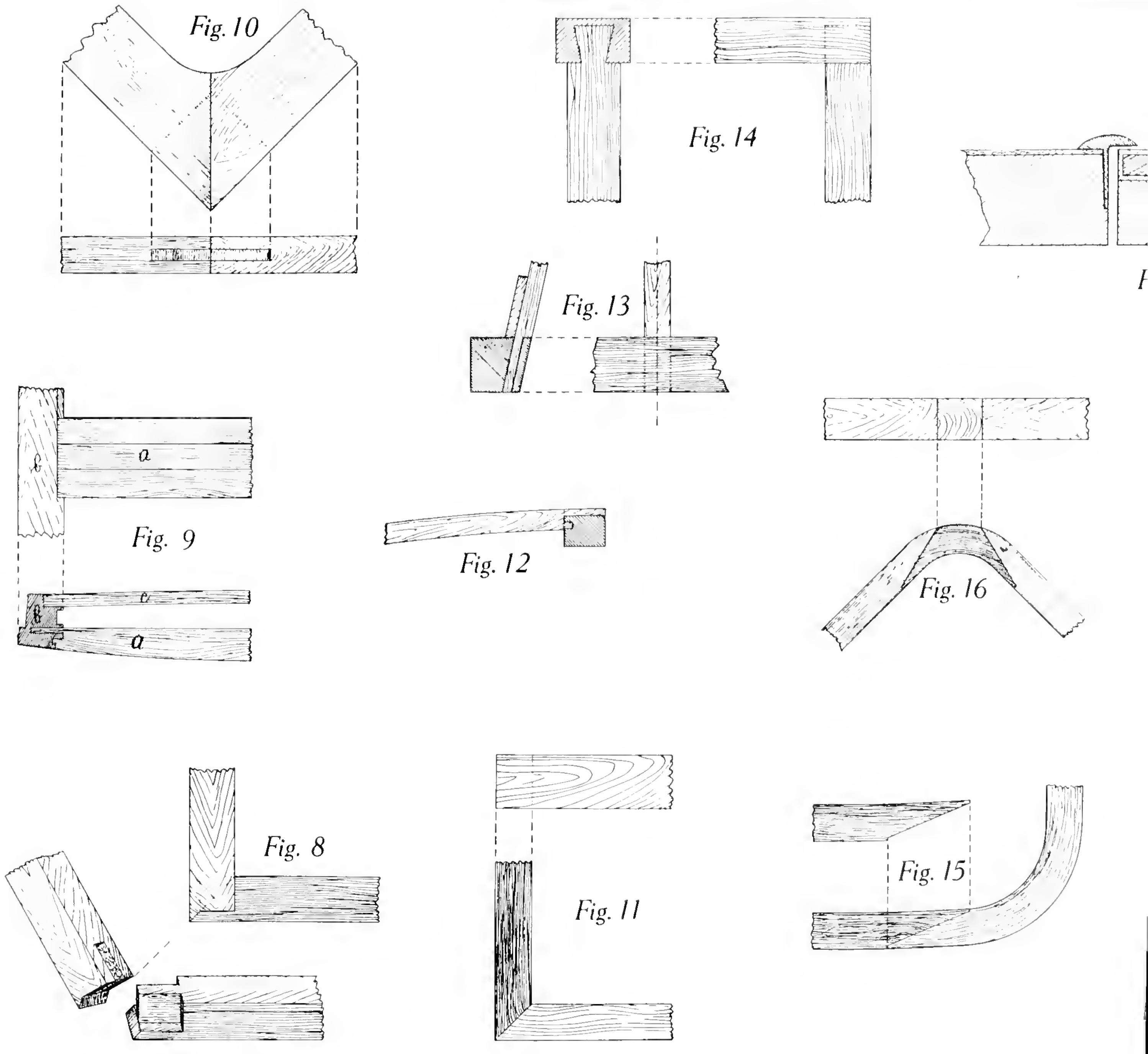
tes a stump tenon and lap joint, which is the half-lap, and is frequently used in ls and pillars.

BASTARD TENON

This joint is shown in Fig. 13 in the framing of a post into a sill and where exposed joints are undesirable. It will be seen that the half-lap joint would show two long joints, while a mortise and tenon joint would be impractical inasmuch as the tenon would be too close to the outer surface.

Fig. 14 illustrates dovetail joints. Figs. 15 and 16 show ordinary splice joints. Fig. 17 illustrates a method for securing metal panels to body framing, and by this method we do away with exposed screw heads and nails, the metal panel being turned around a 1/4″ x 1″ flat iron which is let into a rabbet flush with the standing pillar. This is secured by means of machine screws from the inside of the post which are covered up by the trimming.

Fig. 18 illustrates a method for securing the upper panels, above the belt, of a limousine body. Note that this upper panel is offset from the lower panel, and that the belt rail is rabbeted out to receive an iron plate and around which is formed the upper metal panel. The lower panel also comes up back of this iron, forming a tight joint, the iron being secured by means of machine screws from the inside of the belt rail, as illustrated. This upper offset panel is generally made of wood, but this construction eliminates the troubles incident to wood panel construction, over which the metal panel has the advantage.



ILLUSTRATING THE CONSTRUCTION OF JOINTS

t a Proportional Corner by the Use of Proportional Triangles

ofile or side view of an automobile seat. ialf the bottom view, and Fig. 3 is the side of the seat. Lay out the horizontal line EC om the extreme height of the seat. This nary, but is necessary in laying out the

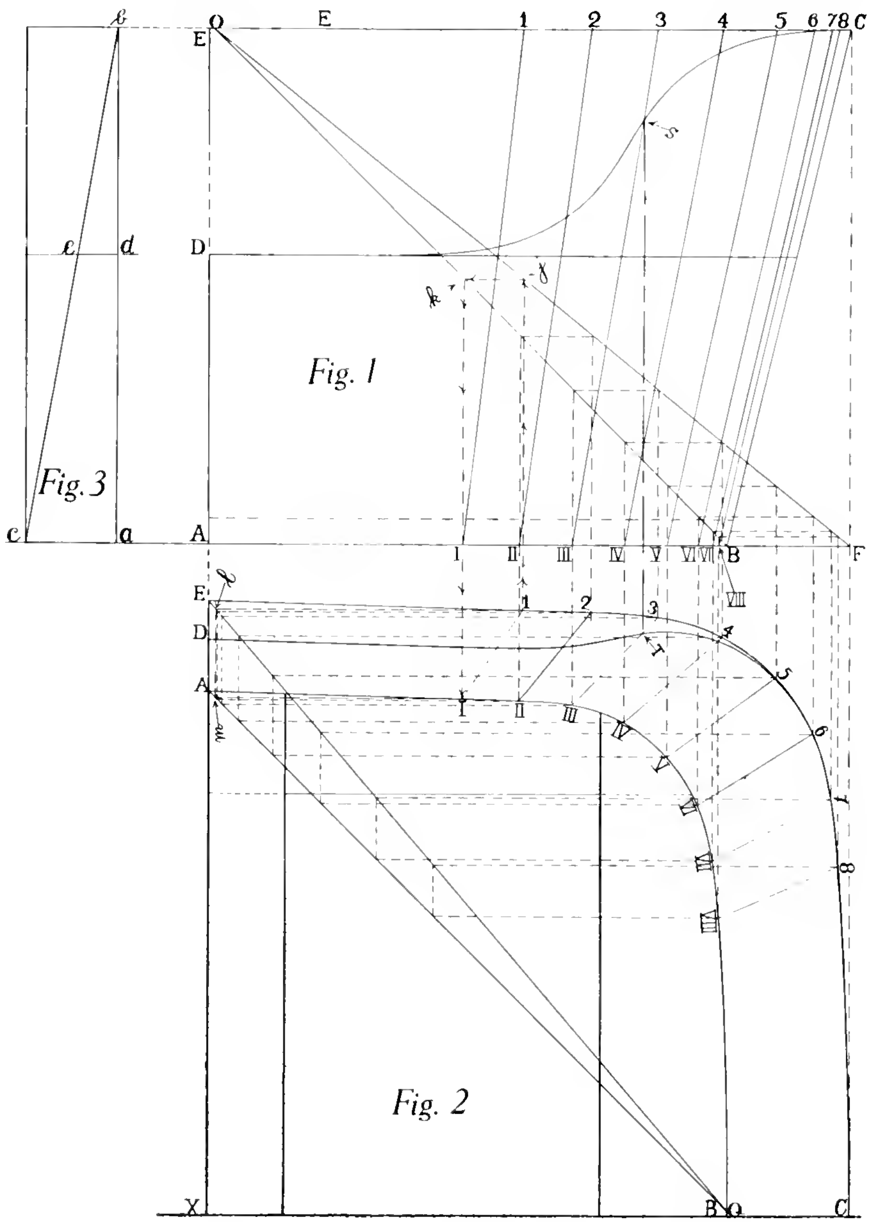
he corner in Fig. 2 it is necessary to assume round the seat, or the bottom line. In this line EC, Fig. 2.

out the proportional triangle FOB. BF is bevel squared down to the bottom of the apex O should be located on the horizontal inning of the proportioning.

the proportional triangle EQA, Fig. 2. of side bevel or flare taken from Fig. 3. x of the triangle, and should be located on The line AQ of the proportional triangle, OB of the triangle on Fig. 1.

ingles located, lay off arbitrarily on line 1, 2, 3, 4, 5, 6, 7 and 8 around the corner. e point up to the outside line of triangle en square point ahead until it strikes inner . 1, at k. From this point drop a perpen- ig. 2.

on line EC, Fig. 2, lay out horizontal pro- side line of proportional triangle, Fig. 2, endicular line on to inner line of triangle



SIDE VIEW, ONE-HALF BOTTOM VIEW AND SIDE BEVEL AND FLARE OF AN AUTOMOBILE SEAT.

LAYING OUT A PROPORTIONAL CORNER BY THE USE OF PROPORTIONAL TRI

at m. From m draw a horizontal line back until it intersects vertical line drawn from k, Fig. 1, thus establishing the point I which is proportional to point 1 on line EC, Fig. 2. Continue this operation with 2, 3, 4, 5 and 6, etc., and we will have obtained points on the seat frame through which the bottom line AB in Fig. 2 must pass.

In order to lay out arm rail, 6 to D on Fig. 2, proceed as follows:

Connect points 1, 2, 3, 4, 5 and 6 on line EC, Fig. 2, and corresponding points on line AB with straight lines. Project these same lines and points on to Fig. 1. Wherever the arm rail line cuts these lines, take s for an example, Fig. 1,

square this point down until it inter
on Fig. 2 at T. Repeating this op
intersections will produce the poin
the arm rail line should pass.

D shows the amount of side
arm rail on line ed, Fig. 3. This
can be applied for obtaining any i
lines AB and EC, provided the f
all around. Do not attempt to us
if the turn-under is either conca
proportional scale as explained a
this book.

ng Out of Proportional Corners by the Use of Parallel Lines and Intersections

we illustrate and explain another system
roportional corners of seats, etc. This
connection with the problem taken up
laying out proportional corners, but is
od which is used a great deal, and we
nt to select whichever is most convenient
we have adopted this system throughout
it the handier of the two.

sary to draw out the seat in the profile
e partly imaginary line a-O drawn hori-
xtreme height of the seat or body. In
, assume either the bottom seat line d-D,
ry line a-A taken from the horizontal line
t of the seat in Fig. 1. In this problem
ut the top line around the seat a-A to
this line in Fig. 3, after we have obtained
Fig. 2 and the flare of the back in Fig. 1,
to Fig. 3, we will obtain the proportional
m and intermediate sections.

around the seat, a-A in Fig. 3, lay out
amely, 1, 2, 3, 4 and 5, same being located
e of the corner. With the use of these
d to obtain points corresponding to these
the seat, Fig. 3, through which the same
. From point 6 on the center line of the seat in Fig. 3 draw a straight line connecting with point 5 on the top line of the seat, and parallel to this line from point VI draw another line extending indefinitely through the seat.

From point A on the partly imaginary line a-A in Fig. 3 draw a straight line, and connect same with point 5 on line a-A, and parallel to this line draw another line from D on the front of the seat at the bottom until same line intersects the line drawn from VI at V.

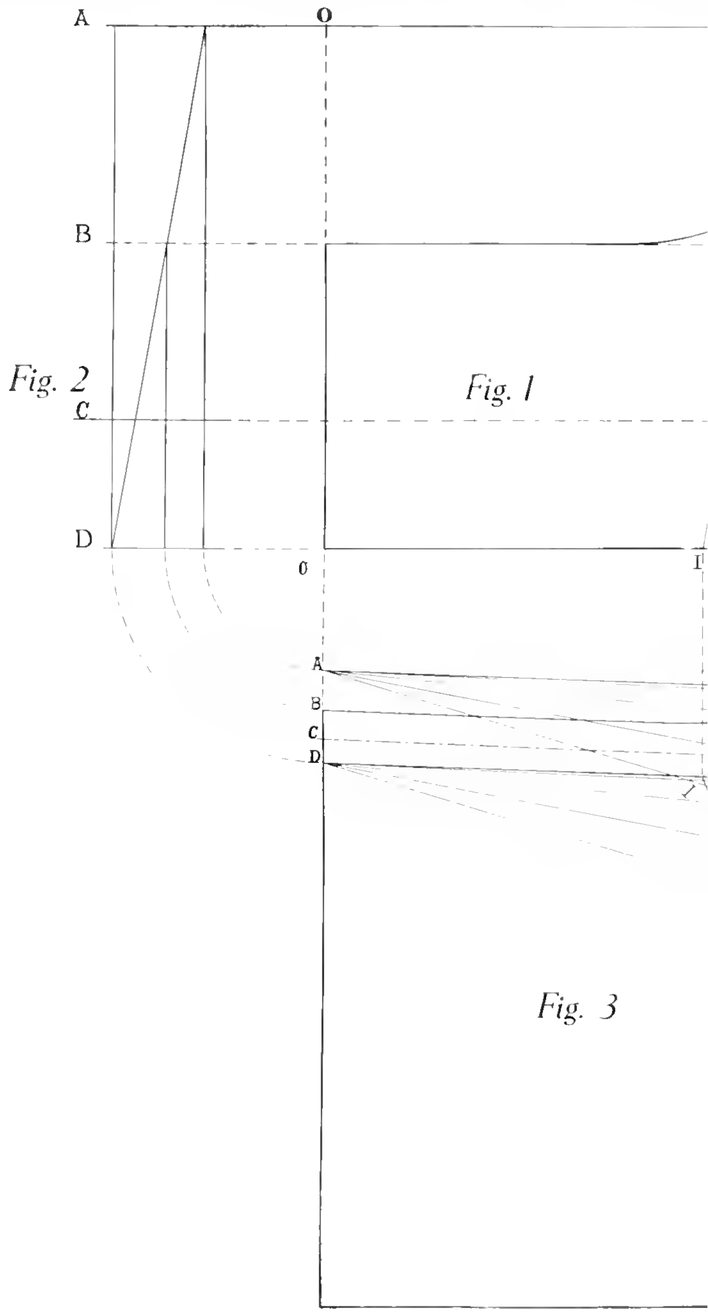
From each of the remaining points, 1, 2, 3 and 4, on the top line of the seat a-A, Fig. 3, draw lines to points 6 and A on line a-A, and parallel to these draw lines from VI, and from D until lines drawn from D intersect those drawn from VI at I, II, III and IV. This establishes proportionally points through which the bottom line of the seat d-D should pass.

Now that we have the top and bottom lines of the seat, it is essential to prick off the arm rail line in Fig. 3, which is accomplished as follows:

Project from Fig. 3 to Fig. 1 on to their relative positions lines 1-I, 2-II, 3-III, 4-IV and 5-V. Wherever the arm rail line passes through these oblique lines in Fig. 1 drop vertical projections until same strikes corresponding oblique lines in Fig. 3, thus establishing points through which the arm rail line shall pass. Take the amount of flare at the front of the seat and the height of the side in Fig. 2 and transfer from D to B in Fig. 3. Draw graceful line passing through the points already obtained, and same will produce the arm rail line in Fig. 3.

Now, we are supposing that the construction of this seat calls for a belt moulding or rail around the seat at the height of c-C in Fig. 1. We wish to produce this line around the seat in Fig. 3, and to accomplish same we will take points where line c-C in Fig. 1 passes through the oblique lines 1, 2, 3, 4 and 5 and project these points down on the corresponding oblique lines 1, 2, 3, 4 and 5 in Fig. 3. Take the amount of flare at the height of C from Fig. 2, and lay same out in its correct position from D to C on the front line of the seat in Fig. 3. Also take the amount of flare at the height of c from the back of the seat in Fig. 1, and transfer from d to e on the center line of the seat in Fig. 3. Connect these points with the points already obtained on lines 1, 2, 3, 4 and 5 in Fig. 3, and we will have produced line c-C in Fig. 3, corresponding to line c-C in Fig. 1, which is proportional with top and bottom sweeps of the seat in Fig. 3.

Likewise any point on the bottom view of the seat in Fig. 1 can be obtained in the same manner, the system being that of projection.



ILLUSTRATING THE LAYING OUT OF PROPORTIONAL COR

Out Seat Panels, the Dihedral Angle of a Corner Block, and Miters of a Wagon Seat

d 2 represent the side elevation and one-. respectively, of a wagon seat. Line be esents the back flare: line be in Fig. 2 lare. In order to lay out the exact size d as follows:

passes at b in Fig. 2, describe an arc s the vertical line at II. Project point ig. 1 until it strikes the vertical line F at d C, Fig. 1, gives us the exact flare of de panel. Lay out a line DC parallel to ide panel de, Fig. 1, until it strikes the rom d at D. Connect points D and a, ive us the front line of the seat panel. sh lines connecting a, D, C and b, Fig. 1, ze of the stock for the side panel.

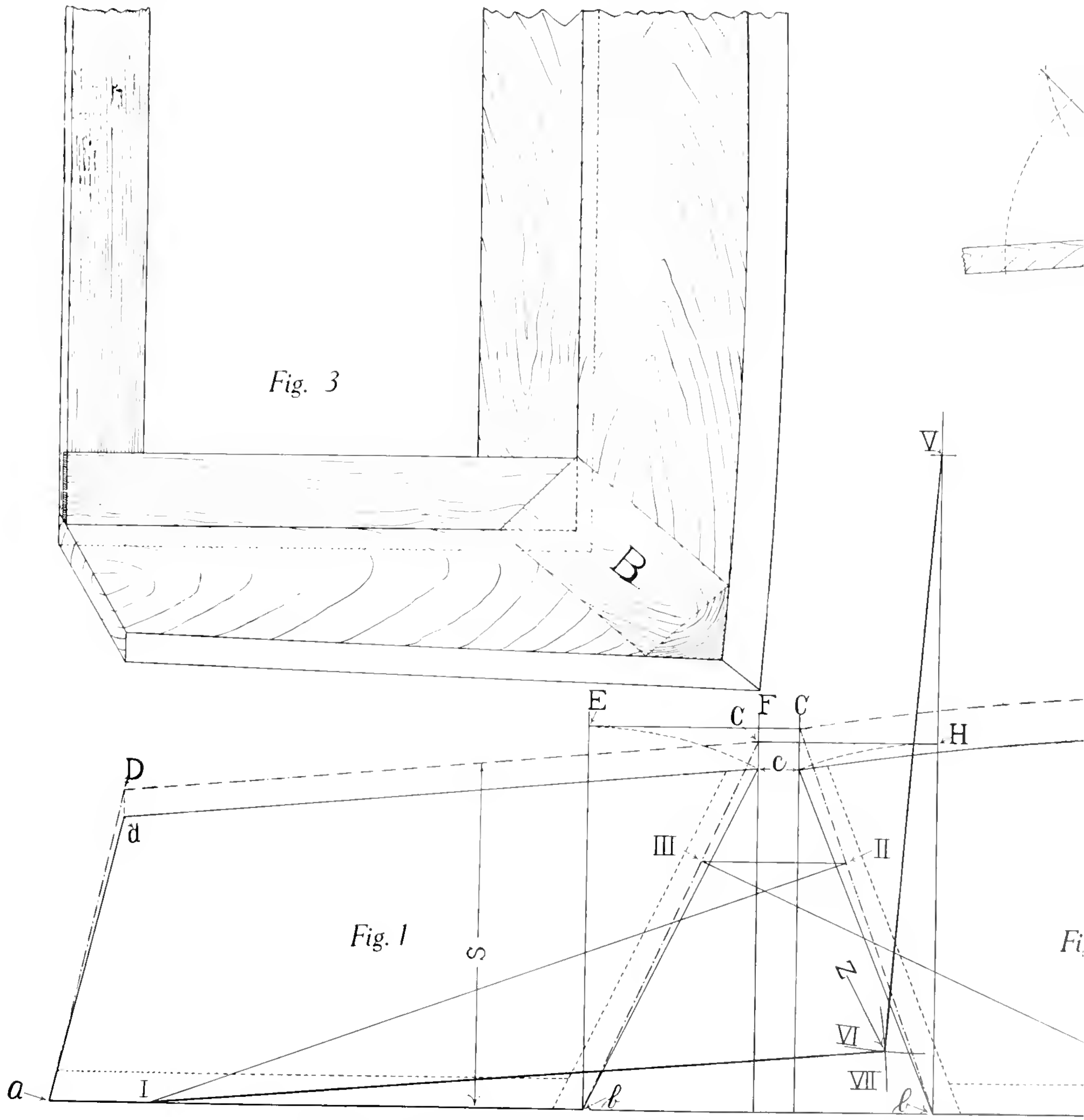
of the stock for the back panel, set the g. 1 and describe an arc from c, striking C. Square this point on to vertical line ct with b, Fig. 2, as shown by dot and the top line of the panel parallel to line he size and shape of the stock for the

e the size of the seat panels, it is desirable dral angle or corner block bevel. From point III, which is taken arbitrarily, on the line of the stock, Fig. 1, draw a line perpendicular to the line of the stock bC, Fig. 1, until it strikes the base line at V. From the line of the stock for the back panel, bC in Fig. 2, square a line from II down to the base line at I. Point II, Fig. 2, is a horizontal projection from III, Fig. 1.

The next operation is to draw a line perpendicular with the base from point b in Fig. 2. Take the distance from V, Fig. 2, to b, Fig. 1, and lay same off from b to V on the vertical line in Fig. 2. Take the distance from point V, Fig. 2, to III, Fig. 1, and as a radius describe arc VI from point V on the vertical line b. Next describe an arc from point I, Fig. 1, with a radius equal to the line from I, Fig. 1, to II, Fig. 2, this arc VII intersecting arc VI at Z.

Now the dihedral angle or corner block bevel will be taken from the angle IZV. In order to find the bevel of the mitres for the seat panels, simply take the corner block bevel and bisect same as illustrated in Fig. 4.

For further explanation, the dot and dash lines in Figs. 1 and 2 indicate the shape and size of the seat panels or stock when laid flat, marked by S, Figs. 1 and 2. In Fig. 3 the corner block B is illustrated, and should be planed up with the bevel as taken from IZV.



