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JOURNAL OF ENGINEERING DRAWING

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THE DIVISION OF ENGINEERING DRAWING AND
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S P E E

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JOURNAL OF ENGINEERING DRAWING

PUBLISHED IN THE INTEREST OF TEACHERS OF ENGINEERING DRAWING AND RELATED SUBJECTS

VOL. 9, NO. 3 NOVEMBER, 1945 SERIES NO. 27

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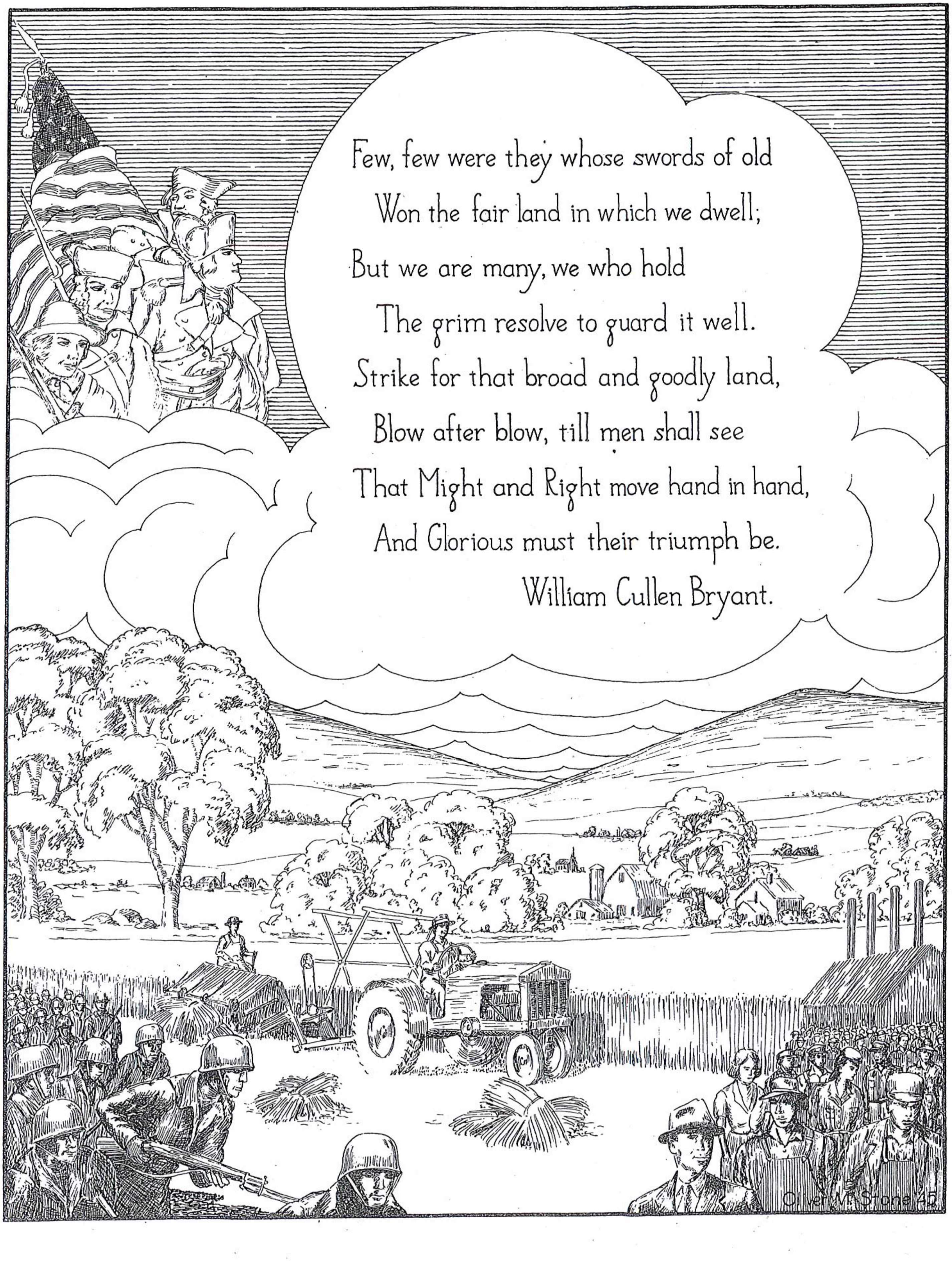