LAYING OUT SEAT PANELS AND FINDING THE DIHEDRAL ANGLE.

aming Up of Bodies Having Contracted and Flared Sides

e illustrate two problems, Figs. 1 and 2, portions of seat framing showing an ned into a seat frame and top rail. The ns is to show how to obtain the bevels of ngle or sail that should be given the post stand in its correct position when set up and flare.

is constructed with a post standing square side view, A, Fig. 1, the post cannot be th the contracted lines of the seat frame ust be set at a certain angle, so that when flared it will stand square or plumb in the amount of contraction and flare deter- bevel that should be given to the joints to stand square in the vertical plane A. equired bevel of the joints or angle of follows:

t the side view A, having the post square the base line. Determine the amount of l lay out on the end view B, and on the he amount of contraction desired. From ge of the post where it intersects the top . I, draw a line perpendicular with the top strikes the bottom line of the seat at III. om II, where the back edge of the post edge of the seat frame, to III on the bottom view C, and transfer from II forward to III on the bottom line of the seat in the side view A. Draw a straight line passing through I and III which will establish the angle or sail on which the post must be framed up in order to have it stand square or plumb in the vertical plane A after it is thrown around on the contraction and flare.

Fig. 2 illustrates a similar example, the only difference being that the post is set up on an angle or sail in the vertical plane A. In framing the post into the top rail and seat frame the bevels for the joints must not be taken directly from the side view A, but should be determined by means of the following system:

From the contraction line b-d on the bottom view C, square a line from the intersection of the back edge of the post with the top of the top rail at I until it strikes the bottom of the seat frame a-e at IV. From point I on the bottom view draw a line square across the body, intersecting the bottom of the seat frame line at III. Take the distance from III to IV on line a-e in the bottom view C, and lay same out on the bottom line of the seat in the side view A from the back of the post II forward to III. Connect III and I with a straight line, thus establishing the angle or sail on which the post must be framed up in order to have it conform, after it is swung around on the contraction, to the angle or sail shown in the vertical plane A. This line also establishes the bevel on which the shoulders for the joints should be cut.

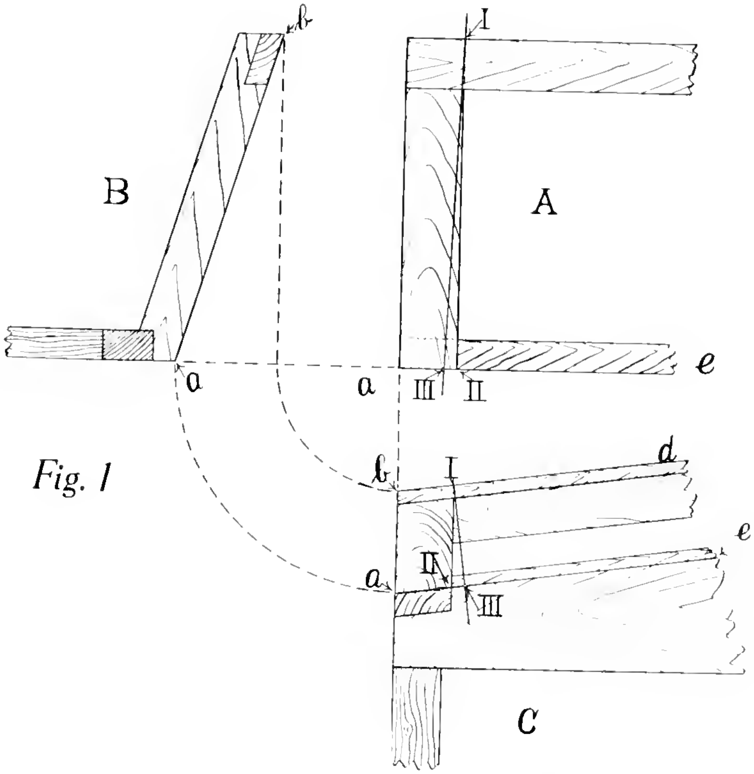


Fig. 1

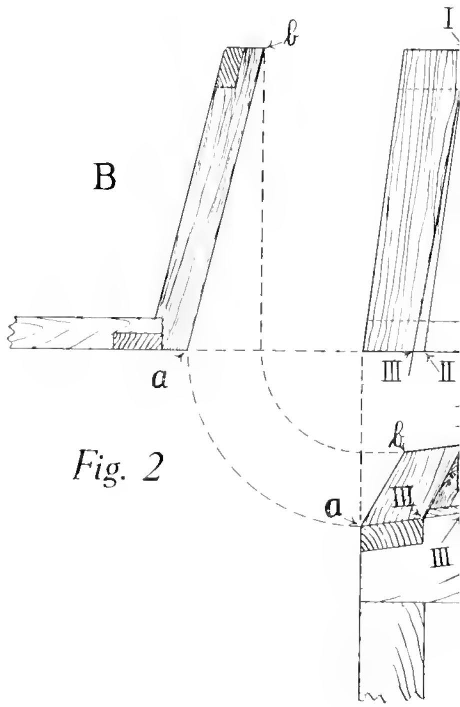


Fig. 2

REPRESENTING PORTIONS OF SEAT FRAMING

Proportional Corner and Laying Out of Horizontal Sections and Corner Strainers on a Torpedo Body

s are illustrated on the rear of a torpedo et us explain the position of the propor- Referring to page 24, we will find the taining the bottom line around the corner p line is assumed.

will be noted that the proportioning ne front of the seat on the side, and the t the rear. The points from which the s regulate the size of the corner some- This, of course, is a matter of taste. If corner at the bottom, he may work the 5, but the method we introduce in this ry satisfactory, and we recommend it on As will be noted, it gives a smaller corner er the side view or profile of the body is , the width from the center line to Z in -under, Fig. 3 should be laid out on the

on is to assume the line Z-Y, Fig. 2, taken Fig. 1, and Y-Z, Fig. 4, but care should a smooth and graceful line around the

op corner sweep forms tangents to the s, as at f and e, Fig. 2, draw horizontal pectively, until they intersect at H, Fig. 2. Fig. 2, up until it strikes the horizontal line Z-Y, Fig. 1, and from this point draw a straight line parallel to t until it strikes base line X-T at g. Square this point down to the side sweep, Fig. 2 at g, and this gives us the commencing of the proportional corner on the side.

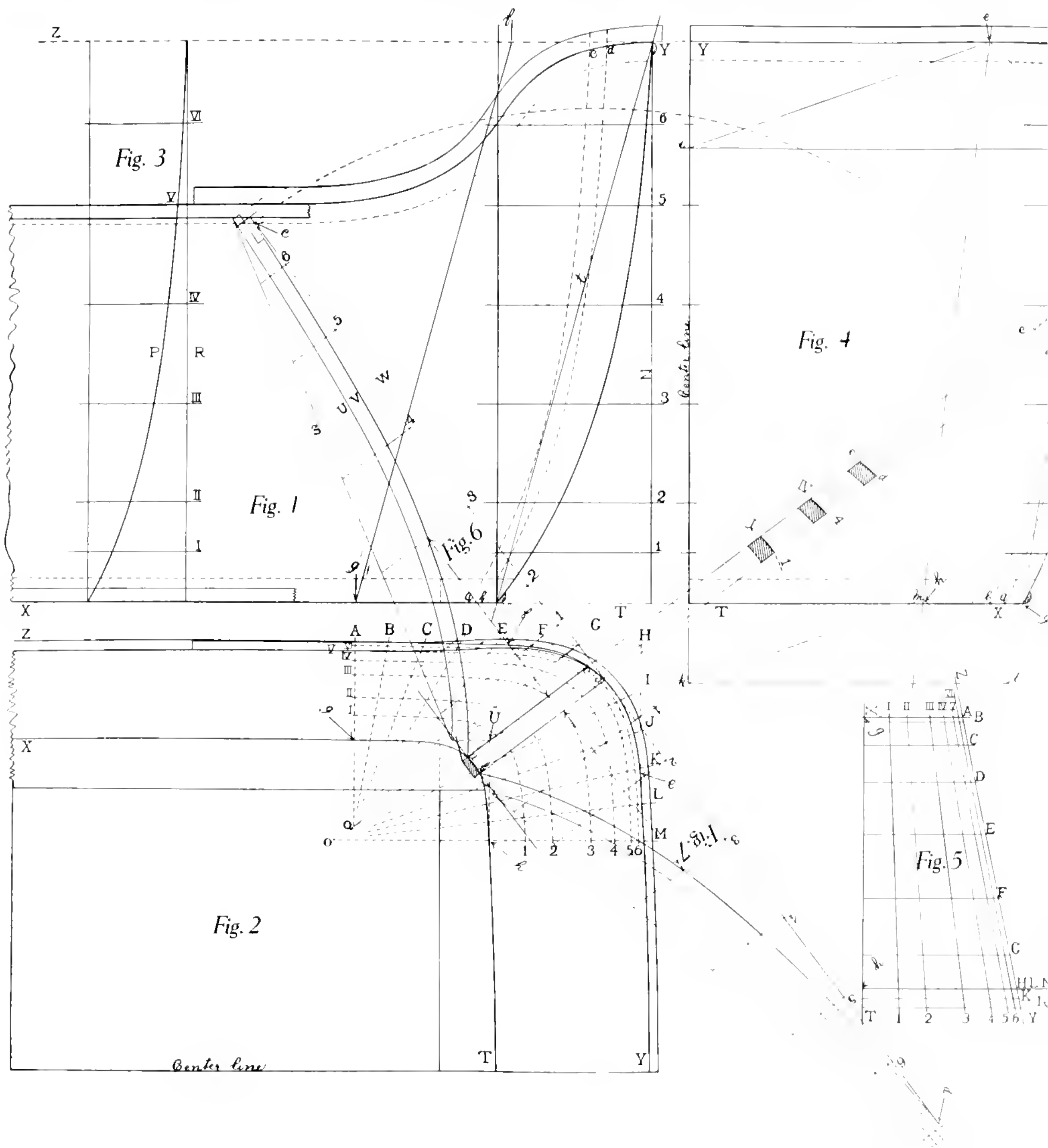
To find out where to commence the proportional corner at the rear, lay out points A and g, Fig. 4, which correspond to A-g, Fig. 2. Connect these points on Fig. 4 with a straight line.

From e on the horizontal line Y-Z, Fig. 4, which is taken from center line to e, Fig. 2, draw a line at any convenient angle, say 45 degrees, until it strikes straight line connecting A and g at j, Fig. 4, from which draw a horizontal line until it strikes center line of rear view at i. Connect i and e, and we will have completed a triangle e-i-j.

Draw another triangle mkl, Fig. 4, with the sides parallel to those of the triangle e-i-j, Fig. 4. At any convenient point, l for example, which is located on straight line passing through A-g in Fig. 4, draw a line parallel to e-j. From point k on center line of rear view, which is a horizontal projection from l, draw a line parallel to i-e, and these two lines intersecting at m form the second triangle, mkl, Fig. 4.

Connect the apexes e and m of the triangles with a straight line, and the point where same cuts the horizontal base line T-X at h, Fig. 4, gives us the point h on Fig. 2, from which draw a horizontal line until it cuts the back top sweep at M.

Now we have on Fig. 2 points A, g and M, h, from which



ILLUSTRATING THE PROPORTIONAL CORNER, HORIZONTAL SECTIONS AND CORNER STRAI

PROPORTIONAL CORNER AND LAYING OUT OF HORIZONTAL SECTIONS AND CORNER STRAINERS ON A TORPEDO BODY—Continued

from the top line the points necessary to ne of the corner, as in problem on page 25. lished, continue the bottom side sweep X-g g. 2. Also lay out the bottom rear sweep M-Y.

essary to have sections of the corner at ween the top and bottom lines of the seat make the necessary forms to enable us t shape of the seat or body at a given point

al and vertical lines from g and h, respec- tersect at U, Fig. 2. Draw a straight line and a horizontal line through M and h at O, Fig. 2.

enient number of points around the corner on line Z-Y, Fig. 2, as B, C, D, E, F, G,

tween H and M only, Fig. 2, draw straight ly until they converge at O, as from I to O.

through A and g a line intersecting line Connect points B, C, D, E, F, G, between nt Q.

tions of sections of the body in Figs. 1, ce desired, as, for example, sections 1, 2,

Take the amount of turn-under at each of these sections from the side turn-under at Fig. 3 and the back turn-under at Fig. 1, and transfer same on to the lines AQ and MO, respectively, Fig. 2. For example, take the turn-under at III, Fig. 3, from the square line R, to convex turn-under line P, and lay it out from point A to III on line AQ, Fig. 2, and so on.

On Fig. 5 is laid out the proportional scale used in finding the sections around the corner between Ag and Mh, Fig. 2. Let X-T, Fig. 5, represent the base line or X-T on Fig. 2. From line X-T, Fig. 5, first lay out the side turn-under of the body, g to A, taking same from g to A, Fig. 2.

At any convenient distance from gA, Fig. 5, lay out the amount of rear turn-under, h to M, from line X-T. Draw a straight line through A-M; likewise lay out sections 1, 2, 3, 4, 5 and 6 on side and back turn-unders, Fig. 5, as taken from Figs. 1 and 3, and connect with straight lines.

Transfer the turn-unders between lines Z-Y and X-T, Fig. 2, at B, C, D, E, F, G, H, I, J, K and L, laying same out on proportional scale from line X-T until they strike line Z-Y, Fig. 5. As the greatest amount of turn-under on this corner is between A and M, Fig. 2, we have to extend lines X-T and Z-Y beyond M on the proportional scale, Fig. 5.

Having the proportional scale complete, it only remains to lay off the different turn-unders, 1, 2, 3, 4, 5 and 6, at B, C, D, E, F, G, H, I, J, K and L from the scale on to the corresponding points of Fig. 2.

POSITION OF PROPORTIONAL CORNER AND LAYING OUT OF HORIZONTAL SEC STRAINERS ON A TORPEDO BODY—Continued

This much accomplished we will connect the points between Z-Y and X-T on lines B, C, D, E, F, G, H, I, J, K and L, Fig. 2, and we will have the desired sections of the corner at the heights of 1, 2, 3, 4, 5 and 6, Figs. 1 and 4.

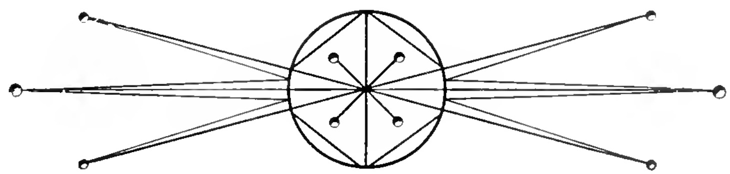
On most bodies of the type illustrated here, the construction calls for a strainer set up and framed into the sill at the corner, as shown in Fig. 2. This strainer should be set up square from the bottom, that is, square from a straight line passing through the intersections of the outer edges of the strainer and corner at the bottom, in order to obviate as much as possible the necessity of beveling the strainer. In this problem we illustrate a very simple method for laying out the full size of the strainer at the front and back sides.

First let us lay out the strainer on the corner of the body, Fig. 2, wherever it may be desired. Take the width of the strainer and lay it out on line X-T at ab, Fig. 2. From a straight line passing through these points, square front and back lines of the strainer through sections 1, 2, 3, 4, 5 and 6 until they cut line Z-Y at cd, this being the top of the strainer in Fig. 2.

Having determined the front
strainer on Fig. 2, proceed to lay s
Figs. 6 and 7. Let us lay out a stra
to the front face a-e of the straine
line should be equal in height to line

At right angles to this line, dra
taken at the heights of these lines
sections 1, 2, 3, 4, 5, 6 in Fig. 2 i
strainer, square points on to lines 1
Connect these points and it will give
line V of the strainer. For the ins
the thickness of strainer from line
S, Fig. 6, shows the line of the stoc
would be cut.

The same operation is applied
back side of the strainer, Fig. 7, exc
be squared from the back side of st
I-1, IV-4 and c-d are sections of
corresponding lines on Figs. 1, 2 an

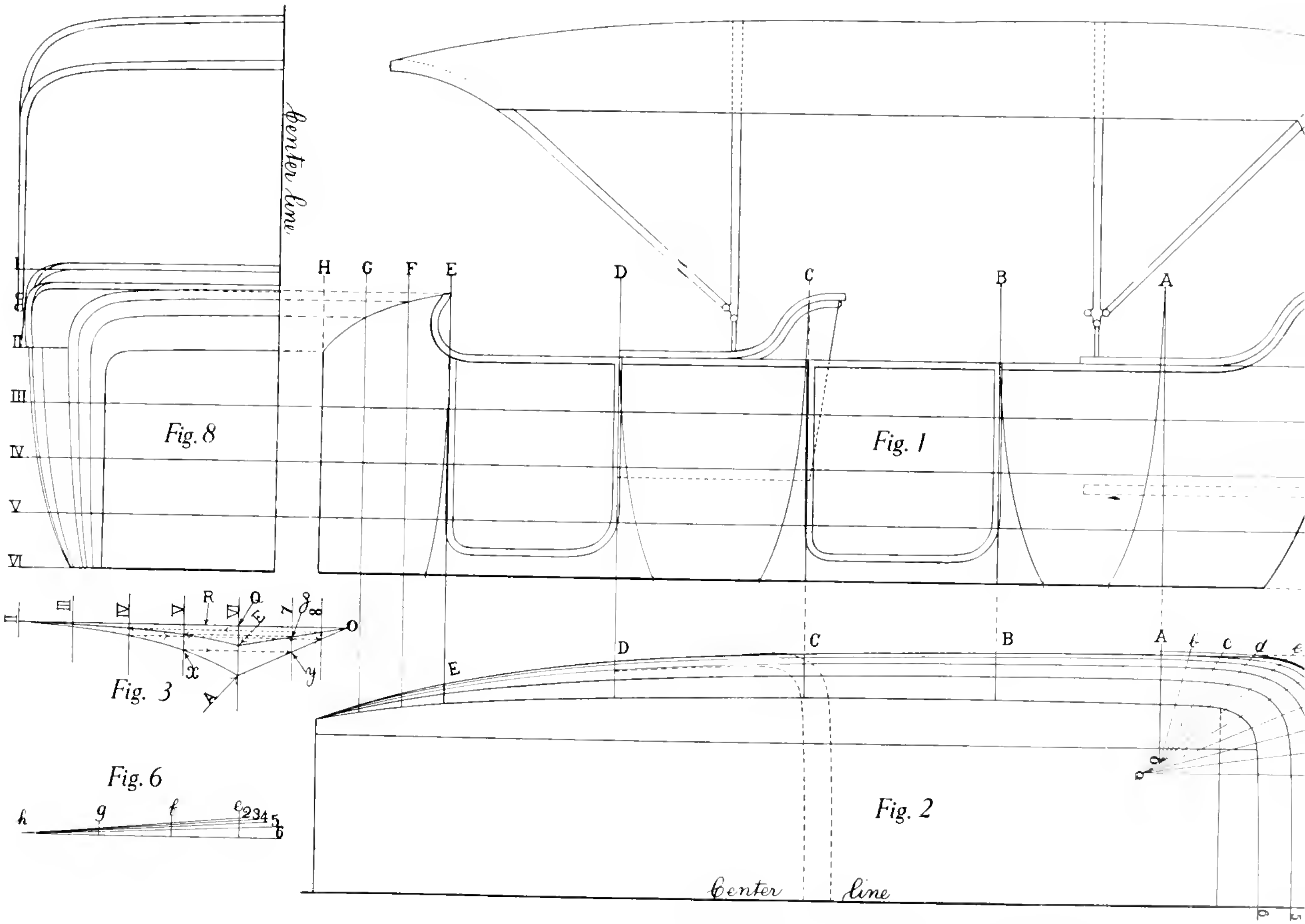


ıg Out of Twisted or Winding Surfaces, Illustrated on a Torpedo Body

)UCE in this problem the application of a
accurate method for laying out twisted
g surfaces on the side of a torpedo body
rtional horizontal and turn-under sections
e obtained so that after the body is con-
ossess harmonious and symmetrical lines.
at in the illustration of this body there is a
the rear corner to the dash, Fig. 2. In
turn-under sweeps at each of the standing
, Fig. 1, it is necessary to obtain horizontal
ne body at 3, 4 and 5, Fig. 1. (First the
out complete as possible, independently of
ons 3, 4 and 5. The top line 2 at the waist
should be laid out in Fig. 2.)
3, which shows the side turn-under line of
the application of the proportional triangle
of the turn-under line E. Having assumed
take the amount of turn-under at E, Fig. 2,
line VI from Q on line R, Fig. 3. Lay out
V and V, in Fig. 3, at the same heights as
ion lines in Fig. 1. Lay out the triangles
) from the base line VI, Fig. 3, the apex of
ng located at a convenient distance below VI
ever the sections cut the turn-under sweep
ection V for example, square the intersection
large triangle at y. From y draw a per-
til it strikes small triangle at z. Square
point from z on to the section line V again, and this gives us point through which the turn-under sweep E passes. Continue this operation with all the sections until the desired points are obtained by which the completed sweep E is determined.

Now having the turn-under sweeps at A and E, let us next proceed to lay out the horizontal sections at 3, 4 and 5 through the body in Fig. 2. In order to establish these sections we will bring into use the proportional scale, Fig. 4. Let e, Fig. 4, represent the turn-under of the body at E, Fig. 2, and a the corresponding turn-under at A in Fig. 2. Lay out on e, Fig. 4, turn-unders at sections 3, 4 and 5, as taken from III-IV-V, Fig. 3. Likewise lay out the turn-unders on a, Fig. 4. Lay out straight lines between a and e at 3, 4 and 5, Fig. 4, and take the total turn-unders at D, C and B, Fig. 2, and lay them out on proportional scale in Fig. 4, at d, c and b. From this we can readily prick off our turn-unders at 3, 4 and 5, from d, c and b, and transfer the same on to D, C and B, Fig. 2. These points established, it remains only to connect them with proper side sweeps and we have completed the horizontal sections, 3, 4 and 5, from which, with lines 2 and 6, we can lay out the exact turn-under sweeps of the standing pillars at D, C and B, Fig. 1.

Fig. 5 is the proportional scale used in laying out the sections around the corner, Fig. 2. Fig. 6 is the proportional scale for laying out the sections through the shroud. Figs. 7 and 8, the one-half rear and one-half front views, respectively, are usually worked out after the turn-unders are determined.



ILLUSTRATING THE LAYING OUT OF TWISTED OR WINDING SURFACES.

ng Out a Belt Line and Moulding for a Limousine Body

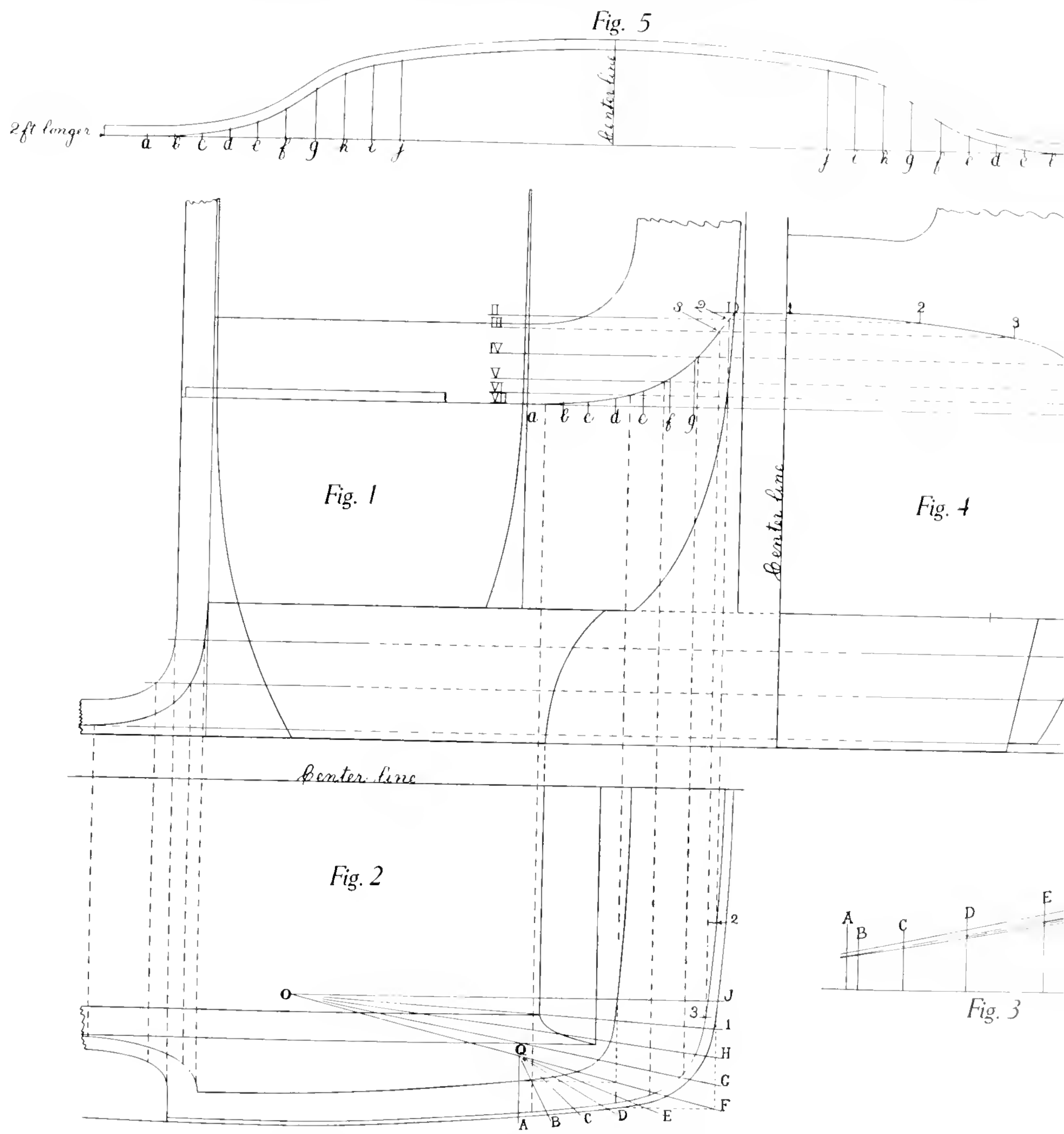
l graceful belt line around the corner and limousine body is sometimes difficult to produce a working line on the draft which in will give satisfactory results is what we xplain and illustrate in this problem. It is belt line on the back of the body should ch or sweep (usually the same as the roof). te this, the belt line at the center of the om 6 to 8 inches higher than the belt line t on the side of the body, this, of course, at on the width and design of the body, etc.

position of the belt line on the side of the nter of the back on Fig. 1. Between these he horizontal section lines II, III, IV, V Next lay out these intermediate sections on . 2. To produce these sections in Fig. 2 service a system which has been explained in that of the proportional scale, Fig. 3.

le sweep or curve, draw the line on the semi- from 1 to 3, number 3 being the point from n Fig. 2 commences to round. This back t the horizontal section lines 2 and 3, Fig. 4. from the center line of the body to each ransfer same until they strike the sections Next project points 2 and 3 from Fig. 2 responding section lines. Connecting points 1, 2 and 3 in Fig. 1 will give us the line of the belt corresponding to the line intersecting points 1, 2 and 3, Fig. 4.

There now remains to be laid out the continuation of the belt line from point 3 to a in Fig. 1. This is worked out by the eye, and care should be taken to produce a graceful and true line. After the belt line on the profile in Fig. 1 is completed, project the same on to Fig. 2, and thence to Fig. 4. The line which we have established on Fig. 1 does not look as pleasing to the eye as would be desired, but, on the other hand, after the body is constructed and the line is viewed in perspective, it will be surprising to note what a graceful and well proportioned belt line this method will produce. It must be remembered that the corner of the limousine body is never viewed as it appears on the working drawing, but is always seen with a certain amount of perspective, and appears very much different than it does on the draft.

On metal paneled bodies the panels are joined at the belt line, and are usually covered here by a metal moulding, which is securely fastened to the body framing. This moulding is sometimes of soft metal, and sometimes of steel. If it is of soft metal it is not very difficult to form the moulding around the belt line on the job, but if it is a steel moulding that is used, it is desirable to bend or form the moulding flatwise first, and in order to do this a line should be laid out full length on a board or some indestructible article for the blacksmith, to be used in forming this moulding. To obtain the correctly developed line from the working draft, proceed as follows:



LAYING OUT A BELT LINE AND MOULDING FOR A LIMOUSINE BODY

NG OUT A BELT LINE AND MOULDING FOR A LIMOUSINE BODY—Continued

horizontal line, as shown in Fig. 5, and center line. Square from the horizontal e, f, g, h, i, j, the distance between each center line is taken from corresponding lt line in Fig. 2. From the horizontal line ttom of the belt moulding, prick off the ioulding at points b, c, d, e, f, g, etc., and ponding lines in Fig. 5. Connecting these points in Fig. 5 will give us the true shape of the belt moulding on the under side, when laid out flatwise. Gauge the top line of the moulding from this line.

In Fig. 5 it will be seen that the ends of the moulding are broken off short on account of lack of space, the moulding being marked two feet longer at each end. From this point on, the moulding is straight, and it is not necessary to lay this out as long as we take the correct length from Fig. 2.

Pricking Off Corner Pillar on Twisted or Winding Landaulet Body with Example for Laying Out Jo

LAY OUT the profile of the body as in Fig. 1. Also draw the outside line of the body Y on the bottom view. Then lay out parallel to line Y the bottom line of the body N-O, which for a distance is an imaginary line, but is useful in laying out the cheat line. Determine the amount of cheat wanted and lay out on the bottom view of the drawing as line Q. This is also an imaginary line, considering that the body side continues down to the base line H on the elevation. The adopted cheat line Q creates a twist in the side quarter of the body from vertical section line 8. This is invariably necessary on jobs of this kind for the purpose of producing graceful lines on the back view of the corner in Fig. 4. To determine the amount of cheat wanted, it is sometimes necessary to experiment until we work out what we think is the most pleasing line for the back view of the corner in Fig. 4. After the correct amount of cheat is found, we may adopt same as a standard for all jobs of this style so long as the body side sweeps and widths are uniform; therefore the line is something which cannot be developed, but must be assumed, and depends entirely upon the taste of the designer, and to execute properly requires considerable experience and skill.

To prick off the rear corner of this body, take into consideration the twist or wind in the side surface, and proceed as follows:

In Fig. 2 lay out the normal turn-under sweep of the body at section 8 as shown by the inside turn-under line O. Take the amount of turn-under from the extreme outside of the corner in Fig. 1 to the cheat line Q at the rear, and transfer on to line h-H, Fig. 2. From each turn-under as located on line h-H, Fig. 2, lay out the proport
apex for same being located on lin

To produce the correct pro
extreme rear corner of the body.

The normal turn-under sweep
space off on same a number of li
will. These lines also should pa
line in Fig. 1. At the point where
turn-under sweep in Fig. 2, drop
proportional triangle for the n
intersected, and from these poi
striking the proportional triangl
sweep, and where same is intersect
on to corresponding lines a-A,
and g-G.

For example, take point on
through which line d-D passes in
line on to the line of the propor
below line h-H. Square this p
of the proportional triangle, and f
projection until line d-D above h
produces a point through which
sweep of the body at the rear c
proceed with all the other points,
sweep Q in Fig. 2. Where lines
Fig. 1, cut the line of the corner
points 2, 3, 4, 5, 6, 7 and 8, passi
of the body.

To produce the line of the c
and back views, proceed as follow

CORNER PILLAR ON TWISTED OR WINDING SURFACES OF A LANDAULET BODY WITH EXAMPLE FOR LAYING OUT JOINT IRONS—Continued

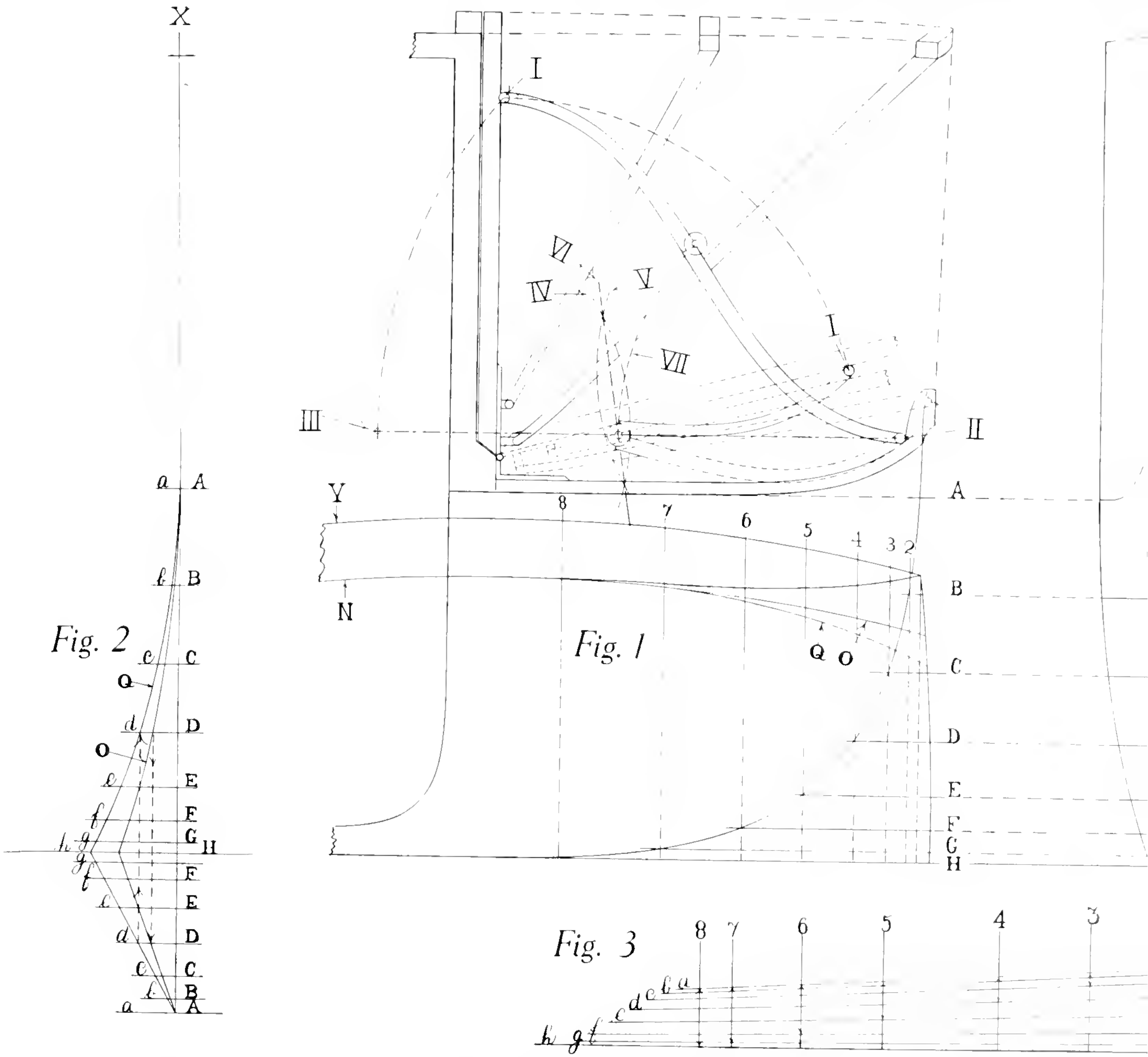
nt of normal turn-under O in Fig. 2, and e horizontal line h-H to a on line 8, in tional scale. At any convenient distance it from the horizontal base line h-H on f turn-under with the cheat as taken from . This will establish point A in Fig. 3, nnected by straight line with a on line 8. of over-all turn-under on lines 2, 3, 4, 5, tom view of body, and wherever these dis-nes a-A and h-H of the proportional scale ical lines passing through the scale. Con-mount of turn-unders at lines b-B, c-C, g-G, Fig. 2, from vertical line X to the sweep O, and transfer these turn-unders on g. 3.

nt points B, C, D, E, F and G on line 1, m vertical line X to cheat turn-under line ect corresponding points on lines 1 and 8 ght lines.

2, Fig. 3, take the amount of turn-under ne b-B, and transfer from the outside of orresponding line 2 in Fig. 1. Continue 3, 4, 5, 6 and 7, Fig. 3, being sure to take of turn-under each time from the lines those in Fig. 1.

ed points on lines 2, 3, 4, 5, 6 and 7 in h the bottom line of the corner pillar must ansfer these points on to the rear view , so as to determine the shape and width pillar in the back view. In order to do e center line of the bottom view, Fig. 1, s 2, 3, 4, 5, 6 and 7, and wherever the corner pillar intersects same lines, transfer distances from the center line in the back view, Fig. 4, to corresponding lines B, C, D, E, F and G. The desired points obtained, connect with graceful and pleasing sweep or curve, and we will have worked out accurately the back view of the corner pillar, from which the stock for same may be laid out with assurance that it will work out correctly.

In laying out the joint irons for the top, the principal object in view is to illustrate an accurate system for determining the center or the break of the joints. After having designed the joint irons when in upright position, and having located the props on the profile of the body, Fig. 1, lay out a horizontal line from the center of the lower prop as shown by dot and dash line on the illustration. Take the distance from point II the center of the lower prop iron to the center of the upper prop I as a radius, and describe an arc striking the horizontal line at III. Determine the position of the center line of the upper prop I after the top is lowered, and with the compasses fixed at point I, or the center of the upper prop, describe an arc V, the radius of which is greater than half the distance from I to III. With the same radius, describe arc IV from III intersecting the arc previously described. Lay out the center line VI, which passes through the horizontal line on which is located points II and III. This intersection determines the center or break of the top joints. From the center of the lowered prop I, to the center of the joint or break on line II-III, describe an arc striking the joint iron when in an upright position, and lay out the center a little bit above a straight line passing through points I and II. The center of the joint or break should always be offset in this way in order to tighten or lock when in an upright position.



PRICKING OFF CORNER PILLAR ON TWISTED OR WINDING SURFACES OF A LANDAULET BODY W
FOR LAYING OUT JOINT IRONS.

g Out of a Coupé Pillar and Construction of Forward Part of an Enclosed Body

our object is to teach the student how
upé pillar in detail, which makes a very
nstructive problem. In addition we have
up briefly the ordinary construction for
an enclosed body. This will be especially
ginner, as it will give him a better insight
onstruction.

ecided upon the side view, turn-under and
body, we will proceed to lay out the shut
pillar. The bevel of the pillar where the
d be made to conform as much as possible
face of the lock. From this point to the
bevel is the same.

lines II, III, IV, V and VI, Fig. 1, and
n lines 2, 3, 4, 5 and 6, in Fig. 3. Deter-
ius the door will swing to open at sections
At 5 the bevel is the same as that on the
ill open without any trouble, but we cannot
on the pillar below section 5, as the turn-
oor opening farther away from the center
cessitating a greater bevel in order to have
trying the shut bevel at each section in
mel points it will be found that the greatest
e bottom of the door. Set the trammel
ne rear outside edge of the coupé pillar in
ion, and describe an arc cutting the inside
and outside edges of the door, and connect intersections with a straight line, thus establishing the bevel on which the door will open at each section.

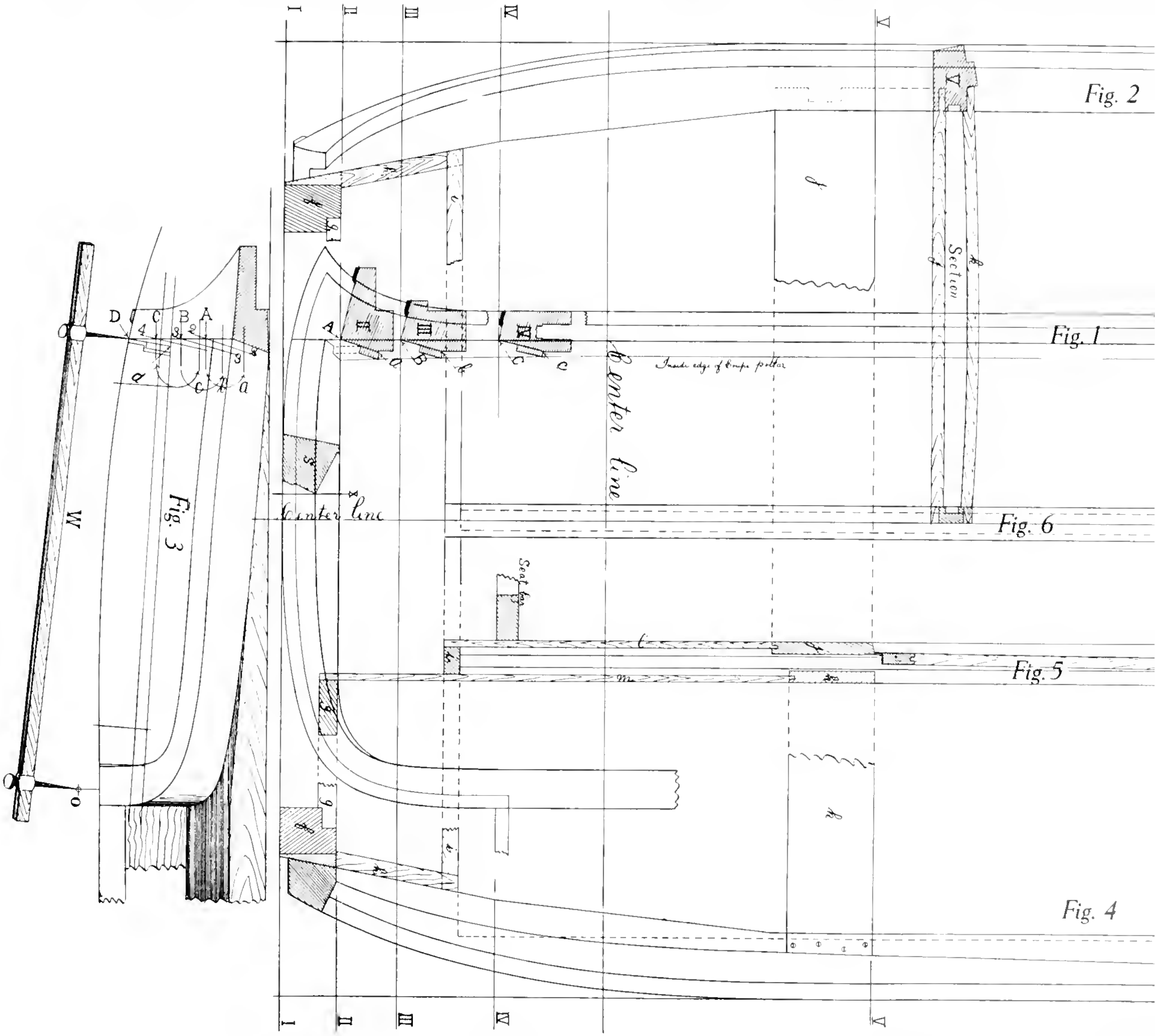
In order to obtain a perfect fitting door, the lock pillar and coupé pillar must be worked off to these different bevels, causing the inside face of the coupé pillar to be on a twist below the lock. Notice that the bevels of the coupé pillar are worked each time from the rear outside edge of the coupé pillar. This gives us a straight line for the front of the door and rear of coupé pillar in Fig. 1.

Referring to Fig. 3, A, B, C and D are points on the outside of the coupé pillar at sections 2, 3, 4 and 6. Points a, b, c, d are points on the inside of the coupé pillar at corresponding sections.

From the door line to the inside of the coupé pillar same should be rabbeted out 1/4 inch to allow for the trimming. This is shown on Fig. 1 at sections II, III and IV, also on Fig. 4 at section VI.

In connection with Figs. 2 and 4 we have shown the header, which should be securely framed into the coupé pillar by means of a mortise and tenon joint, as illustrated in section 10. p in Figs. 1 and 4 represents the head rail or roof rail, into which the coupé pillar should be framed by means of a mortise and tenon joint, as illustrated more clearly in Fig. 2 and section 10.

Between the two coupé pillars there are two drop windows which require a center post, Figs. 5 and 6. This center post



THE LAYING OUT OF A COUPÉ PILLAR AND CONSTRUCTION OF FORWARD PART OF AN ENCI

ING OUT OF A COUPÉ PILLAR AND CONSTRUCTION OF FORWARD PART OF AN ENCLOSED BODY—Continued

eader by means of a mortise and stump
lapped into the cross-bar i, Fig. 5.
represents the neck-bar, which is mortised
· as shown in Fig. 2. Sometimes it is
› this into the coupé pillar.

5, represents the garnish board on the
nd on to which is secured the trimming
moulding. This should be in two pieces
› give clearance enough for, and facilitat-
the window frames. The garnish board
l into the coupé pillar, and screwed, but

and the garnish board k, Fig. 5, are
ve the lining boards l and m, which are
ı to the cross-bars i and g, Fig. 5.
esents a post framed into the sill f and
: post forms a bearing for the inside of
h is secured to the same by means of glue

In Fig. 5 we illustrate a light construction for the division window posts, that is, of fastening $\frac{1}{2}$-inch x $\frac{1}{2}$-inch angle brass to the bottom edge of the glass frame, and permitting one web of this angle to straddle the fence iron instead of having the complete frame to jump the fence, as is customary in most cases. By the use of this construction we lighten the division post in Fig. 5 at least $\frac{5}{8}$ inch, or the thickness of the frame.

p, Fig. 4, shows the roof rail rabbeted out to receive the roof board, which is usually of three-ply veneered stock, and should be glued securely and nailed frequently. Over this is glued the roof cloth, which should extend far enough outside of the roof to cover the joint between the roof board and the roof rail.

Section V shows section of the coupé pillar neck-bar and garnish rails at the fence line. It will be noted that the garnish board k in section V is in two sections, and is swept so as to give clearance for window pull when the window is lowered or raised.