Few, few were they whose swords of old
Won the fair land in which we dwell;
But we are many, we who hold
The grim resolve to guard it well.
Strike for that broad and goodly land,
Blow after blow, till men shall see
That Might and Right move hand in hand,
And Glorious must their triumph be.
William Cullen Bryant.
Oliver M. Stone '45

The Editor's Page

Since the S. P. E. E. Meeting was cancelled in 1945 the Chairman of the Drawing and Descriptive Geometry Division has asked that the Publication Committee of the Journal of Engineering Drawing for 1944-45 continue during 1945-46. Your continued support in every way is solicited and we wish to thank you for the splendid cooperation during 1944-45. We are happy that a big increase was made during the past year in the number of subscribers and that we have a larger working capital to start the new year than for the previous year despite the fact that many of our Drawing teachers were in the Armed Forces and we have just witnessed a crucial year of war.

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It is interesting to compare our English neighbors Drawing Practice Standards with those in this country. Lecturer D. A. N. Sandifer of the University of Birmingham, England has prepared an interesting discussion for our information in this issue of the Journal.

* * * * *

Professor J. D. McFarland of the University of Texas has presented convincing evidence of ways to make Descriptive Geometry practical to students and make them conscious of the need for a thorough understanding of the subject. Regardless of the method used in presenting the course the applications of practical uses are valuable.

* * * * *

The Curtiss-Wright Engineering Cadette Program at Purdue demonstrates an excellent method of cooperation between colleges and industry. Such programs in peace times would be stimulating and educational.

* * * * *

Professor Northrup's paper on the Value of Production Illustration is interesting for he teaches in the heart of that great industrial area where the value of such drawings are appreciated.

* * * * *

Visualization of Motion by Pivoted Cutouts is something different and is informational. It demonstrates another industrial application of drawing that can be useful in advanced drawing classes. The application has been made useful in that there will be no additional expense involved for making of cutouts.

* * * * *

Drawing Department heads throughout the United States and Canada in High Schools and Colleges will render a valuable service if they will report changes of positions, promotions, papers written, talks made and all other activities of their staff members of the editor of the Drawing Journal.

New ideas and problems are in demand for the Guide Line's page. How about sending those problems that you would like to have worked.

* * * * *

Professor O. M. Stone of Case School of Applied Science has certainly demonstrated his artistic ability as exemplified by the Frontispiece page. His selection is most timely and we need more such pages for future editions of the Drawing Journal.

MAKE DESCRIPTIVE GEOMETRY PRACTICAL

by

James Dorr McFarland
Associate Professor of Drawing
The University of Texas

It has been truthfully said that one of the first principles of teaching is to arouse student interest in the course. Also, it is equally true that all of us have been asked the question, "Where will I ever find any use for descriptive geometry in my engineering work?" The question can be answered and the students' interest aroused by the same method. Present the course in a practical manner. It is agreed that a few students will learn to analyze a problem and obtain the solution, provided they have competent instruction, although they can see no practical application for the problem. The majority, however, will not. Ordinarily, our students are freshmen and sophomores. They have decided for various reasons to become engineers, and most of them feel that a course which does not sound like engineering in its content is of little importance to them and should be disposed of with as little effort as possible. They cannot see the relationship between their future work and finding the intersection of a line and a plane, or the angle between two lines, or any of the other fundamental problems of descriptive geometry; and their interest wanes accordingly. They should not be expected to become enthusiastic about the course so long as this feeling exists. Furthermore, it does not improve their interest much to tell them occasionally that a certain problem has a practical application to some problem in engineering and then continue to solve theoretical line and plane problems. Unfortunately, there are too many engineering teachers today who remember only that the course they took in descriptive geometry was uninteresting, had something to do with piercing points and traces of planes, and was difficult and obscure. Now they are asking us why descriptive geometry is required of engineering students. They do not know what we are teaching in the course or how it is presented. This is regretable. There is some justification for the feeling, however, and we are at fault if we do not try to correct it.