The Framing Up of a Door and Pricking Off of a

THIS ARTICLE supplements the laying out of a coupé pillar and construction of forward part of an enclosed body. There are a great many different methods for framing up doors. Every bodymaker has his own ideas in regard to this subject. Let this article be intended more for the apprentice than for the experienced bodymaker.

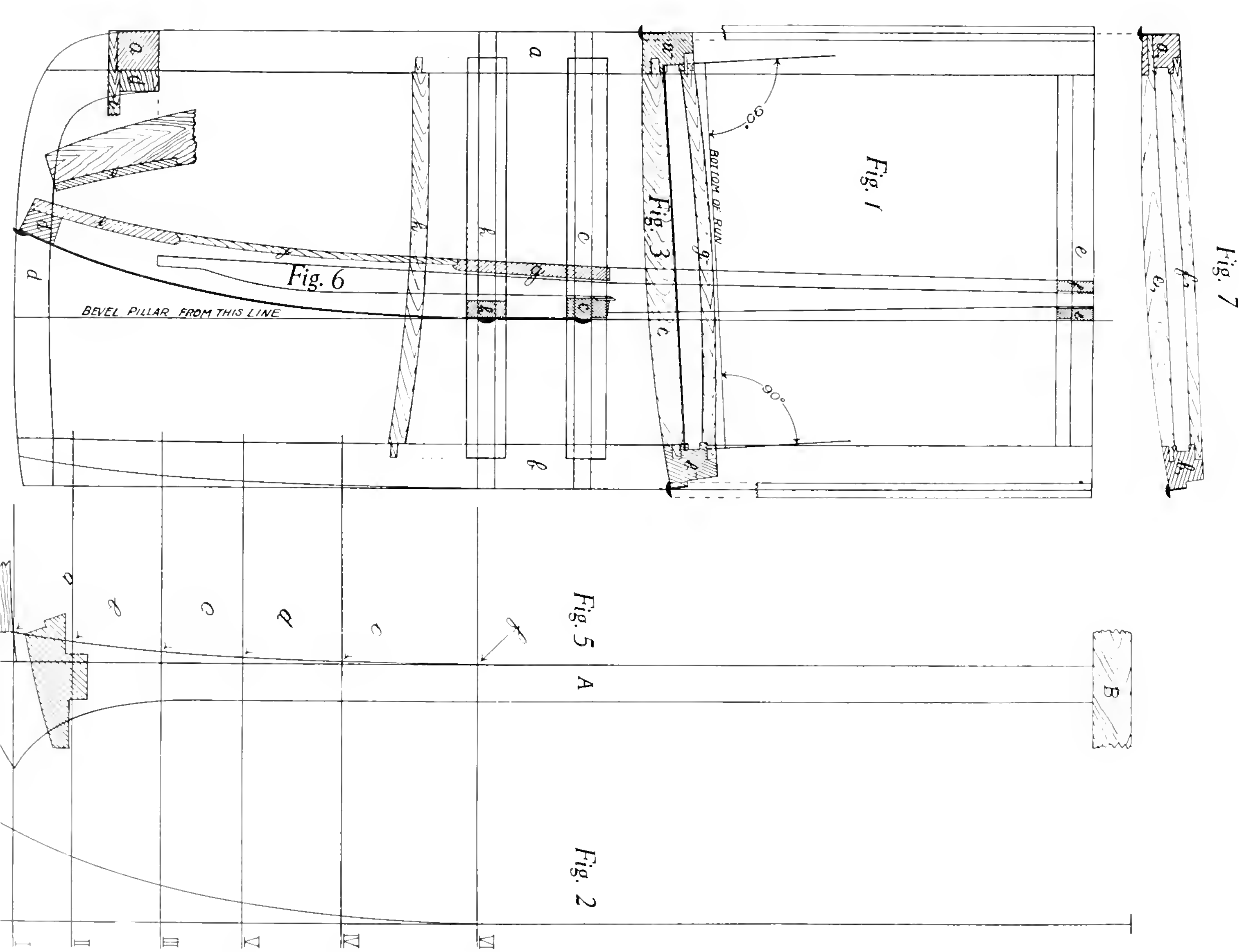
a and b, Fig. 1, represent the door pillars, a being the hinge pillar, and b the lock pillar. The thickness of the hinge pillar is $2\frac{1}{8}$ inches, while that of the lock pillar is about $2\frac{1}{4}$ inches on the outside. These thicknesses are sometimes made more or less, according to the style and construction of the body. e and f are the top rails; g is the lock board; c and h are the fence and belt rails, respectively; j is the lining board; and i is the bottom board. In grooving out the door pillars for the glass frame runs, it is necessary that these be grooved out square. d is the bottom rail of the door, and is half-lapped into the lock and hinge pillars, the joint for the hinge pillar being shown at a and d.

Fig. 7 shows two methods for framing the outside top rail e into the door pillars. Either method will be found practical. The joint used for framing the top rail e into the hinge pillar a is that of a bastard tenon. In framing the top rail e into the lock pillar b we use a stump tenon. The inside rail f is rabbeted into both pillars. Great care should be taken in framing the outside top rail e into the pillars, being sure to get a tight-fitting joint and as much stock outside of the tenon as practical.

Fig. 3 shows a section of the door at the fence line, and
the method used for framing
into the door pillars. The fen
pillars a and b. The lock boar
a and b. The belt rail h is als
pillars. The bottom board i is ha
a and b. In this construction it
bottom side d into the door pilla
all the strength required.

Fig. 6, the section taken at
shows the glass frame run and
laying out glass frame runs, c
plenty of clearance for the glas
out sticking and at the same
glass frames are $\frac{5}{8}$ inch thick,
wide at the fence and top and
for clearance, and also paint. It
width of the door pillars at the
the outside of the pillar to the wi
11/16 inch for the window seat
plate, $\frac{1}{8}$ inch clearance, another
run, $\frac{1}{8}$ inch more clearance, and
the width of the door pillars a
in Fig. 6.

Determine the length of th
project above the lower edge of
about $\frac{3}{8}$ or 7/16 inch, and lay
frame run below the fence line
glass frame or window to drop



THE FRAMING UP OF A DOOR AND PRICKING OFF OF A COUPÉ PILLAR.

THE FRAMING UP OF A DOOR AND PRICKING OFF OF A COUPÉ PILLA

make this calculation so that about 1/4 or 3/8 inch of the top frame of the window will show above the fence plate, although in some cases it is impossible on account of the conditions of the chassis, sometimes necessitating cutting the corner of the door, which prevents the window from dropping clear down. At the lower end of the glass frame run in Fig. 6 note that the run is 11/16 inch wide, and parallel for a short distance. This causes the window to fit closely at the bottom, and prevents chattering at this point. The glass frames should never come in contact with the window runs, there usually being screwed channel rubbers on the ends of the frame which work up and down in the runways. There should be plenty of clearance between the door bars, lock board, lining boards and the glass frames. As there is usually attached a strap to the bottom of the glass frame for raising the window, it is always advisable to sweep the lock board g in Fig. 3, which gives clearance for this strap and fixture. Set the lock board and lining boards so that they may be easily removed in case of any interference on the inside of the door. The lock board should not be glued to the pillars, but just screwed, and the joints should be well painted. Always give the runways a coat of linseed oil or primer as soon as possible.

Referring to the framing up of the top and fence rails, we advise that the rails be recessed or set under 1/16 inch, as shown in Fig. 6, thus breaking the joint.

These are a few general instructions and hints which may apply to the framing up and construction of any high door, but should not be regarded as fixed rules.

With reference to the prickin
is shown in Fig. 5 at A. Fig.
pillar, and B is the top rail. C
represents a section of the coupé
bevel throughout.

In getting out a coupé pillar
to bottom, that is, beveling the pill
from the outside of the pillar bef
causes the coupé pillar to be hea
a simple method for getting the s
and has been employed in carriage
of the body was not very great
where the bodies are a great dea
turn-under, it is not found as
explained in the problem for lay
construction of forward part of
as it produces a curved line pass
d, e and f, Fig. 5, which causes
the bottom than it is at the top.

In pricking this pillar off, la
I, II, III, IV, V and VI throug
amount of turn-under at each sec
out on Fig. 4, passing through t
pillar. Wherever these sections
a, b, c, d and e, Fig. 4, project
corresponding sections at a, b, c,
necting these points gives us the li
pillar and door.

The Construction of Glass Frames

al may be said in regard to the construc-
s frames. but in this article we will treat
ry construction. which. like any part of a
upon the judgment of the mechanic.

ts an assembled glass frame. a being the
back. c the top. and d the front. The
ed without injury to the frame.

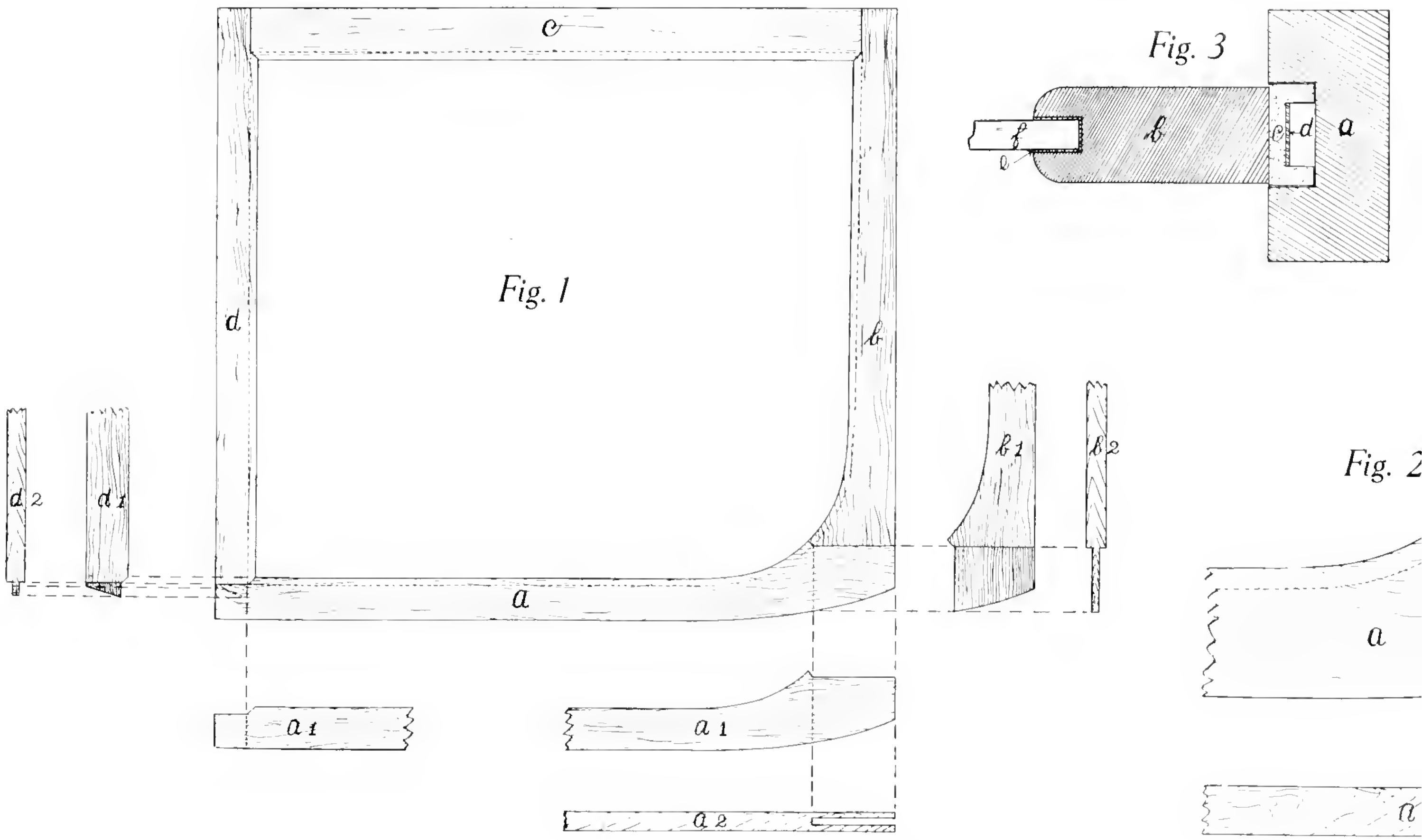
omplish this it is necessary to leave two of
In this case we leave the lower joint in the
l the upper joint in the right hand corner
me will be in two pieces. If all the joints
. and anything happened to the glass that
vould be almost impossible to reset a new
e. As it is constructed here. this can be
without injuring the frame in any way.
the frame is rounded off as shown in
me should be mitered at the inner corners
. illustrated in Fig. 1.

. 1. show the lower part of the front piece
show the shape of the tenon which is let
e bottom piece a1. The same kind of a
corners except the round corner. and this
bare-face mortise and tenon. b1 and b2.
ower end of piece b. It also shows the
. a1 and a2 show a part of the bottom
nortised to take the tenon on the back
the shoulders run horizontally on the lower
ent raising and lowering of the window causes considerable strain on these lower joints. and in constructing them this way they are much stronger and there is less liability of the joints opening up. If the shoulders were vertical on the lower frame. all the strain would be on the tenons. and the joints would be more liable to open. Notice that the tenon on d1 in Fig. 1 is cut on an angle. which is also true of the tenons on the top piece c.

Another way for constructing the joint at the round corner or joining the two pieces a and b is shown in Fig. 2. In this method we mitre the two pieces together and unite them with a false tenon. This joint is frequently used. but is not as reliable as that shown in Fig. 1 because it shows a longer joint and there is more liability of the joint opening.

Fig. 4 represents a section of a glass frame which is rabbeted out to receive the glass. The rabbet is made deep enough to allow for a moulding which is fastened on the inside of the frame to hold the glass in place. Using this construction it is possible to glue all joints in the frame. as the window glass is fastened and held in place by means of the moulding b.

Referring to Fig. 3. b shows a section of the glass frame grooved out to receive the glass f. In using this construction there should be placed between the glass and the frame a thin strip of rubber. as shown by e. This holds the glass tight in place and prevents rattling. which is sometimes the case when the glass is not of uniform thickness and the glass frames are grooved out uniformly. This rubber is shellaced to the glass. Sometimes nothing but putty is used for setting the glass. but. if rubber cannot be procured. we believe felt will be found to give satisfaction.

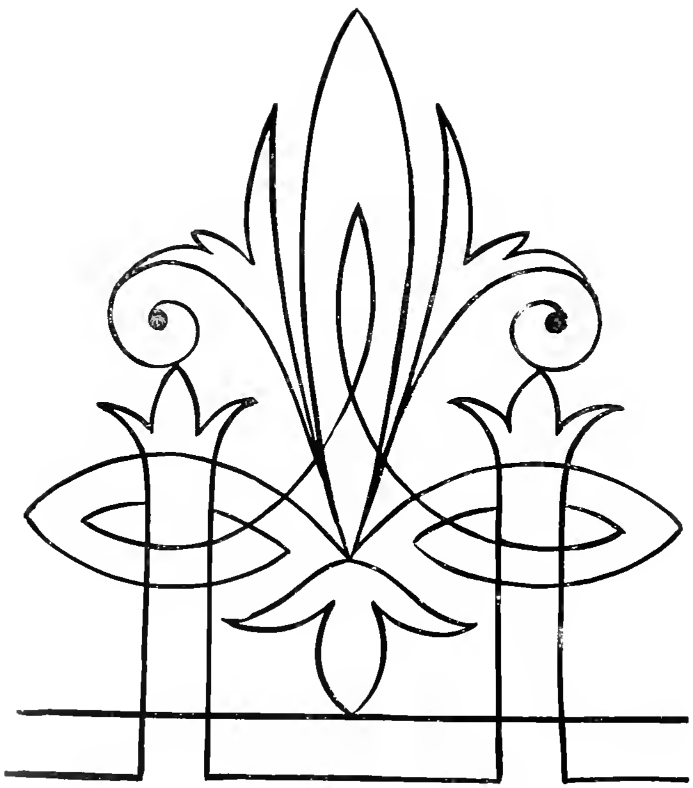


THE CONSTRUCTION OF GLASS FRAMES.

THE CONSTRUCTION OF GLASS FRAMES—Continued

fly of the method for setting the glass frame . 3, represents the door pillar grooved out)n the end of the glass frame is screwed The plate d is usually set inside the channel :rews are put in from the inside and through channel rubber c should fit closely into the in the pillar a, Fig. 3, and the glass

frame itself should not come in contact with the glass frame run. Glass frames are usually made of mahogany, and the finish is important: therefore pains should always be taken to obtain perfect fitting joints, and the best of judgment should be used in the construction of the joints, for which there is no law laid down, but the foregoing are simply some practical hints on construction which has proven very satisfactory.



The Laying Out of a Wheel-house and Rear Mud

IN A BODY which is especially wide across the rear seat it is often necessary to make a wheel-house, or depression in the side of the body, so as to give sufficient clearance for the rear wheel. In this event the rear mud guard usually fits into or close to this wheel-house, and conforms somewhat to its shape. We will first take up the method for laying out the wheel-house in a body, such as illustrated.

Lay out the profile of the wheel-house and mud guard on the side view of the body, Fig. 1. On the rear view, Fig. 4, determine the amount of clearance necessary between the body and the wheel, and lay out inside line of wheel-house t-q-x. From Figs. 1 and 4 we will lay out the wheel-house on the bottom view in Fig. 2.

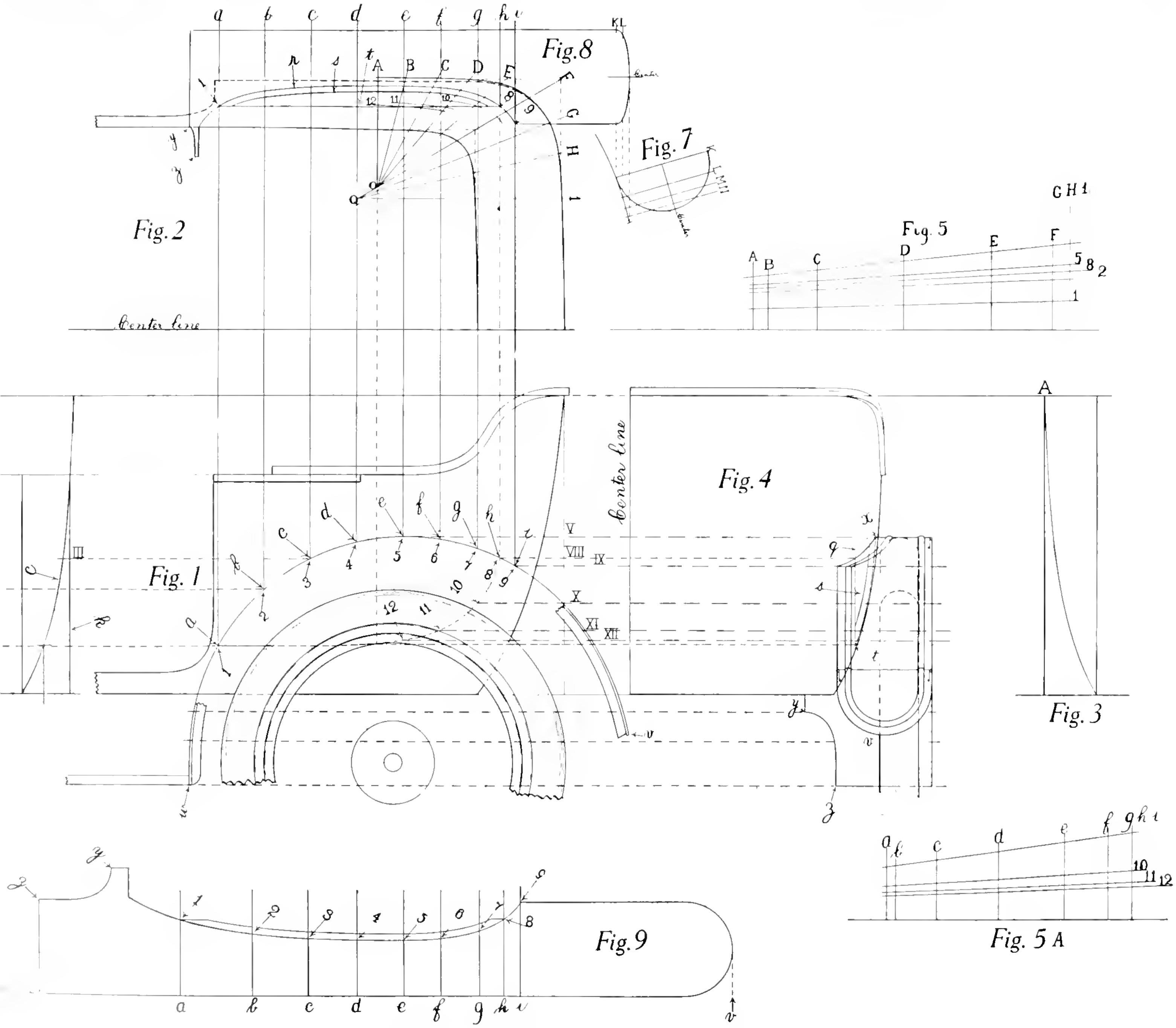
On Fig. 1 lay out on the profile of the wheel-house, points 2, 3, 4, 5, 6 and 7, arbitrarily, and by means of the proportional scale in Fig. 5, lay out sections in Fig. 2 taken at heights of points 2, 3, 4, 5, 6 and 7 in Fig. 1. Squaring these points from Fig. 1 on to sections in Fig. 2 will establish points through which the outside of the wheel-house line r must pass. The inside line of the wheel-house t should be taken from the section of the wheel-onse at t on Fig. 4, and transferred on to Fig. 2, where it will show as a horizontal line.

Wherever the outer line of the wheel-house intersects the inner line at the front and rear, numbers 1 and 8, Fig. 2, square down points intersecting the profile of the guard, establishing points 1 and 8 in Fig. 1. Lay out horizontal section lines 10, 11 and 12 on Fig. 1. By means of the proportional scale, Fig. 5A, lay out these sections through the inside line of the wheel-house t on Fig. 2, and
inside line of the wheel-house t dro
they strike the corresponding sectio
these points 10, 11 and 12, with 1
the bottom line of the wheel-house
where the surface of the wheel-hou
of the body.

It will be seen on Fig. 2 that
$^3/_4$ inch wide around the top of the
be set into the wheel-house level acr
a bearing for the mud guard. The
wheel-house and is secured at this le

In Fig. 6 we have the turn-und
the turn-under sweep at correspondi
Fig. 2. Fig. 3 is the turn-under
round corner on the side at A, Fig

After this much is understood i
a simple matter it is to lay out th
necessary to lay out the profile of
Fig. 2 the inside line s of the ledg
represent the inside line of the guar
1 and 8. Determine the width of t
lay out inside line of same in Fig. 8
of the body at 9. Connecting 8 and
of the guard, Fig. 8, as far as 1.
closely the side of the body until it re
frame. From this point until it joi
usually cut away for the spring or b



LAYING OUT OF WHEEL-HOUSE AND REAR MUD GUARD.

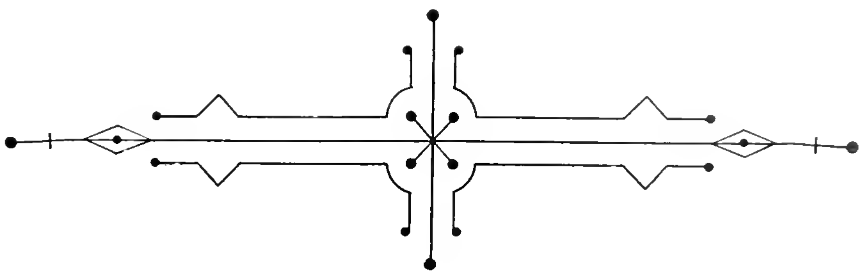
THE LAYING OUT OF A WHEEL-HOUSE AND REAR MUD GUARD—Co

Fig. 4. Lines a, b, c, d, e, f, g and h, Fig. 8, are projections from points 1, 2, 3, 4, 5, 6, 7, 8 and 9 in Fig. 1, and will be used in developing the pattern of the guard in Fig. 9.

Fig. 7 shows a section of the rear end of the guard as taken from Figs. 1 and 4 and brought up close to Fig. 8, with the end squared from the profile in Fig. 7, for the purpose of working out the points K, L, etc., on the plan view of the end of the guard in Fig. 8. Let lines K, L, M and N be drawn through the end of the guard until they strike the profile in Fig. 7. Draw vertical lines from each point through the end of the guard on Fig. 8. From the center line on Fig. 7 take the widths of the guard at K, L, M and N, and transfer on to corresponding lines from the center line in Fig. 8. This gives us a true view of the rear end of the guard in Fig. 8, although the same is not necessary for laying out the pattern in Fig. 9.

The sole object for laying out the guard in Fig. 8 is for pricking off the widths at various points to be used in developing the pattern, Fig. 9. To obtain the pattern, Fig. 9, it is first necessary to lay out the fu around the curve of the profile w t veloped length on the outside edge o Transfer distance between points w, Fig. 1 to the pattern, Fig. 9, wor the guard w to get the true length Through these points in Fig. 9 dra outside of guard. Transfer width b, c, d, e, f, g and h, Fig. 2, to corres of guard in Fig. 9, establishing p and 9. Connecting these points wil the guard where it fits into the whee

Lay out the round end at the re same round or radius as in Fig. 7. the guard from Fig. 4 on to the the necessary flanges all around the ever may be desired, and the patte cutting out the stock.



ng Out Pattern of Panel for a Metal Seat by the System of Triangulation

ATION is a system for measuring up and surfaces for the purpose of obtaining pat-eet metal work, and has long been used for eet metal workers and cornice makers. It he automobile and carriage trade in making with straight flares, but cannot be used on vex or concave both ways, or, in other words, e to be hammered. For a convex or "King this system would be of no use, but for a as illustrated herein, or for mud guards, y panels, etc., it is invaluable, inasmuch as and expense of setting up temporary forms desired patterns.

the illustration, Fig. 1 is the elevation of a seat, and Fig. 2 is one-half the bottom view. wo views that we obtain the pattern of the

g out the pattern of the seat it is necessary e of the arm rail in Fig. 2 as it drops down seat. Space off on the top line around the 3, 5, 7, 9, 11 and 13, Fig. 2, commencing starts to round at the back, and continuing s shown. Space off as many parts equally Fig. 2, connecting these points on top and eat with straight lines, project same points and lines on to corresponding positions in Fig. 1. Wherever the arm rail line on the profile intersects the oblique lines connecting top and bottom points of seat, Fig. 1, project these points on to the corresponding lines in Fig. 2.

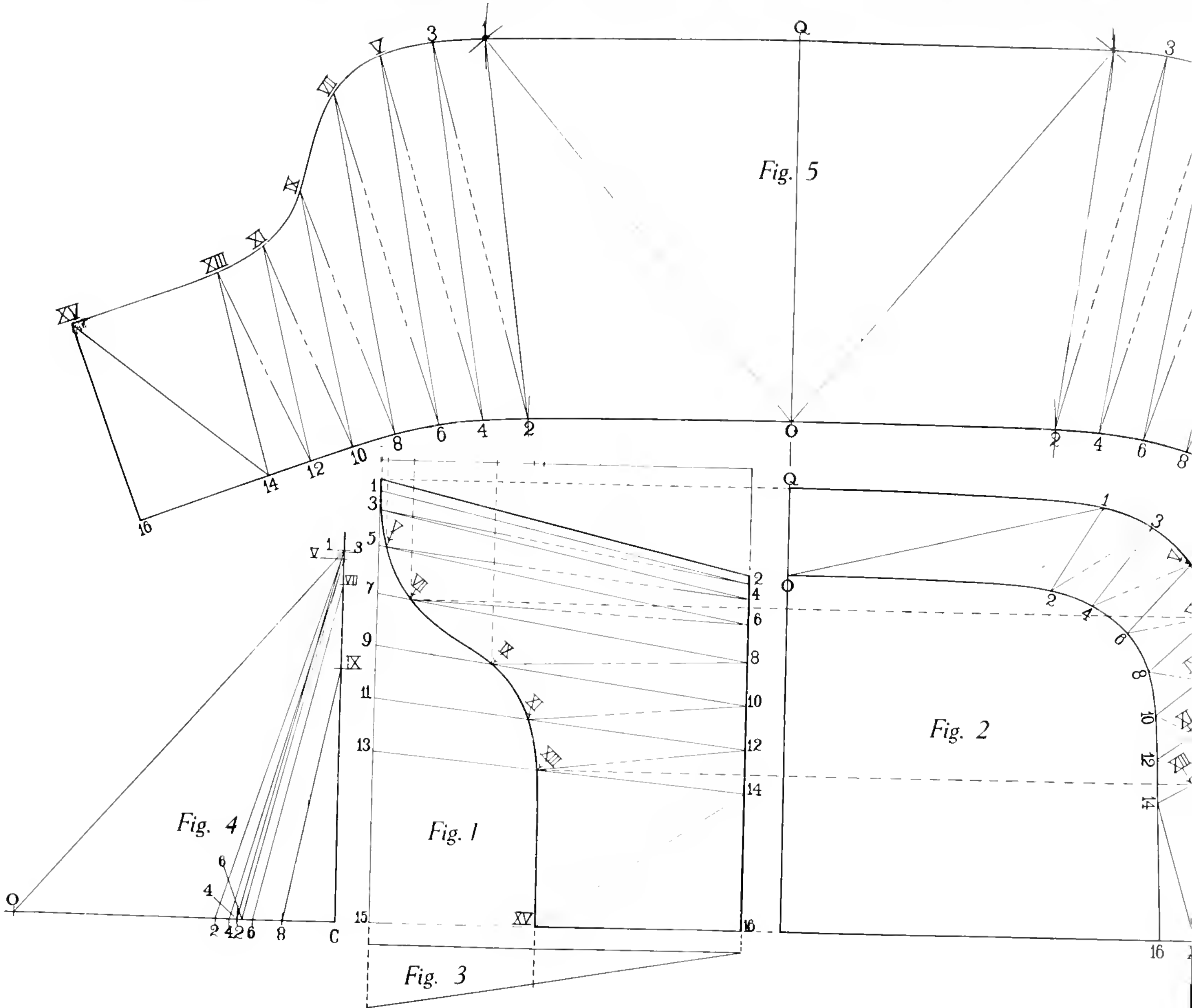
For example, take point VII on line 7-8, Fig. 1, and project horizontally until same strikes line 7-8 at VII in Fig. 2, thus establishing a point through which the arm rail in the bottom view must pass.

Lay out the triangles from these points on the arm rail and points on the seat bottom on Figs. 1 and 2 as shown.

In starting the pattern, Fig. 5, lay out the center line OQ, which is equal to the full height on the flare of the seat at the back, Fig. 1. With the dividers take the distance from Q to 1 on the top line of the seat, Fig. 2, and transfer on to the pattern, using this distance as a radius, and swing it out both sides of the center line from Q.

In order to find the intersection of point 1 on these arcs, proceed as follows:

Use the distance from O to 1 in Fig. 2 as the base of a triangle, and lay same off on any convenient space on the drawing, as Fig. 4, O to C. Taking the height of the seat perpendicularly from the bottom to point 1 at the top as the altitude or perpendicular, lay out on the triangle chart in Fig. 4, C to 1. Connecting O with 1 in Fig. 4 will give us the hypothenuse of the triangle or the true length of line



LAYING OUT PATTERN OF PANEL FOR A METAL SEAT BY THE SYSTEM OF TRIANGUL

'ATTERN OF PANEL FOR A METAL SEAT BY THE SYSTEM OF TRIANGULATION—Continued

listance should be laid out from O on Fig. 5 ie are drawn from Q at 1.

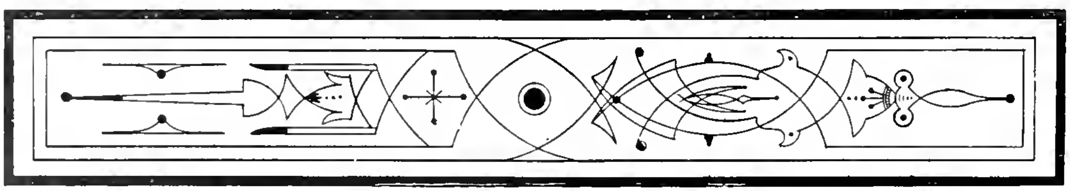
nt 2 on pattern, take distance from O to 2, off as a radius from O, Fig. 5, both sides ke the distance 1 to 2, Fig. 2, as a base of a t off on Fig. 4 from C. Connect 1 and 2 se or the true length of the line sought, and rom point 1, Fig. 5, until it intersects the at 2, and so on until the arm rail commences ter 3 on Fig. 2 we cannot take the spaces line direct, as same is dropping until it runs line at XIII.

pace the top line of the arm rail correctly t on Fig. 5 it is necessary to lay off another btain the true length of lines between 3 and h is done as follows:

line 3 to V, Fig. 5, take the space from 3 ay it off from C on Fig. 6 as the base of a amount that the arm rail drops, from 3 to ay it off from C on vertical line as the altitude, Fig. 6. Connecting 3 and V will give us the hypothenuse of the triangle c3V, Fig. 6, which is the true length of line 3 to V, Fig. 2, and should be laid off from 3 on Fig. 5. The same operation is necessary for every space on the arm rail between V and XIII, laying out each triangle to obtain the true length of each line.

As the points on the arm rail after 3 are getting lower it is necessary to change the altitude of each triangle on Fig. 4. Take the distance from 8 to IX, Fig. 2, for example.

Using line 8 to IX as a base, lay this distance out on Fig. 4 from C to 8. Take the perpendicular height of IX on Fig. 1 from the seat bottom and lay it out as the altitude, Fig. 4. Connecting 8 and IX, Fig. 4, will give us the hypothenuse of the triangle or the true length of line 8 to IX, Fig. 2, which should be laid out from 8 on Fig. 5 until it intersects the arc drawn from VII at IX. Continuing these operations with all the points as shown will give us the outline of the pattern, Fig. 5. Around this pattern whatever flanges are necessary for turning under the seat frame and railing, etc., may be added.



Laying Out of Pattern for a Shroud Pane

THE SAME system of triangulation is applied in this problem for obtaining the pattern of a shroud as was used for working out pattern of the metal seat panel.

The elevation and front view of the shroud, Figs. 1 and 2, are first laid out. Then on Fig. 2, the front view of the shroud, space off points on inner and outer lines as indicated by numbers. The location of these points is not fixed by any rule, but good judgment should be used in placing them where necessary only, the corners being the parts where the spaces should be laid out most frequently in order to insure the most accurate results. The flat or nearly flat surfaces do not require as many triangles. Connecting the points on the inside and outside lines of the shroud in Fig. 2 will establish the triangles with which we will lay off the full pattern of the shroud in Fig. 5.

Lay out the full length of line O-Q on the center of the pattern, Fig. 5, as taken from Fig. 1. In spacing off the points on the back line of the pattern in Fig. 5, do not take the distances direct from the outer line on Fig. 2, as these spaces do not represent the exact length of the lines, as well be seen by looking at Fig. 1. The rear line of the shroud slants back toward the bottom. Therefore lay off triangles for each space separate, as in Fig. 6.

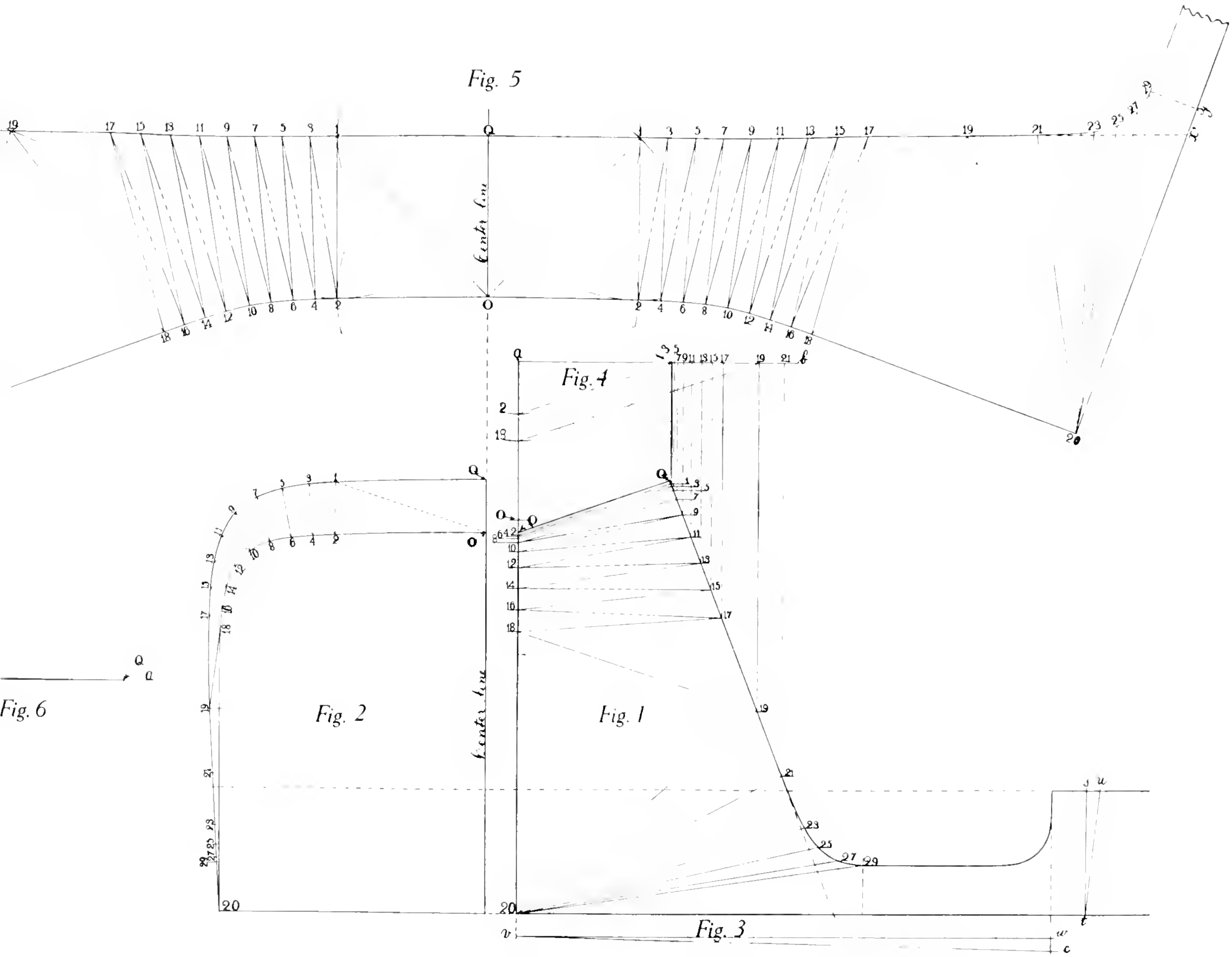
For example: In spacing off point 1 in pattern, Fig. 5, take the distance from 1 to Q in Fig 2, and lay it off as the base of a triangle on line a-a, Fig. 6, from Q. Take the distance that the shroud slants back, Q to 1 in Fig. 4, and lay

it out in Fig. 6 from line a-a to
triangle. From Q to 1 in Fig.
the true length of the line Q to
swung off both sides of Q in Fig

In order to find point 1 in F
of line O to 1 in Fig. 2, as follow

Square upon line a-b in F
Take the distance from O to 1 in
line a-b at the front line of the
O and 1, and we will have the
a-O-1 in Fig. 4, or the true length
Lay this distance off from O in
are drawn from Q at 1.

To describe the arc from O,
be located, take distance directly
same as the radius for describing
line of the shroud is perpendicula
numbered points can be taken dir
Fig. 2. For finding point 2 on th
1 to 2 in Fig. 2 as the base of
vertical line from a in Fig. 4.
on to the line a-b in Fig. 4. From
of the triangle a-1-2, or the true
Fig. 2. Lay out this distance f
it intersects are drawn from O at
matter of getting the true length
enuse of each triangle represen
transfer same on to pattern in Fig

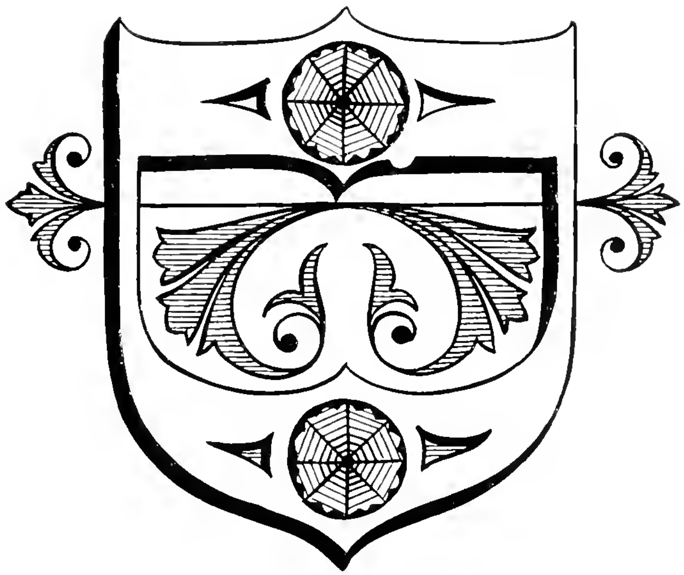


LAYING OUT OF PATTERN FOR A SHROUD PANEL.

LAYING OUT OF PATTERN FOR A SHROUD PANEL—Continu

To avoid complication and confusion we have shown a few of the triangles only in Figs. 4 and 6, but in general practice each triangle will have to be laid out to determine the true length of lines desired. After the descriptions of the operations used in Figs. 4 and 6, with the same principle the remainder of the triangles may be laid out to determine the required points on the pattern, Fig. 5.

C, Fig. 3, represents the co
at the height of the seat bottom.
ever, with the pattern, but is use
line around the shroud in Fig. 2.
is obtained, add whatever flange
the style of construction used, etc



ng Out Patterns for a Front Mud Guard and Splasher

we illustrate and explain methods used
terns of a front mud guard and splasher,
which are twisted. Fig. 1 is the side view
front wheel and chassis frame in con-
nder. Fig. 2 shows the relation of the
e chassis and shape of splasher where it
board. Fig. 7 is the plan view of the
pattern extended.

to lay out the side view and plan, Figs.
, and from these two views, with the aid
, Figs. 2, 3, 4 and 6, we obtain the patterns
s explain method of laying out the full
ted mud guard splasher, Fig. 5.

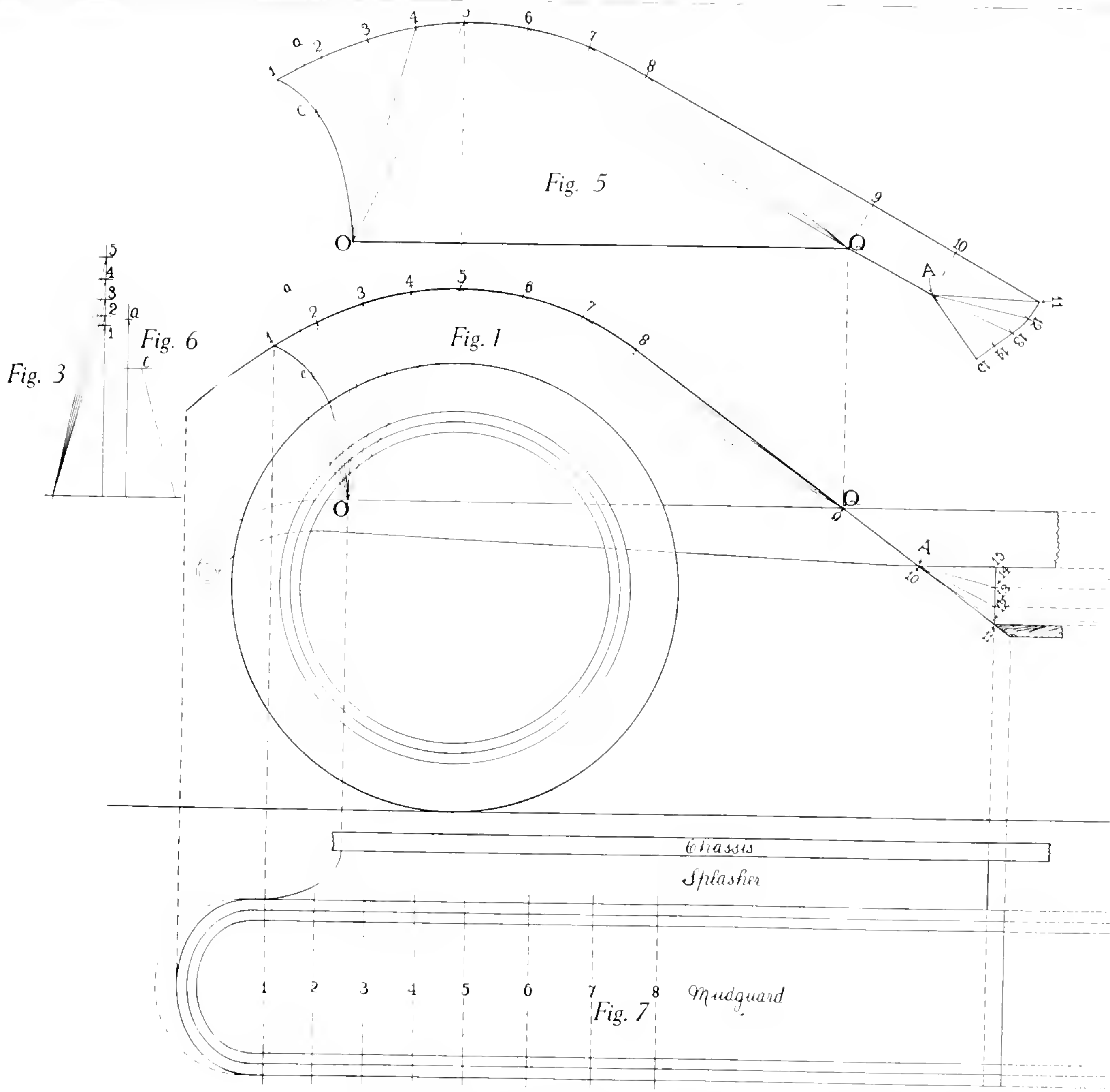
ided which is the most simple way to form
ittle twist as possible, and with this object
t the surface of the splasher inside of the
. 1, is flat and has but one bevel or flare.
at between points Q and A, and 9 and 10,
e the splasher flat.

o points 1 and 5 on the splasher in Fig. 1
o give the splasher a slight twist in order
line of the inside edge of the guard on
oints Q, 5 and 8 in Fig. 1 it will also be
form the splasher somewhat to meet the
f the fender, Fig. 7. The lower end of
joins the running board and chassis frame
sted into the required shape. Wherever
rfaces appear it is necessary to space off
points and triangles frequently in order to assure accurate and satisfactory results.