We can do much to arouse the student's interest, and can do a much better job of teaching, if we will present the majority of the problems in such a manner that their application to engineering is apparent. Finding the true length of an inclined pipe or a guy wire, or the struts in an airplane, or any other oblique member of a structure, is much more interesting to the students than finding the true length of a line AB. Similarly, the angle a line makes with a plane, especially if the plane is given by its traces, has little to recommend it when compared to finding the angle which a straight member makes with a plane face of the piece or structure of which it is a part. The angle between two lines can be given as the angle between two struts, or between two members of a crane hoist. The distances between two lines can be given as the clearance between two control cables in an airplane, or between two members in a steel structure. A wide awake teacher can think of many practical applications of the usual problems. All of the problems in descriptive geometry have applications to engineering and industry, and if presented in that fashion, students will not be inquiring about how and when they will find a need for their training in this interesting and important subject.

Of the various methods of teaching the course, I am convinced that the "direct method" is best. It is easier for the student to apply it to the ordinary drawing board work and consequently easier for him to understand. He can visualize a plane much better as a polygon, or by means of its strike and dip lines, than he can by its traces. He learns to orientate himself with respect to the object or structure which he is drawing, and to draw it as he sees it when looking in the required direction of sight.

This mental attitude of a change of position, and the orientation of the views, are of fundamental importance to the student if he is to learn to visualize thoroughly and develop a systematic space analysis for a problem instead of simply remembering that certain steps, or constructions on the drawing board are required to solve it. In general it can be said that in using the "direct method" the solution will show one or two views in which the spatial relationships are shown in the simplest manner.

(Continued on page 7)

(Continued from page 5)

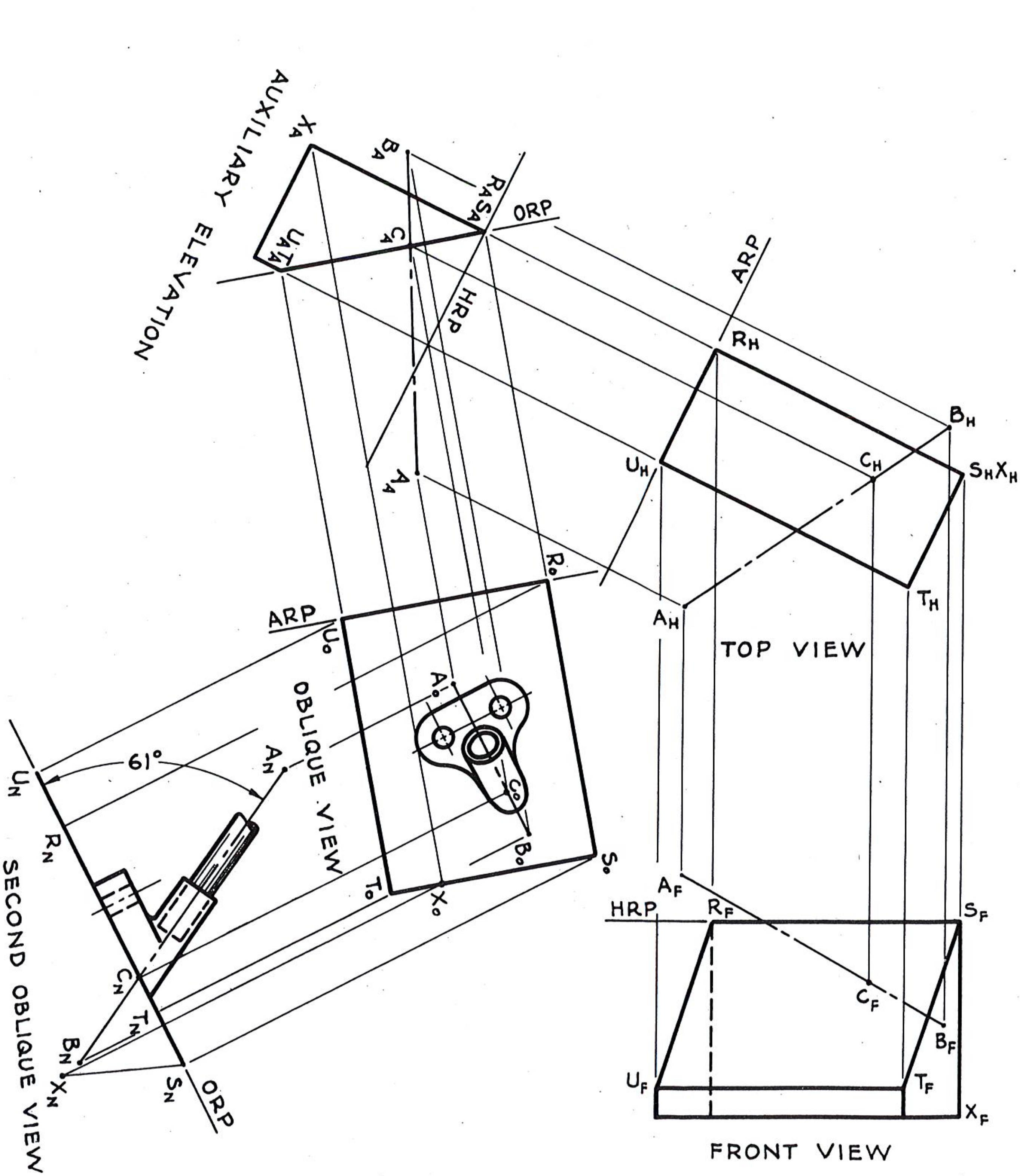
The accompanying drawing illustrates the direct method of obtaining the angle between a line and a plane. In order to gain the engineering approach, the problem is to design an angle bracket for fastening a steel rod, having AB as its axis, to the inclined surface RSTU. Obviously, the views needed for the design are a normal view of the plane and a view adjacent to it showing a normal view of the axis AB and an edge view of RSTU. The student will readily understand this because he has been taught to move around the object and look at it in the direction necessary to show the required relationship between the line and the plane. This method of solving the problem gives two oblique views which are the two simple views needed for designing the bracket and locating the holes necessary for attaching it to the inclined surface. There are other methods of solving the problem, of course, but it is questionable if any of them are as easily understood by the student, and certainly none of them are as practical for the designer on the drawing board. By the use of this method it is only a routine matter to work out the projections of the bracket in the top and front views. These views are desirable in many cases and cannot be obtained by some of the other methods of obtaining the angle between a line and a plane.

In a problem of this type, if only the angle between the line and the plane is required, the solution can be simplified by omitting the plane in the first oblique view, giving a simple, straight-forward solution.

This drawing also illustrates another valuable aid to the student in visualizing. It is the matter of orientation. He is taught to place the name of a view so that it can be read as a horizontal line of lettering when looking in the required direction of sight for the view. There are a number of methods for orientating a view but the best is by means of a vertical line in the object. The edge SX was used for orienting the views in the problem just discussed. If there are no vertical edges on the object the direction of one can be established by drawing a plumb line from some corner of the object and carrying it to the various views along with the object. The name of the view will be perpendicular to the plumb line and at its lower end. This method of orientation has been found to be very effective with our students.

All teachers of descriptive geometry should require a high grade of linework in accordance with standard line weights. The problems should be solved in the drawing room with a minimum of assistance and under the guidance of a competent instructor. Home work is conducive to copying, and a student cannot learn descriptive geometry unless he does his own work and a considerable amount of thinking. If he has difficulty with a problem, analyze it for him but let him make the necessary constructions. Our problem is to teach him to think analytically, logically, and systematically in space, not to follow a series of graphical steps or routine constructions.

Much interest and considerable time are ordinarily lost by the student in laying out the problem. There is something to be gained from laying out a problem, of course, but most of such construction is routing work and a waste of valuable time. Work sheets are of considerable value in this connection if they are prepared in such a manner that the problem cannot be solved by merely drawing two or three lines. The problems should be practical, and should be designed to stimulate interest and clear thinking. The study of a good textbook and competent instruction are indispensable, but an opportunity for real service will be lost if the student is not made to realize that descriptive geometry is practical.



ANGLE BETWEEN A LINE AND A PLANE BY McFARLAND

STANDARD DRAWING OFFICE PRACTICE IN ENGLAND

by

D.A.N. SANDIFER,
Lecturer in Mechanical Engineering,
The University, Birmingham, England,

The first national attempt to standardize drawing office practice in Britain was in 1927, when the British Standards Association (now the British Standards Institution) issued B.S. 308. This was a modest work of ten pages which confined itself mainly to suggesting standard sizes of drawings, first angle projection, and standard conventions for representing the parts which occur most commonly in mechanical engineering drawings. It was superseded recently by B.S. 308-1943, a much more comprehensive publication of fifty-one pages in which equal prominence is given to suggested conventions for mechanical and civil engineering drawings. Some of the illustrations are the same as those in the new American Standard for Engineering Drawing Office Practice. Important additions in the new B.S. 308 are suggestions for standard title blocks, lettering, a wider range of sectional views, limits, machining symbols, surface finish, welding symbols, structural steelwork, printing, graphs, and symbols for survey plans. The welding symbols are not given in detail, but reference is made to B.S. 499, in which they appear. A long list of British standard bolts and nuts is included in the section on screw threads.