From the front of the splasher to the center or the highest point of the splasher, Fig. 1, let us lay out points 1, 2, 3, 4 and 5. Connect these points with the front of the splasher at O on the bottom, and we will have the necessary triangles for laying out this section of the splasher. From point 5 on the top of the splasher, Fig. 1, space off points 6, 7 and 8 until the fender curve runs into the chassis line, Fig. 1. In Fig. 2 we show the shape of the splasher where it connects with the running board. It will be seen that the end of the splasher here is curved. Lay off a number of equal spaces XI, XII, XIII, XIV and XV on the splasher in Fig. 2, and project same points on to the rear end of the splasher in Fig. 1. Connecting these points 11, 12, 13, 14 and 15 with A, Fig. 1, will give us the necessary triangles for developing the surface of this section of the splasher.

On Fig. 2 we indicate the distance from the inside of the mud guard or running board to the outside of the chassis frame, which distance will be the base of all triangles in Figs. 3, 4 and 6.

In commencing the actual pattern, Fig. 5, take the distance from O to Q, Fig. 1, and lay out on the bottom of the splasher in Fig. 5. This is the true length of the splasher between these points. Take the distance from O to 5 in Fig. 1 and lay it out as the altitude of a triangle in Fig. 3. With the distance from the inside of the guard to the outside of the chassis frame as the base of the triangle, determine the hypoth-



LAYING OUT PATTERNS FOR A FRONT MUD GUARD AND SPLASHER.

ING OUT PATTERNS FOR A FRONT MUD GUARD AND SPLASHER—Continued

ngth of the line O to 5, Fig. 1. Take this and describe an arc from O, Fig. 5.

ersection of point 5 on this arc, take the 5 in Fig. 1 and lay it out on Fig. 4 as an le, and with a base equal to the distance ame to the inside of the guard, as before oothenuse or the true length of the line this distance as a radius centered at Q, arc cutting the arc described from O at rom point 5 describe an arc with the radius om 4 to 5 in Fig. 1.

ersection of point 4 on this arc in Fig. 5, om O to 4, Fig. 1, and use it as the altitude g. 3, and with a base as given, find the y it out from point O in Fig. 5 until it wn from 5 at 4. Likewise space off points iangle chart, Fig. 3. Also lay out spaces he triangle chart in Fig. 4, and find the arc as previously described.

in Fig. 5, take the distance from 8 to 9 in out from 8, Fig. 5. The intersections of ius drawn from Q, equal to the distance he chassis frame to the inside of the guard, t 9 in Fig. 5. From Q to A, and from the distance direct from Fig. 1, as this is

end of the splasher we have spaced off on s 11, 12, 13, 14 and 15. Take the distance from 10 to 11, Fig. 1, and strike it out from 10 in Fig. 5. Using the distance from A to 11, Fig. 1, as the altitude of a triangle, lay it off on the triangle chart in Fig. 2 with the base equal to the distance from the chassis to the inside of the guard or running board.

After having determined the hypothenuse of this triangle, or the true length of the line from A to 11 in Fig. 1, lay it out from A, Fig. 5, until it intersects the arc drawn from 10 at 11. Space off the distance from 11 to 12, Fig. 5, taken from XI to XII in Fig. 2.

We now want the true length of the line A to 12 in Fig. 1 in order to enable us to locate the intersection of point 12 in Fig. 5. With the distance from A to 12, Fig. 1, as the altitude of the triangle, lay same off in Fig. 2 with the base obtained by squaring up point XII in Fig. 2 until it strikes the horizontal line at the top of the chassis frame. With the base and altitude given, it is easy to determine the hypothenuse of this triangle, which should be described as a radius from A in Fig. 5 until it intersects the arc drawn from 11 at 12, and so on with points 13, 14 and 15, being careful to obtain the correct base of each triangle in Fig. 2, inasmuch as the base of each triangle is ever changing on account of the splasher running closer to the chassis at each point.

Fig. 7 shows the actual plan view of the mud guard, splasher and chassis, as projected from the side view in Fig. 1. The extended dot and dash lines show the developed surface or pattern of the mud guard as taken by measuring the distance from point to point around the profile of the guard in Fig. 1.

Perspective Drawing of Vehicles

IN THIS article we illustrate and explain a system of perspective drawing for automobiles and carriages. In making perspective designs of vehicles it is always desirable to lay them out so that the dimensions of the body can be scaled from the profile of the drawing.

For instance, if one desires to know the width of the door, the depth of the seat, or the height of the job, he can readily obtain the measurements from the profile of the drawing.

In this case the vehicle will not be set up in true perspective, but the effect is as pleasing as if it were. If the job were drawn in true perspective it would not be possible to scale any measurements from the drawing, and it is not necessary for draftsman or designer to be familiar with true perspective drawing in order to become efficient in carriage perspective. The system explained herein will be found to be very simple, and once the designer masters the system, he will find that it will be of great value to him, inasmuch as he will be able to produce rapid and more pleasing results.

In preparing a perspective drawing, the first operation is to lay out the true side view or elevation of the vehicle, as shown in Fig. 1. Next determine the vanishing point, which in this case is to the front of the coupé pillar nineteen feet on the line of vision, but this distance is taken arbitrarily, and after once determined satisfactorily, may be kept as a standard. The line of vision is usually five feet three inuhes from the base or the ground. The vanishing point is not shown on the drawing, as it would extend far out from the edge of the paper or the ordinary drawing board. Instead of showing the vanishing point, we illustrate a more satisfac
the vanishing lines. Fig. 4 represen
point as a center. This arc shoul
or light wood, and then it may be u
same to the drafting board with tw
Fig. 4 by a and b.

Fig. 7 represents a lightly c
an eccentric blade, that is, the top c
perpendicular with the center of
square on the arc as shown, we can
that will vanish at the vanishing p

If the widths of the body are k
draw the front and back views, F
This is shown here by way of illus
draftsman becomes accustomed to
be eliminated to a certain extent.

With T square 7 set on the
inclined line A passing through th
wheel at the base. Let this line con
drawing. After this, draw another
through the center of the near rea
drop a perpendicular line from th
until it strikes the inclined line A a
that the wheel tread is 56 inches,
radius from 2, describing an arc u
B at H, Fig. 8. By connecting
straight line c we will have the li
widths should be laid out.

PERSPECTIVE DRAWING OF VEHICLES—Continued

sents a triangle, the angle of which is about
d which angle is used for all penchant lines,
e offside points or the amount of perspective.
n at will, and, of course, regulates the amount
After the draftsman has made a few drawings
which angle is the most satisfactory and pro-
leasing drawing, and adopt it as a standard
gle.

off rear wheel, draw the penchant line i with
. 5, from point 2 on line A, Fig. 8, until
B. This gives us the base of the off rear
the vertical center line, and use the T square
Fig. 4 for finding the horizontal center and

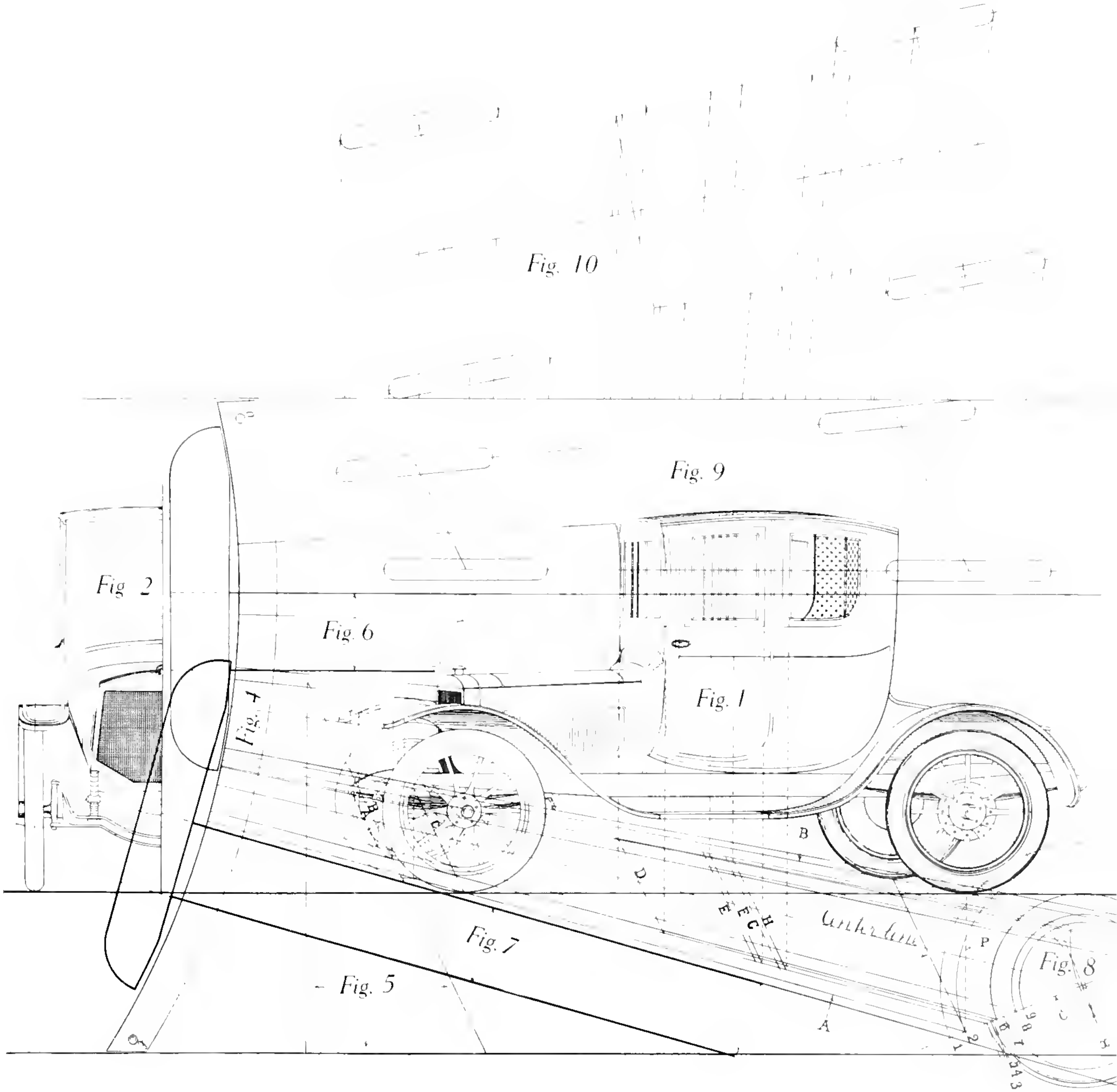
the perspective of any part of the vehicle
narrower than the wheel tread it is necessary
center line, Fig. 8. The center line is obtained
wheel tread on line c at x, from which point
drawn with the T square Fig. 7 on arc Fig. 4.
, if the perspective on the coupé pillar is
width from the center line, Fig. 2. Lay it
the center line in Fig. 8 on line c at V and 5.
e Fig. 7 on arc Fig. 4, draw lines from these
ough Fig. 8. Square down near side of coupé
it until it strikes line 5. Use the triangle,
the penchant line D until it strikes line V.
line from this point on to Fig. 1, and this
le of the coupé pillar at the front. Take the

T square Fig. 7 on the arc Fig. 4 for laying out vanishing lines and obtaining points on the offside of the coupé pillar which should correspond to points on the near side of the coupé pillar, and so on with 3, 4, 6, 7, 8 and 9, Fig. 8, which represent the widths of the body taken at different points on Figs. 2 and 3, and D, E, F, G, H and i represent penchant lines for obtaining the perspective at these points.

Fig. 9 shows how the vehicle would appear in looking down upon it from above. The near side produces a perfect side view as in Fig. 1. Fig. 9 is, of course, false, as the car could not be twisted as shown in Fig. 9, but this is the way the perspective is set up in the profile or elevation, Fig. 1.

Fig. 10 illustrates approximately how the plan would necessarily have to appear if the elevation or side view, Fig. 1, was in true perspective, and is laid out here by way of illustration to show the difference between true perspective and the system of perspective taken up in this article.

Referring to these two figures, 9 and 10, compare the wheel base on the near side of the vehicle, and it will be noted that the wheel base in Fig. 10 is greater than that in Fig. 9, showing that anything in true perspective set at such an angle will appear shorter than it really is, and, if drawn that way, will not permit of the taking of any measurements from the side of the vehicle, as explained previously. In Fig. 9 the reader will note that the wheel base on the near side is the same as that of the wheel base in the elevation of the vehicle, Fig. 1, therefore making it possible to scale this dimension and others direct from the side view or elevation, Fig. 1.



PERSPECTIVE DRAWING OF VEHICLES

Coloring Carriage and Automobile Drawings

vehicle designs, be they carriages, automobiles, n fact, anything in vehicle construction, a cerge, or, we may say, rules, must be followed to ed proficiency to be successful. Besides, con-, after the rules are known, must be had to rtist in this particular line. Of course, different same end. One road may be longer than the ess, after the rules are known, the artist may an as how to get quickest to the road's end.

ge designers who have taken lessons in color erienced artists may differ from our practice after all, when the first rules have been studied ccess will depend more on practice to obtain ch is admired even by those who have handled ears.

le elevation of any vehicle, carriage, automo-, drawn in perspective is acknowledged to be resentation to show buyers, or to print in catan perspective, most of the details contained in e shown, but keeping in mind always that a tion must be retained to represent the style to produce good colored drawings which are ads a great inducement to add this accomplishhich will aid one not only to add taste to his t also furnish an opening to secure a better

ruments, the best kind, are necessary, also to ety of brushes, and an assortment of bristol inds of fine drawing papers, including tracing

water colors, Winsor and Newton have had a tation, but a great variety of cake and tube ined from stores where artists' materials are sed colors are white, brown, blue, green, yellow, nd deep gray, but, of course, by buying a whole re in the box that may be needed. India ink in a necessity. Some prefer Higgins' American make, while others prefer the French make, but both are of excellent quality.

Pen drawings, uncolored or colored, should not be drawn directly on bristol board or any other kind of drawing paper, but should be made either on thin white paper or the regular tracing paper. Mistakes in outlining carriages and automobiles are unavoidable, and, therefore, must be erased, and the surface of the very best drawing paper that is made will be damaged with the eraser, and defects show through the colors. After the sketch is done, it is blackened on the rear side, that is, the reverse side from the drawing. For this, dry lamp black is used. Others save the dust from the pencil sharpener. To obtain the dust, they use a small box with a flat file on top. The file is used as a pencil sharpener, and the dust drops in the box, and is kept in the box until needed.

Most artists use red chalk known as "rouge." Some of the black dust will adhere to the paper where not wanted, and it is difficult to remove it, while the rouge is more easily erased. When the sketch is finished and reddened on the rear side of tracing paper, it is put on the bristol board, fastened with thumb tacks, and all the lines are then gone over with a 6-H Faber or Hardtmuth pencil with a sharp point. Others use a needle or tracer, which will be found among the drawing instruments. By this process, a clean, correct reproduction of the design is obtained, and at the same time the draftsman has a copy for future use.

The foreground of the object must be drawn first, which, on a carriage or automobile, means the wheels on the near side. Each object or part of the vehicle is thus drawn, one after the other, and the last part to be drawn will be the off wheels. At the same time, the required colors must always be kept in mind. If the gears are yellow, and striped black, the face of the spokes near the hubs have generally two fine black lines, also one or two fine black lines on the rim faces, and tires black.

In such a case, the hubs, spokes and rims are colored first, and black lines drawn on top of yellow, and all colors are worked same as India ink. For making small lines on gear or body, also

COLORING CARRIAGE AND AUTOMOBILE DRAWINGS—Continu

scrolling, use a lady's pen. In fact, a lady's pen is very handy for all kinds of lines, even the straight lines. Lines of various thicknesses can be made by more or less pressure, thus avoiding the unscrewing of drawing pens.

Working with a lady's pen requires considerable practice, but, when once mastered, it is a great advantage, and considerable time is saved thereby. A colored plate can not be made except all the outlines are drawn with the required color of the ink. If the gear is yellow, the outlines must be of the same color, and if the body is blue, the outlines are blue, if the colors are of a darker shade. Otherwise, if a light shade, the outlines require a fine black India ink line.

To start the color on bodies, if there is black, such as rockers and boot panels, use Winsor and Newton's lamp black, to which, after being rubbed up to a rather thick liquid, add a very little dissolved gum arabic. To know whether the color has the proper consistency when rubbed up, tip the cup. If right for use, the color must flow slowly. To make all outlines sharp, run them over twice with lamp black with the drawing pen, and fill the rest of the panel between the lines. For the small and narrow black spaces, thin down the color somewhat, otherwise it will have a too heavy appearance. For the rest of the panels, that is, the large spaces, the brush is used, but care must be taken to distribute the color properly.

The painting of the body in coach body colors is exceedingly difficult, and requires considerable practice, as very few of the water colors have sufficient body to cover well. Lamp black, Prussian blue, vermilion and Indian are the only ones having good coloring properties. Most artists require transparent colors, while for carriage, coach and automobile work they must cover the surface at the first stroke, as only a few colors will allow a second coat. Carmine and ultramarine are the only ones, and it requires great care and considerable practice to produce a uniform surface after several coats. Perfect work cannot be

produced with imperfect colors, bu
made just for this work, which cov
application, can be bought in first-cl

Colors of this kind must be rub
ency as explained for lamp black,
freely, but with extreme uniformit
not be retouched, as it will show de

The striping, which gives finish
ing, is used either to cover the edges,
and is done with the drawing pens,
lady's pen, and one that has been u
used, as a new pen is too sharply poi
colors. The colors for striping are
milion, white, yellow, orange, chrom
a combination of the above colors.

After the striping lines have be
body, prepare lamp black, which flow
very fine line under, or right and lef
senting the shade for the striping
they are tufted; lower part darker a
part can be imitated from clear, well
tone illustrations. Make handles,
or gold, but as these are generally
pared to be suitable for this work.
it into a saucer, and allow it to stan
water which rises to the surface, a
arabic gum water, stir well, and ap
dry, burnish with a thin bone with ro
burnt sienna.

A great deal more could be said
above explanation is about the whole
order to be successful, do not mind
greatest care and the very best ma
essential points.

Working Drafts

)WING working drafts represent nearly every
ntomobile bodies, and should be of great service
rence for designs, etc. They are accurately
king scale. The different views are kept clear
which makes them easy to follow.

ly, on account of having to make shop working
it is necessary sometimes to lay out one view on

ge draftsmen and men who can lay out and
from the draft are in good demand, and are
paid men in the trade.

to make a complete working draft of a carriage
ody requires considerable skill and experience.
beginners is to practice free-hand drawing and
o obtain good, true lines, not depending on
ods. Scale drawing is very good practice.

nce obtained by practical work in the body shop
This will give the student a better understanding
ion required on a draft.

ns taken up in this book should be thoroughly
s to be able to apply them correctly. Aim to
as plain and simple as possible, putting on only
orking lines, as any unnecessary lines confuse
well as waste the draftsman's time.

ions and connecting lines shown in the problems
his book should not be on the working drawing.
ded to obtain the desired points, they should
emoved. They are shown in the problems for
it is sometimes better to work out the problem
per separate from the working draft, and make
plate of the line obtained and transfer same to
ft, thereby obviating the erasing of lines and
face of the draft.

working draft the base line of the body is gen-
he center line of the half bottom view, therefore
s of the half bottom view must be drawn on
evation. This is apt to confuse a beginner,
and is one of the reasons for our caution against putting on unnecessary lines.

Before one can make a working draft of a body, he must have a general idea in his mind of what he is to draw. It is best to first make a small scale drawing, or put the design on a blackboard, where it can be looked over and changed if desirable. The proportions of a vehicle can be studied better from a blackboard.

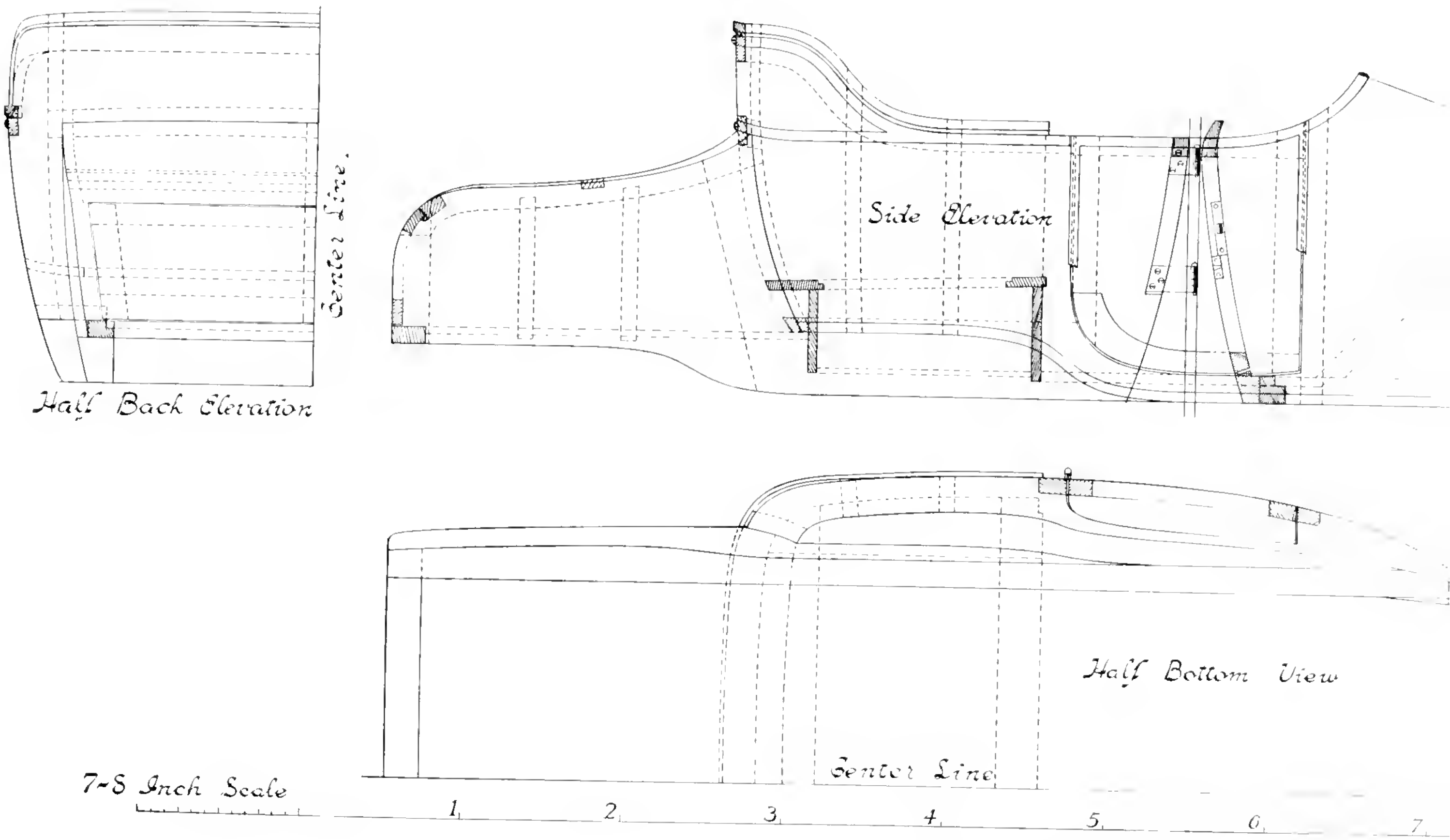
Special attention should be given to the full-size draft board and tools for making a draft. Well-seasoned soft pine is the best material for the board, which should be made large enough for the full size of the body. The board should not be less than 7/8" thick and jointed and glued up well. Hardwood cleats should be placed under the board, not fastened directly to it, but so as to allow the boards to expand and contract without warping. Have all edges planed off square. This is very important to insure accurate work. If the draft board is made so that it can tilt at any angle, it is more convenient.

The best of drawing instruments, squares, triangles and curves are necessary. It is also desirable to have a bench and vise at hand, so that the different patterns or sweeps may be made as desired. In making these patterns or sweeps, great care must be taken to get them smooth and true, using the eye to ascertain, by sighting along the edge of the sweep.

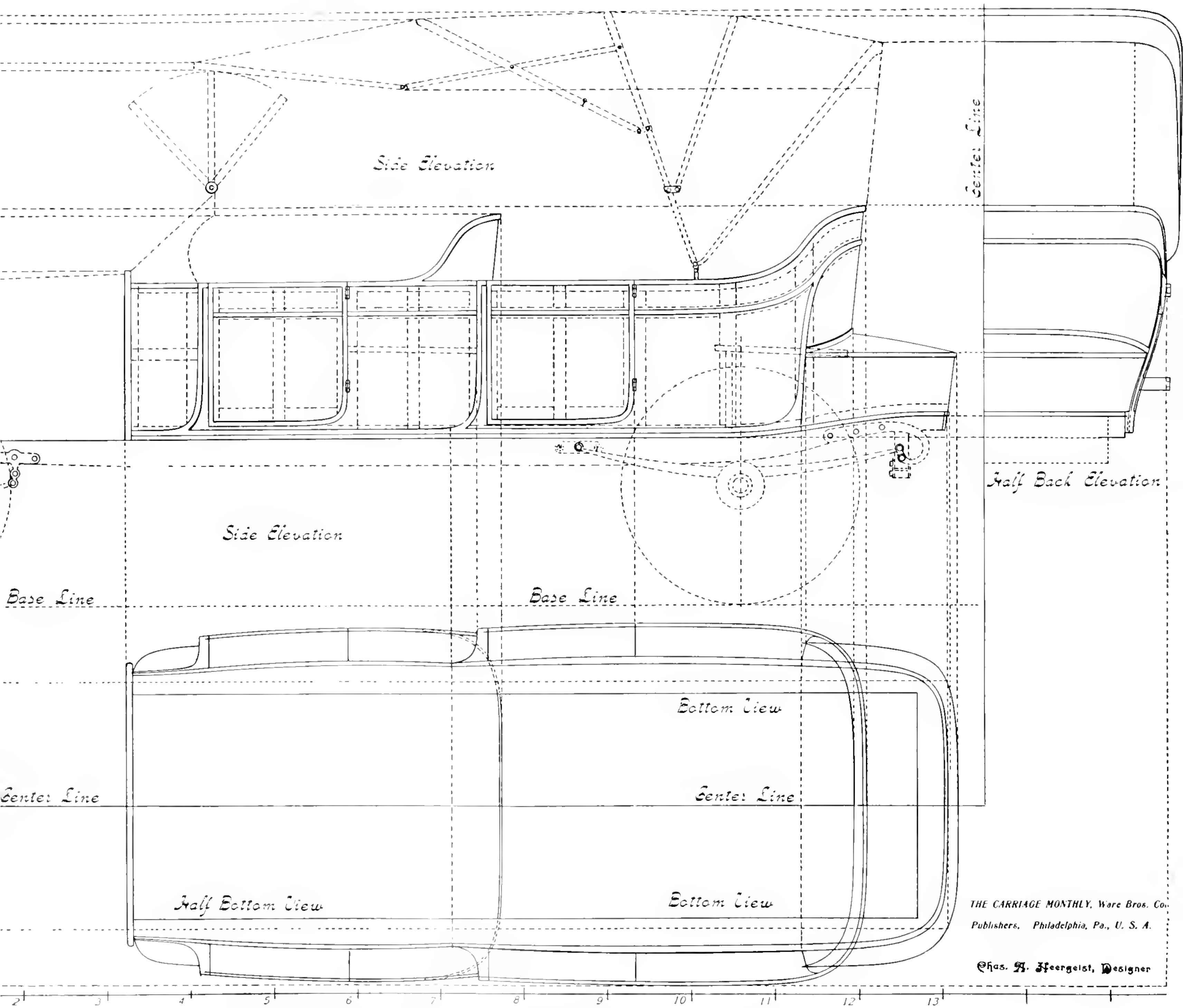
It is customary to lay out the near side of the body or the left side elevation first. Outline the body in all views as much as possible, and then fill in the detail and construction. Always aim to keep the body as light in weight as possible, consistent with strength, as unnecessary weight in the construction of any vehicle is undesirable.

Provisions should be made to accommodate locks, hinges and other hardware. The ironing and trimming should also be considered.

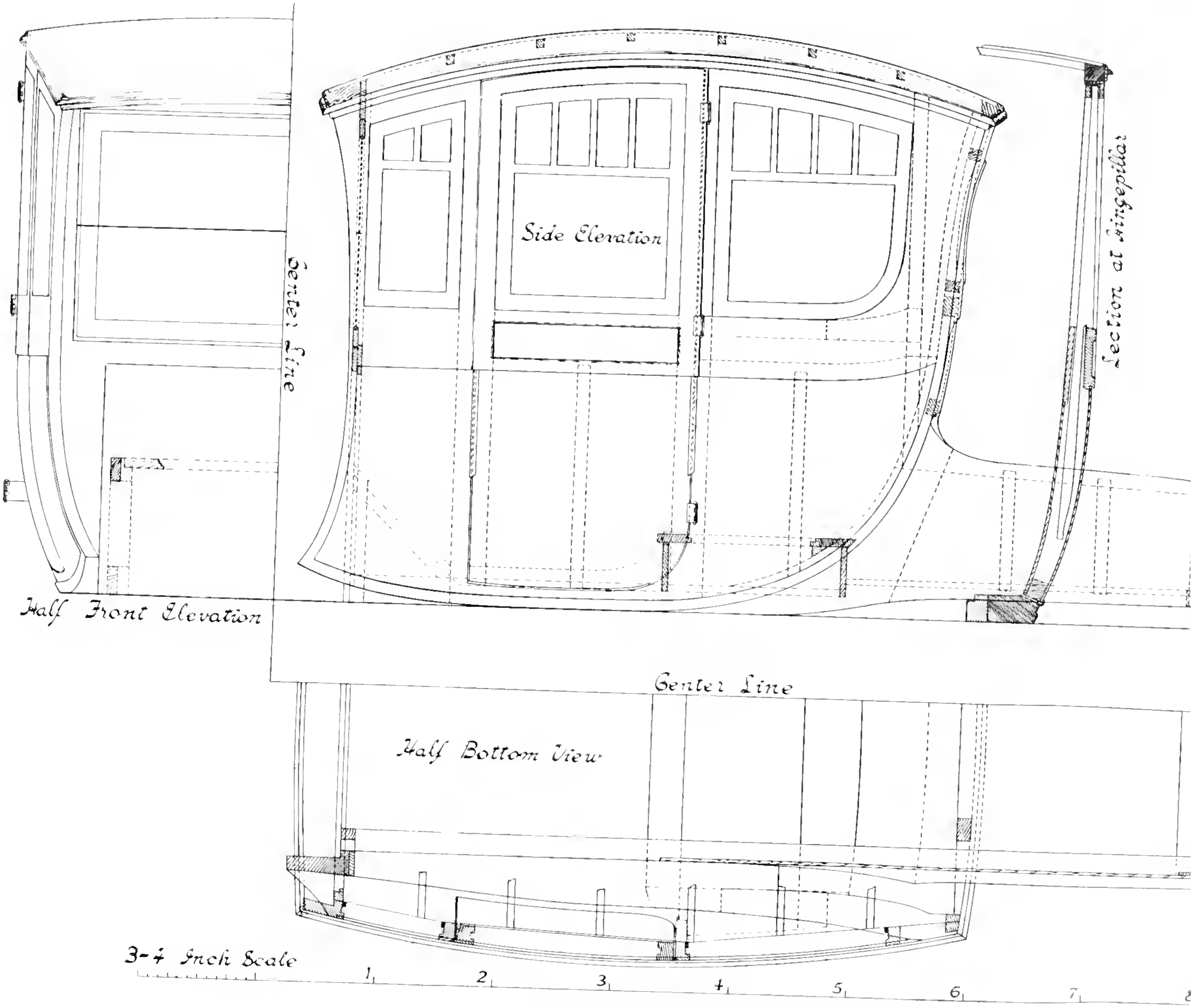
And so we could go on indefinitely giving advice, but most of these things must be learned by experience. So we advise the beginner to "stick to it" and put forth his best effort in all things. Perseverance and careful work will lead to success.



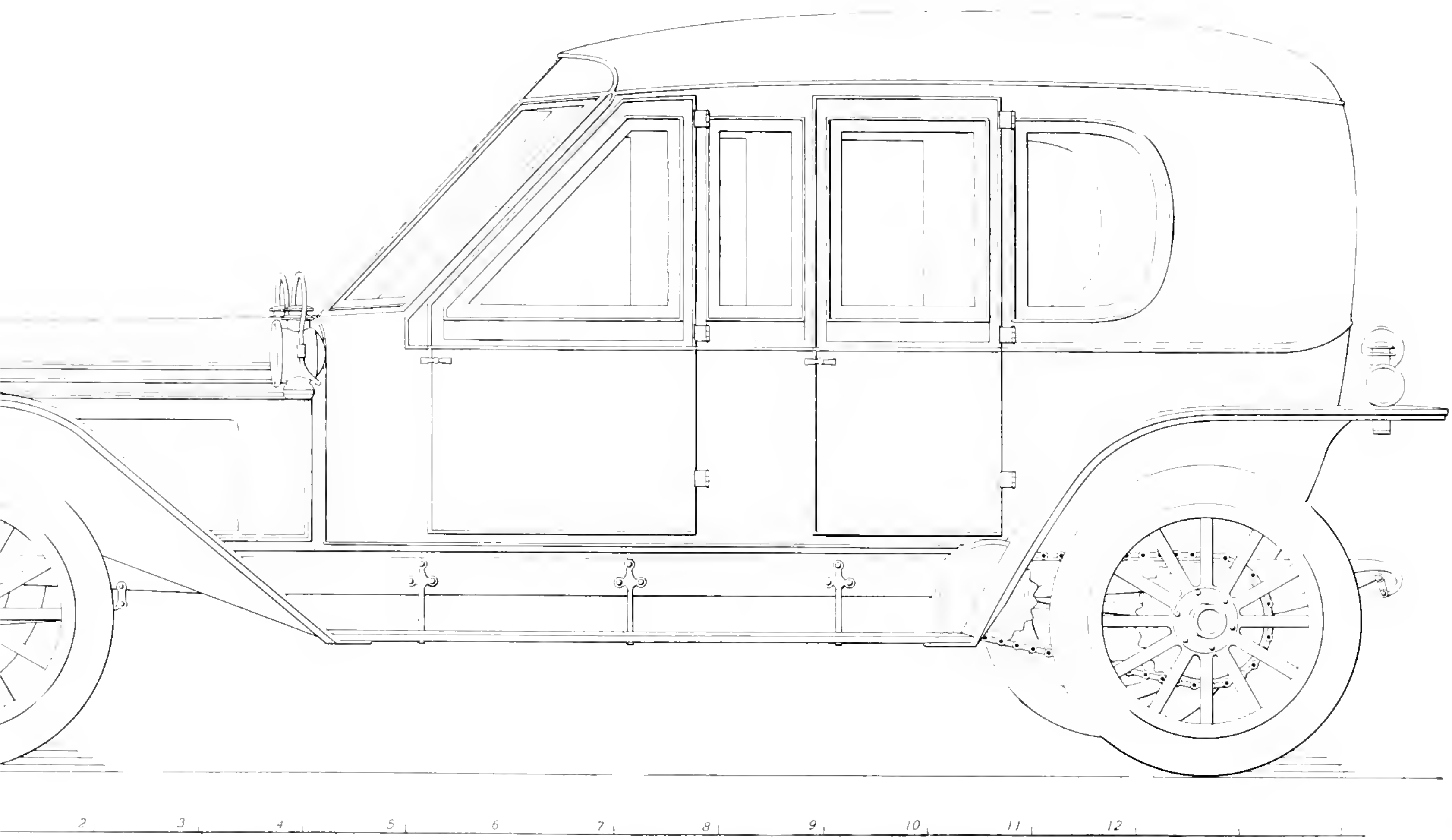
WORKING DRAFT OF TORPEDO ROADSTER.



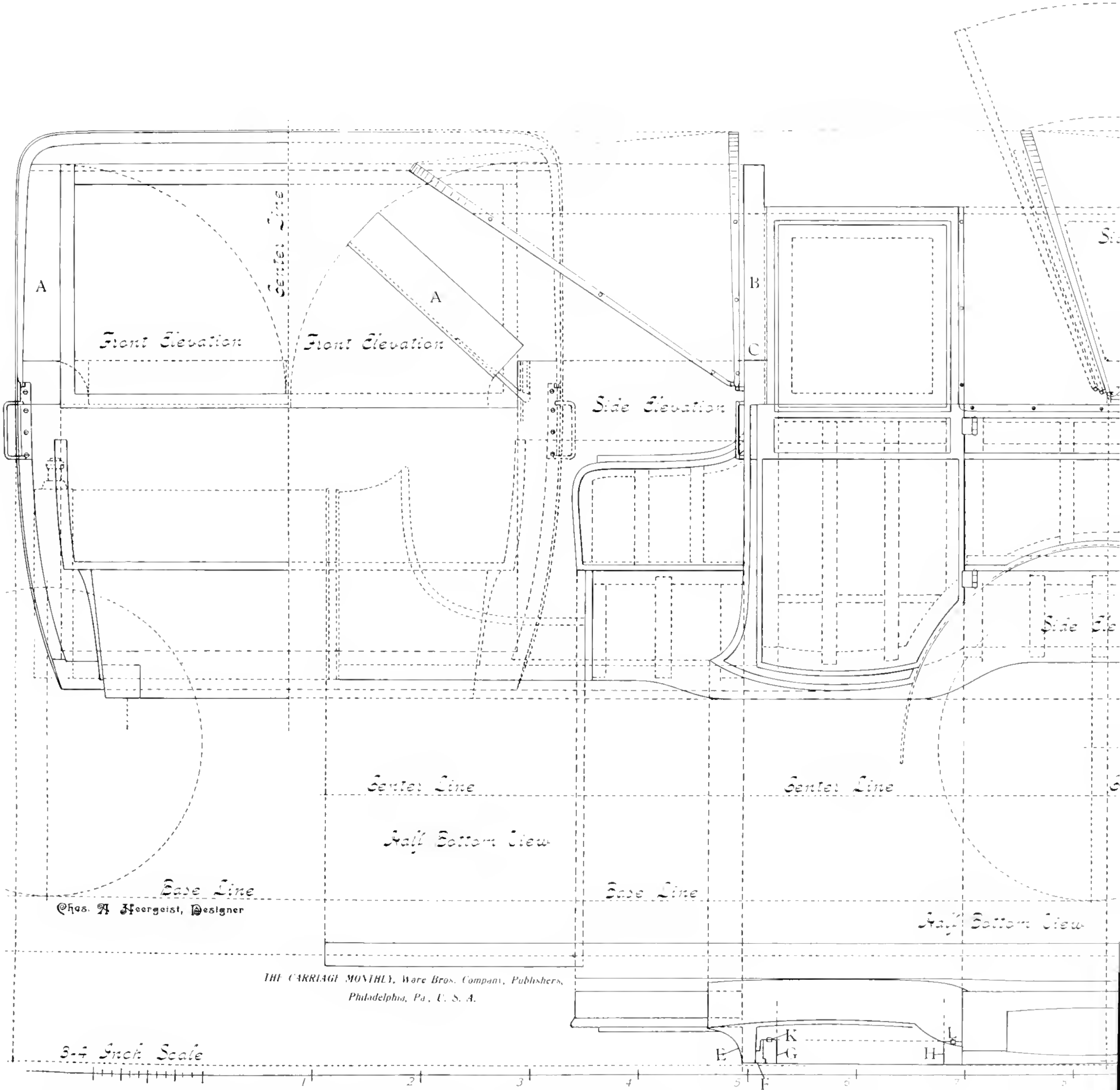
NEW DESIGN OF TORPEDO BODY, WITH CONVEX-CONCAVE TURN-UNDER.



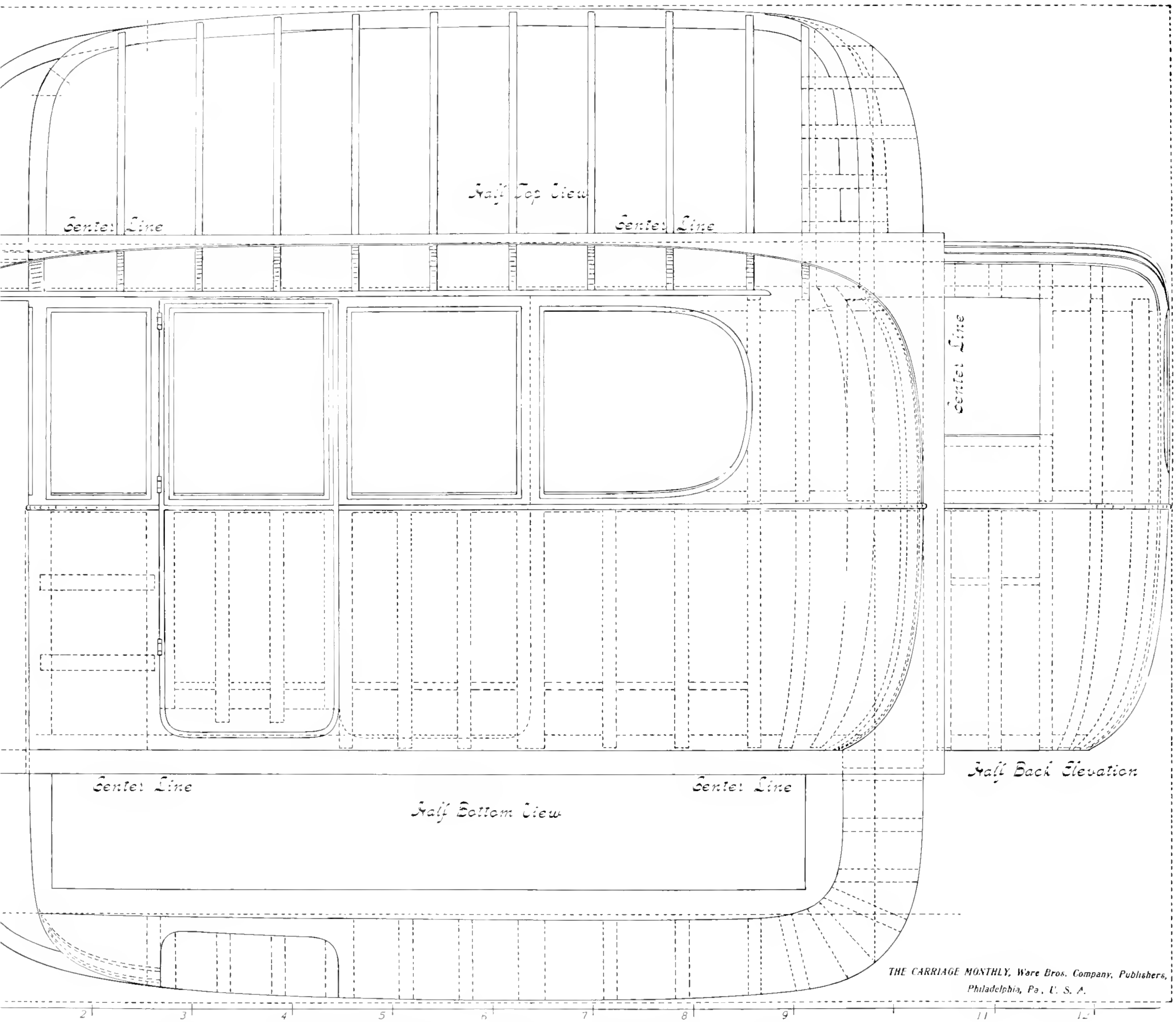
WORKING DRAFT OF COLONIAL COUPÉ.