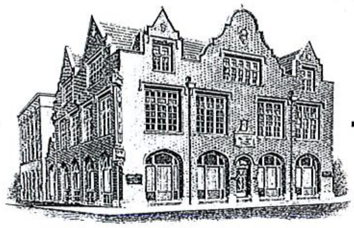
Attempts are at present being made to evolve common standards for screw threads in this country and America, and the work so far accomplished by the Combined Production and Resources Board is described in a Report of Conferences on Standardization of Screw Threads and Cylindrical Fits, numbered CG(ME)8737, obtainable from the British Standards Institution. The Screw Threads Committee of the Institution has recently sent a questionnaire to many firms, asking for their views on a standard pitch/diameter series for screw threads.

The Newall Standard System of limits and fits was the first generally adopted in Britain, and this was followed by B.S. 164-1924 and B.S. 164-1941, but some firms still use their own systems. Suggested standard tolerances for plain limit gauges are given in B.S. 969-1941. There is an increasing need for more guidance from drawing offices on the question of limits. For example, when specifying particulars for screw threads the designer should take into account the class of fit required, and any allowances to be made for plating coats, as well as the range of standard drills available for tapping. A very good paper on "Drawing Office Practice in Relation to Interchangeable Components" was read before the Institution of Mechanical Engineers in 1944 by C.A. Gladman of the National Physical Laboratory. The paper includes a drawing dictionary of proposed conventional notations, and is worthy of careful study.

In the past, large firms or groups of firms have sometimes evolved their own drawing office standards, which have been circulated among their staffs. In view of the comprehensive nature of B.S. 308-1943 this seems rather unfortunate, but there is no denying that some firms have special requirements not yet covered by the national standards. For example, one such publication which has recently come to the author's notice calls for special casting and stamping drawings in which the dimensions include all machining allowances, and the finished sizes are shown in phantom (chain-dotted or dashed) lines. The direction in which sheet metal should be blanked or pierced, and whether the burr is to be removed, are also asked for on the drawings in which such parts appear. It is almost inevitable that differences will exist between the British Standard and such private publications. Thus in the same example quoted above, dimension lines are shown unbroken, with dimension figures for horizontal distances above the line, and figures for vertical dimensions to the left of the line, reading from the right of the drawing; in B.S. 308 the dimension lines are shown interrupted for the insertion of the figures (except for limiting dimensions, which are shown one on either side of the line). Incidentally, this latter arrangement constitutes an anomaly within the British Standard itself, but is preferable to the common method of giving limits of small numerals added to or subtracted from a single basic dimension.

In the drawing offices at Birmingham University the students are encouraged to use only those methods which have become generally accepted as standard. They are acquainted

(Continued on page 11)



(Continued from page 9)

with third angle projection, but practically all the prints used employ first angle, as recommended in B.S. 308. Many British firms still use third angle, particularly for very large drawings, on which it is an advantage to have side views adjacent to the sides of the elevation that they represent. There seems little to recommend the system of combining third angle side views with a plan under the elevation, which is inconsistent.

Students at Birmingham are taught to aim at a high standard of draughtsmanship, but even greater importance is attached to correct geometrical interpretation of drawings. The reason for this is that most graduates eventually become fully qualified engineers, needing an ability to read drawings more than facility in their production. The author has recently seen many examples of the work of students in an American University, and these set a standard of draughtsmanship higher than our own, the probable reason being that many of these students spend two years only in the University, and then take up posts in which they do a considerable amount of drawing board work. They are taught to produce very high quality tracings, whereas at Birmingham the students only attempt this work if they specially ask for it, and then only one or two tracings. Nearly all large British firms train lady tracers in their own drawing offices.

In a short article it is not possible to touch on all the items that have been recommended for standard practice, and the following brief comments are therefore confined to those features which seem particularly worthy of discussion.

Until recently, most drawing offices indicated machining requirements by means of a small letter f near or across the line representing the edge of the surface to be machined, or alternatively by means of short section lines adjacent to the edge, either inside or outside the surface, sometimes continuous along the whole surface, sometimes only at intervals. Neither of these methods indicates what kind of machining is required, and they are therefore inferior to the method suggested in B.S. 308-1943, which it is to be hoped will come into general use. This method consists of drawing a small equilateral triangle near to or touching the surface to be machined, and where necessary inserting a capital letter within the triangle to indicate the type of machining: T for turning, M for milling, D for drilling, G for grinding, etc. A list of 22 abbreviations is suggested, some being double, such as RG for rough grind. If letters other than the four single ones just quoted are employed, it would probably be a help to the shops if a key for the meaning of each letter were given on the drawing. In the B.S. 308 illustration accompanying this suggestion, all the triangles are shown with one side horizontal and an apex underneath. This involves the use of arrows pointing from the triangle to the machined surface in some cases where space is restricted, an unfortunate complication of a very sound method. However, two other drawings in the specification illustrate a preferable variation, all triangles pointing symmetrically to, and touching, the machined surface, and where space is limited they are placed normal to a projection line from the surface. This method of indicating machining requirements has appeared in a recent edition of an English textbook. The only American drawing using the method which the author has seen employed one triangle to indicate rough machining, two for smooth machining, and three for grinding, a key being given on the drawing, and all the triangles blacked in. This is a rather cumbersome variation and is limited in scope, but it is probable that better examples are already in use.

The British Standard recommends a long list of abbreviations for general engineering terms and materials, but it seems likely that many of these would be of little help unless in regular use. In the standards booklet of a private firm referred to above, a list of abbreviations is given with the caution that they should not be used less space is limited or they are of very common occurrence, such as R.P.M., lb./sq.in., ft.lb., etc. This firm also recommends that designers should strive for pleasing appearance in machinery; and that all drawings should bear the date of commencement and draughtsman's signature, in order to cover questions concerning patent infringements.

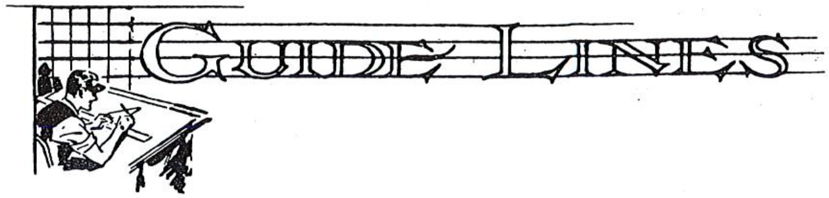
An article in the "Production and Engineering Bulletin" for May, 1945 (Vol. 4, No. 29) issued jointly by the British Ministries of Labour and Production, stresses the usefulness of simplified working drawings for supplying to operators, showing only the necessary information relating to the operation to be performed. Thus surfaces to be machined are drawn in lines at least three times as heavy as the remaining outline.

Where a web or rib occurs in the plane of a drawing of a central section, it is usual to draw a full line between the web and the adjacent sectioned part, leaving the web blank. Although not strictly correct, since the section plane passes through the centre of the web, this method is preferable to the alternative of sectioning the web as well, and using a line of short dashes between the web and adjoining part. A compromise recently encountered in both British and American drawings is a division line of short dashes with section lining of both parts, but only alternate section lines carried across the web. This makes the web stand out effectively, but is scarcely to be recommended in favour of the established unsectioned web.

Curiously enough, there seems to be no mention in the standard specifications of the method for indicating a diameter dimension when only half of a symmetrical section is drawn. Possibly this is because the half view is looked upon as misleading in industry. To give a radius instead of diameter on a half section is risking misinterpretation or miscalculation in the shops. The best method seems to be to give the diameter on the usual dimension line, but for the line to have one terminal arrow only, on the half view, the other end of the line finishing indefinitely just beyond the centre line.