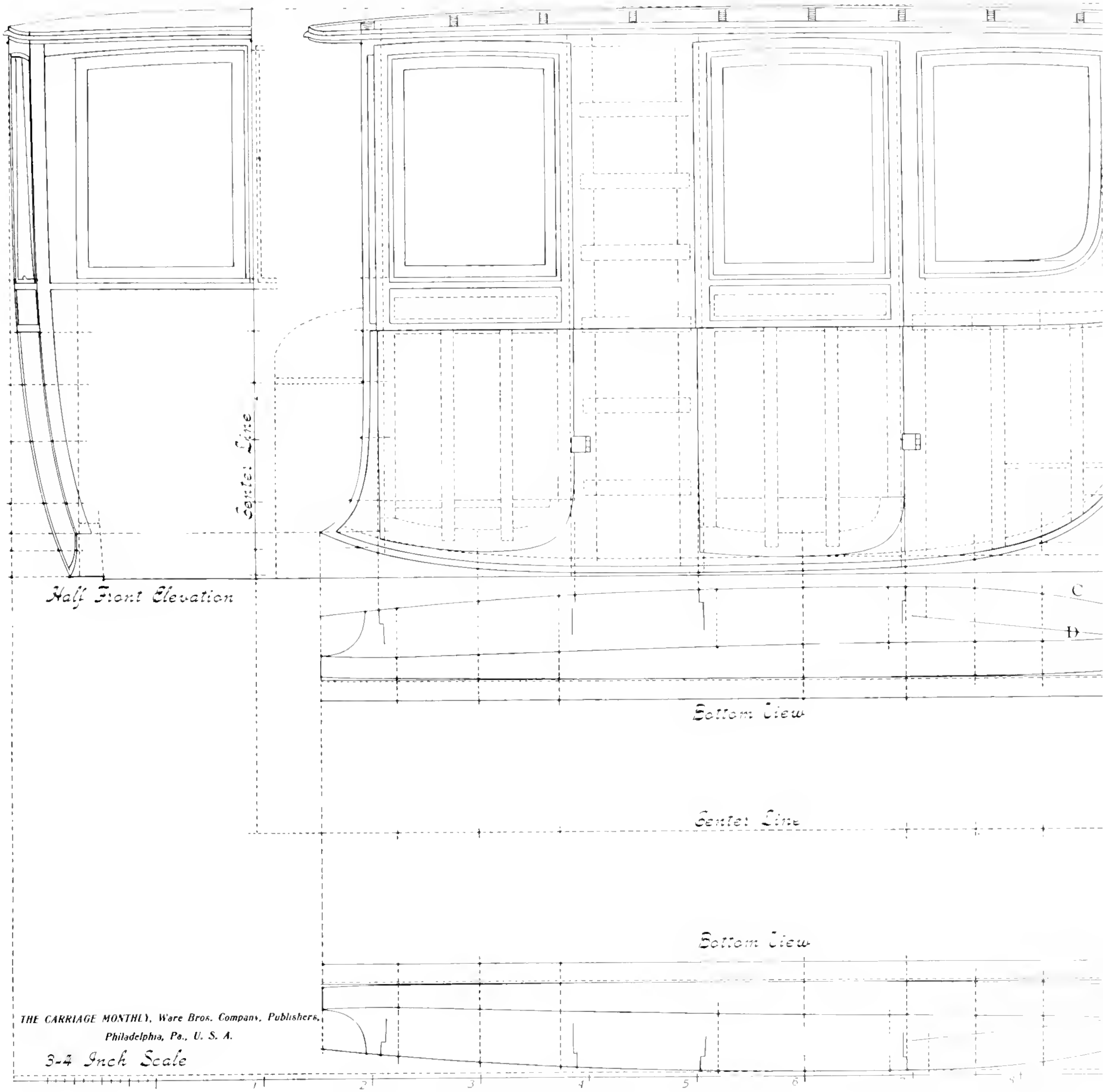
FOUR DOOR LIMOUSINE WITH REAR ROUNDED CORNERS AND ROUNDED TOP



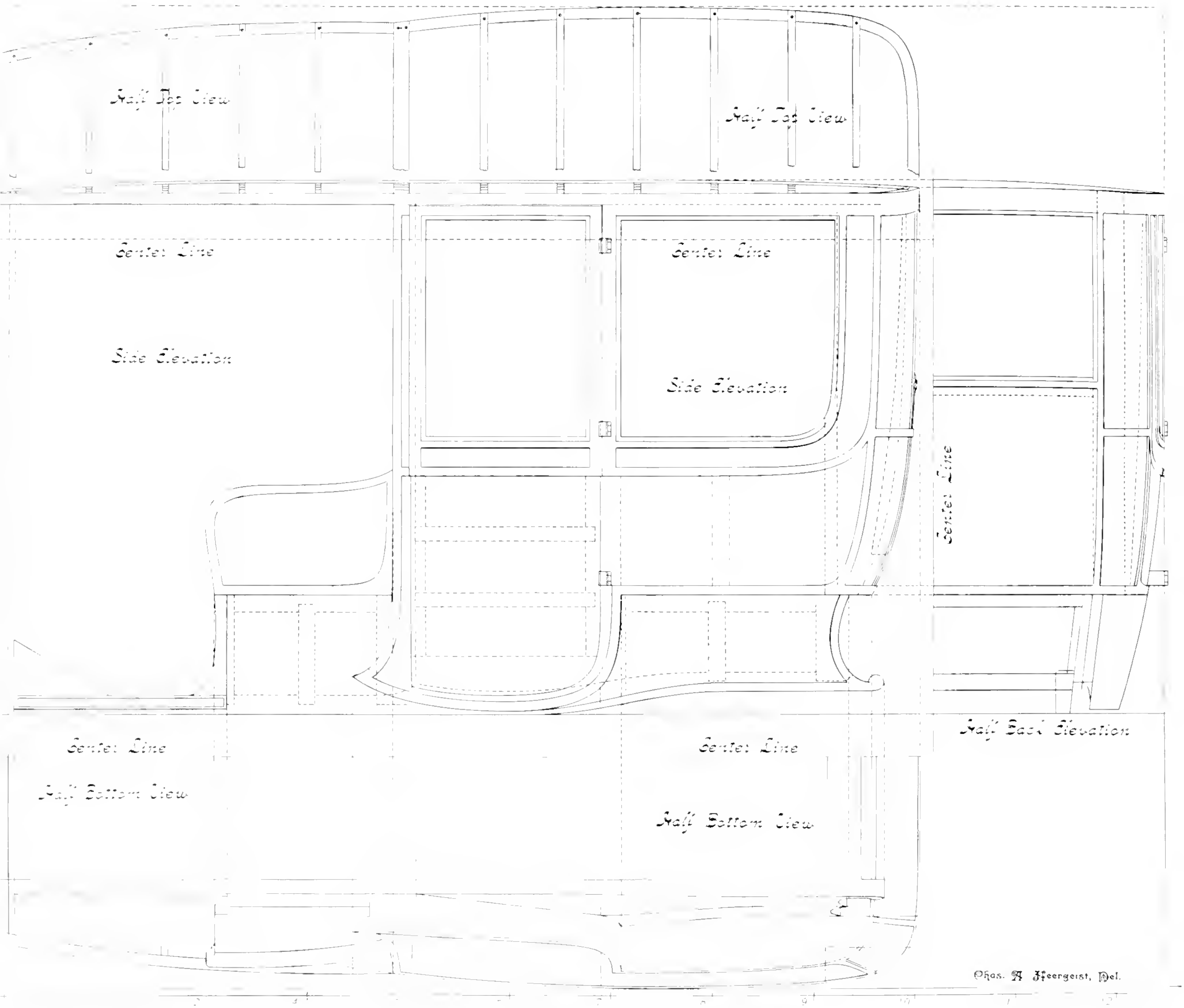
WORKING DRAFT OF TOURING CAR BODY, WITH NEW FOLDING TOP, DROP CHASSIS, ILLUSTRATING FRONT, S
AND BOTTOM VIEW.



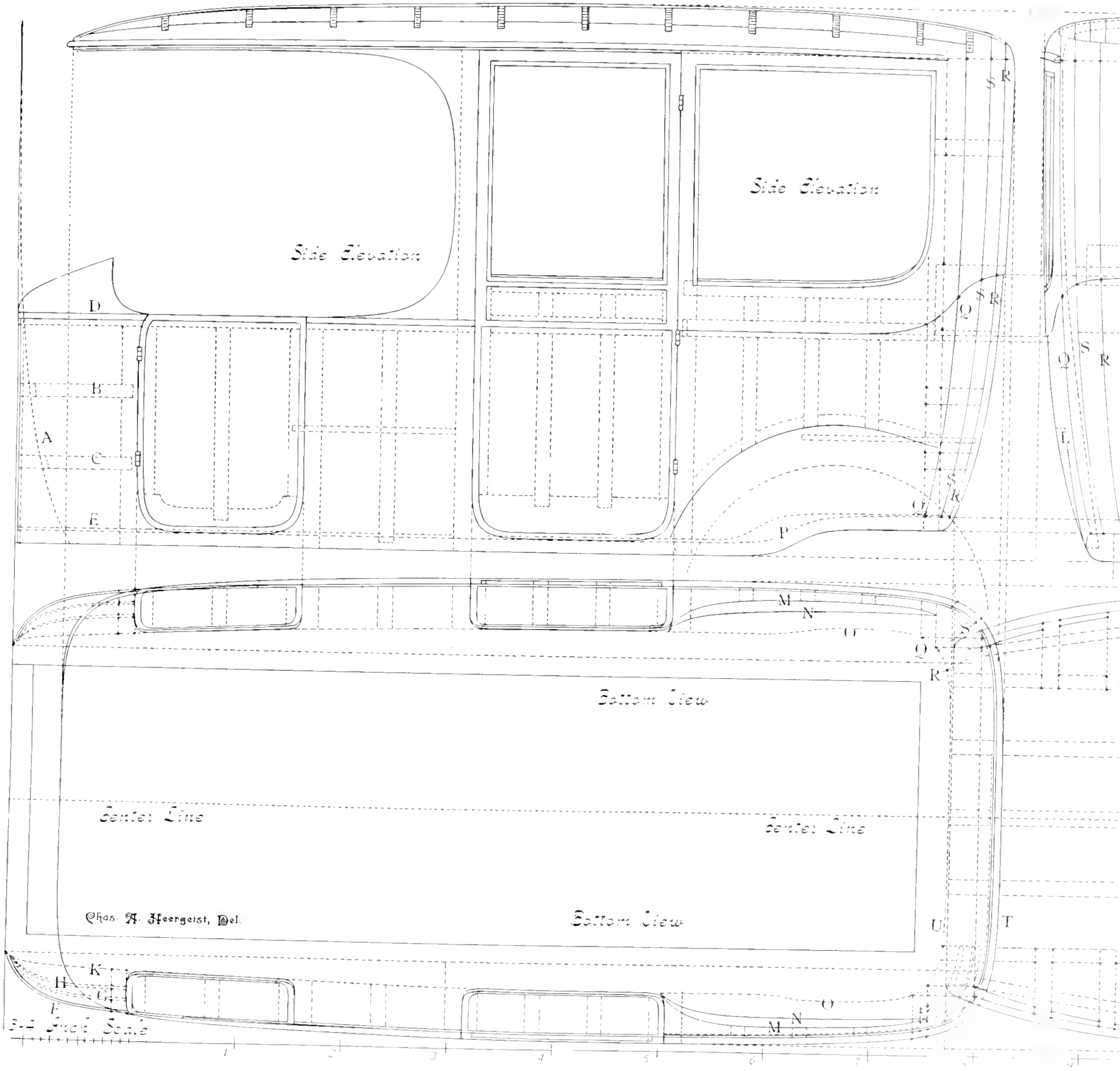
WORKING DRAFT OF LIMOUSINE BODY WITH ROUNDED ENDS AND SWELL SIDE SURFACES.



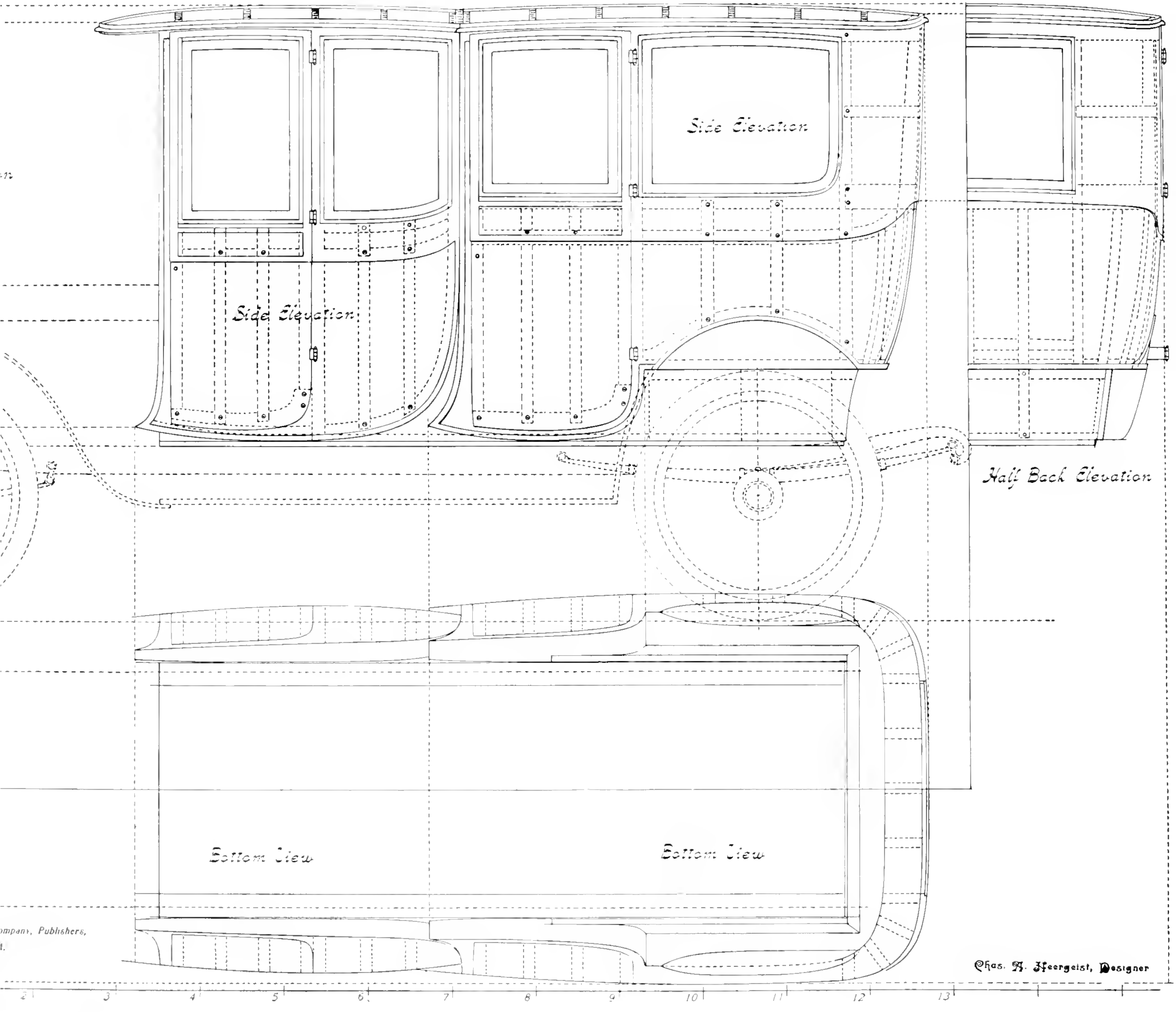
FOUR DOOR CLOSED LIMOUSINE BODY WITH REAR SQUARE CORNERS, FITTED TO A STR



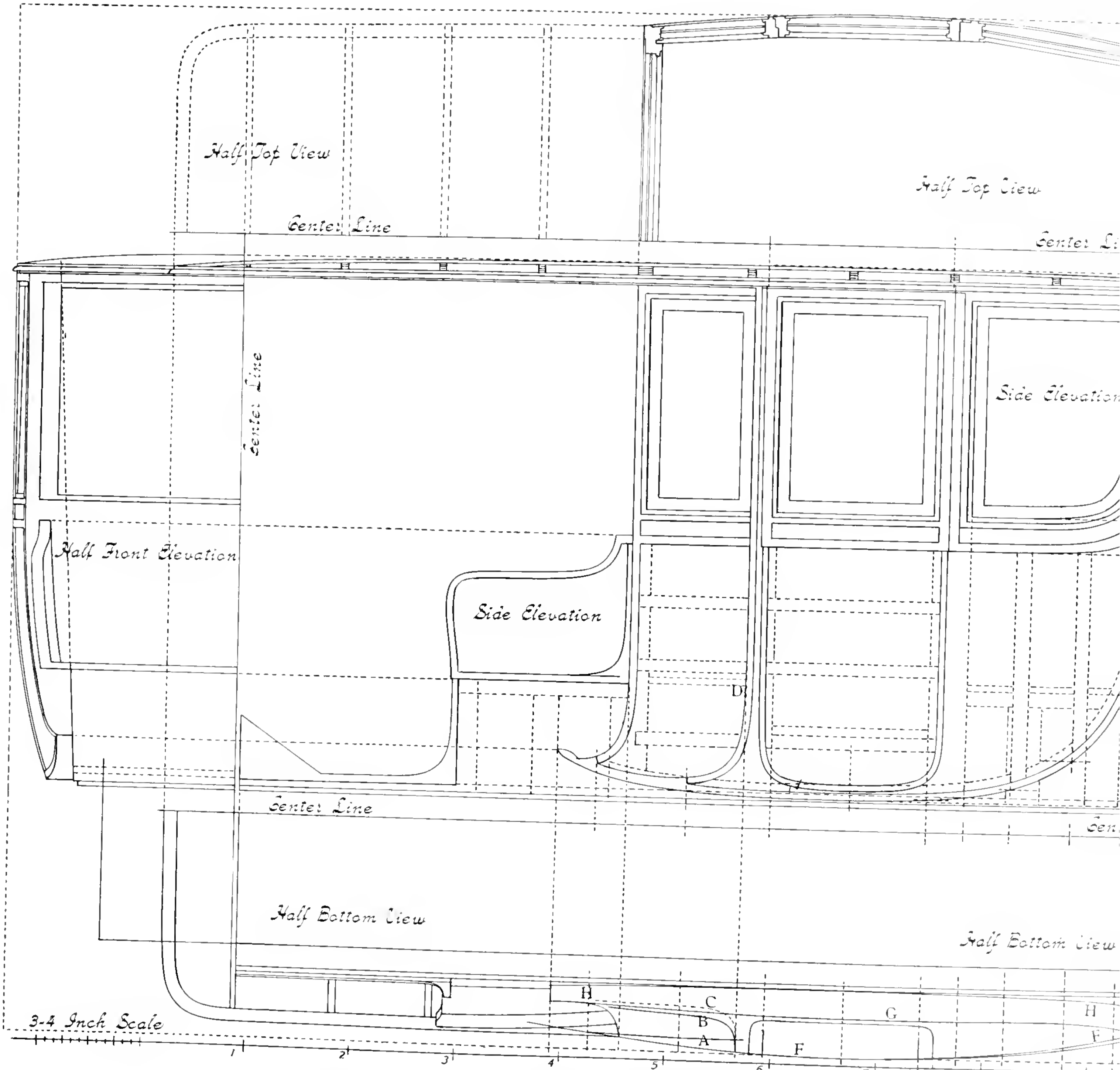
SIZE LIMOUSINE BODY WITH SOLID REAR CORNERS, FITTED TO A THREE-INCH DROP FRAME.



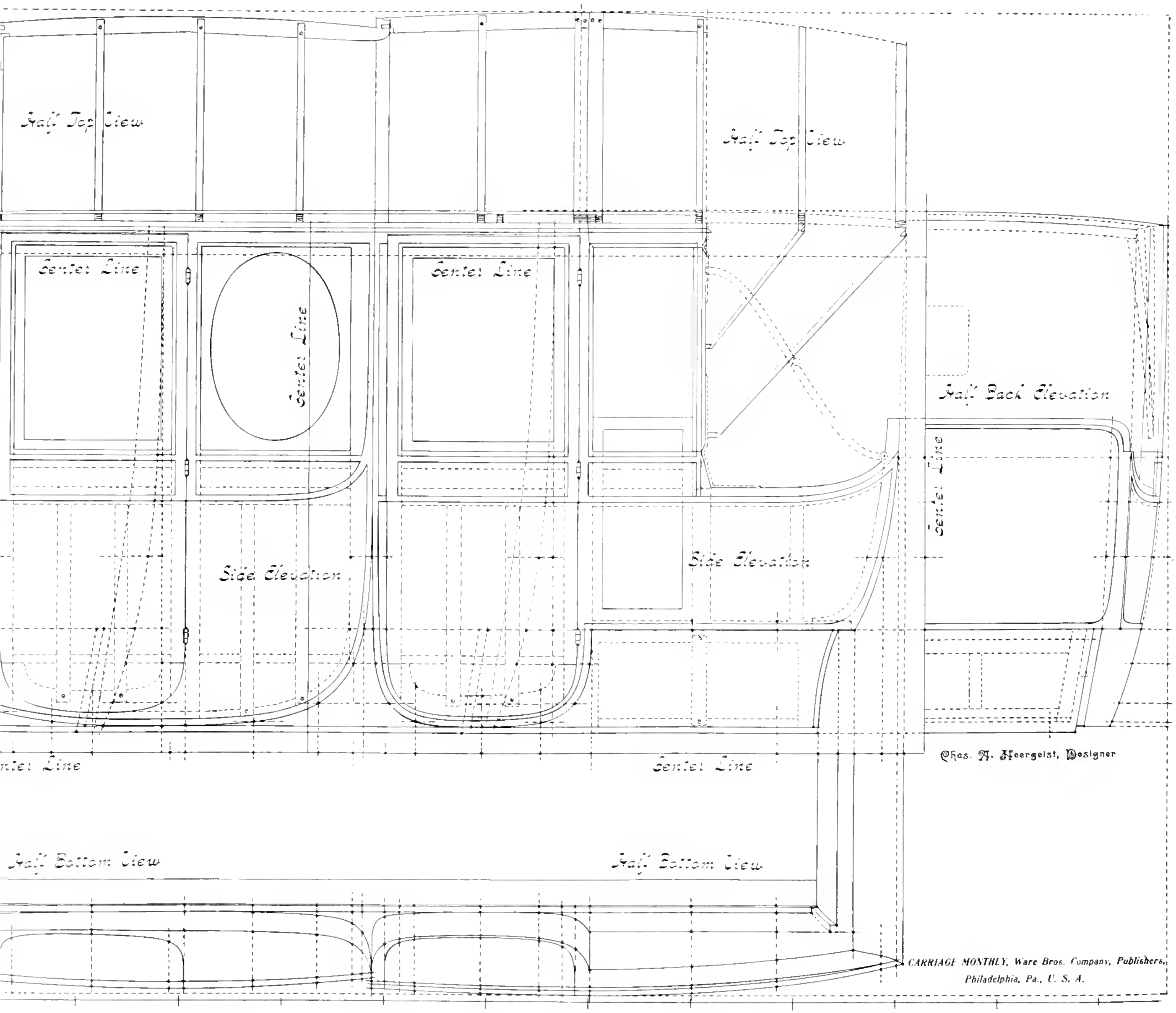
TWO LOW AND TWO HIGH DOOR LIMOUSINE BODY WITH SOLID ROUND CORNERS AND ROUNDED TOP, FITTE



... OF AN EXTENSION-FRONT BROUGHAM BODY, SHOWING SIDE ELEVATION, HALF FRONT AND HALF BACK ELEVATION AND BOTTOM VIEW.



WORKING DRAFT OF LIMOUSINE BODY, WITH ENCLOSED FRONT AND ALL GLASS FRAMES TO DROP; ILLUST
HALF FRONT AND HALF BACK ELEVATION AND BOTTOM VIEW.



MOUSINE-LANDAULET BODY, WITH ENCLOSED FRONT AND ALL GLASS FRAMES TO DROP; ILLUSTRATING HALF TOP AND BOTTOM VIEW, HALF FRONT, HALF REAR AND SIDE ELEVATION.
BODY BELOW SIDE QUARTERS IS RECESSED.