In an appendix to B.S. 308-1943 the subject of reproduction of drawings is adequately summarized. The most common types are blue prints with white lines, and dye-line or ammonia gas prints giving brown, black or blue lines on a so-called white background. Usually this background is far from clear, and shows up all imperfections in the tracing, to such an extent that very old tracings often give almost unreadable prints. Nevertheless this type has almost superseded the blue print, mainly because it costs very little more, lends itself to pencilled or inked alterations and comments, and permits the use of colour washes if desired. Presumably the author is conservative in preferring blue prints, which can be corrected just as easily with pen and chemicals, or yellow lead pencil. True-to-scale prints are of course best of all, giving a black line on a natural unsensitized paper, but they necessitate the equipment of the photo print trade and are more expensive unless in very large numbers. They also enable the use of a combined print showing both drawing and picture of the part described, a valuable method for teaching purposes, and in common use in American University work.

Little has been said about welding symbols, and nothing of Production Illustration, but both these branches of the subject are dealt with very competently in the issue of this Journal for November, 1944 (Vol. 8, No. 3.).

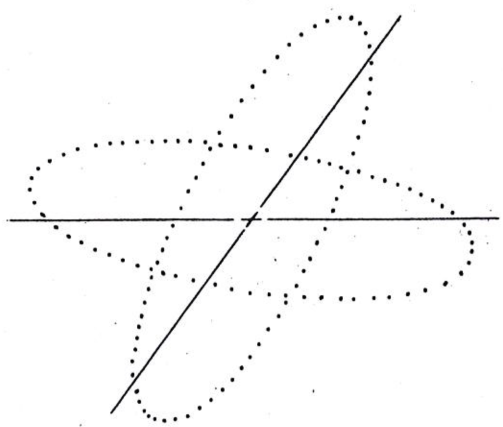


The following appeared in the May issue of the Journal of Engineering Drawing:

A GRAPHICAL PROBLEM
TO INVESTIGATE MATHEMATICALLY

Professor George J. Hood of the University of Kansas writes: "While plotting some ellipses with a trammel, I became curious as to what would happen if the two lines taken as axes were not perpendicular. The drawing below shows the results. Possibly some reader of the Journal who keeps up his analytics may be interested in determining if the resultant figures actually are the ellipses they seem to be."

Send your solutions to the editor of the Journal of Engineering Drawing before August 15, 1945 and one or more will be carried in the November 1945 Journal.



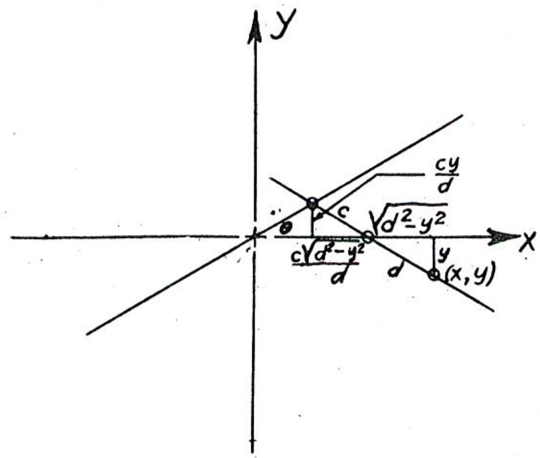
The first correct answer to reach the editor came from Professor H.C.T. Eggers of the University of Minnesota and here is the solution.

EQUATION FOR AN ELLIPSE PLOTTED
ON AXES THAT ARE NOT PERPENDICULAR

Proof:

$$x - \frac{c}{d}\sqrt{d^2 - y^2} - \sqrt{d^2 - y^2} = \frac{cy}{d}\cot\theta \qquad (1)$$

$$x - \left(\frac{c}{d} + 1\right)\sqrt{d^2 - y^2} = \frac{cy}{d}\cot\theta \qquad (2)$$



Let

$$K_1 = \frac{c}{d}\cot\theta$$

$$K_2 = \left(\frac{c}{d} + 1\right)$$

$$x - K_1 y = K_2\sqrt{d^2 - y^2} \qquad (3)$$

$$x^2 - 2K_1X\,y + K_1^2 y^2 = K_2^2(d^2 - y^2) \qquad (4)$$

$$x^2 - 2K_1X\,y + (K_1^2 + K_2^2)y^2 - K_2^2 d^2 = 0 \qquad (5)$$

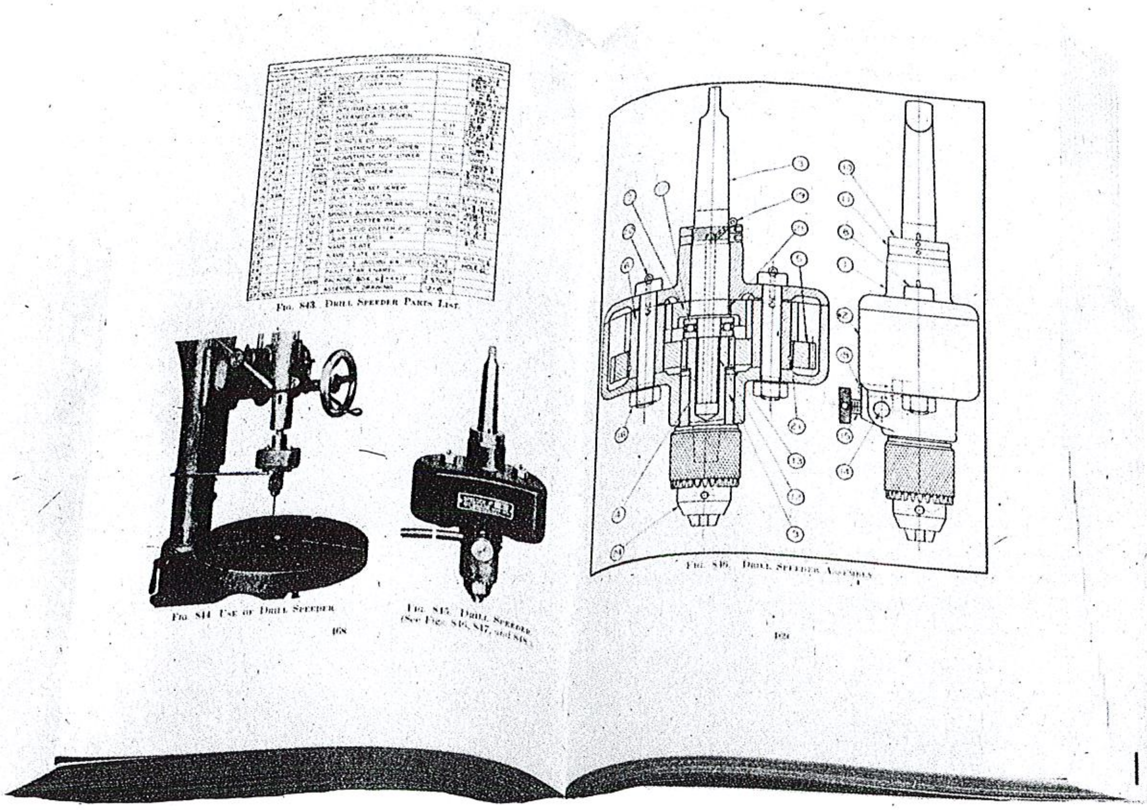
$$\text{Characteristic} = 4K_1^2 - 4K_1^2 - 4K_2^2 = \text{Negative}$$

∴ Equation (5) is equation of an ellipse.

NOVEL SLOGAN
* * * * *

Mrs. H.C. Spencer, the wife of Professor H.C. Spencer of the Illinois Institute of Technology has a novel slogan for the 1946 Drawing Summer School. Come again Mrs. Spencer and the wives of other professors are invited to contribute to the Journal. Here it is.

P IXILATED
ROFF'S
LAN
ROHIBITED
ROGRAM



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CURTISS-WRIGHT ENGINEERING CADETTE PROGRAM AT PURDUE UNIVERSITY 1944-1945

by

S.B. Elrod
Assistant Professor of Engineering Drawing

During 1943 Curtiss-Wright Corporation carried out a large scale program to train "Engineering Cadettes" to help relieve the shortage of technical help in the engineering departments of their various plants. Purdue University was one of seven schools participating in this program. Most of the Purdue-trained girls went to work at the Columbus Plant of the Airplane Division, although a few went to plants at Louisville, Kentucky and Buffalo, New York. The program lasted ten months.

While these cadettes were received by the engineering staffs with some misgivings it was soon apparent that the majority of them were capable of carrying out many of the less technical duties of the staff, and the majority of those still at Columbus have now reached the rating of "Junior Engineer", on a par with regular graduate engineers.

Within a few months after the close of the first program, the Columbus plant was confronted with another impending manpower shortage in their engineering department. The experience of the first program indicated that a repetition of that program was the best solution for the shortage. This has led to the recent 1944-45 program, carried out at Purdue University for the Columbus Plant only.

This program was set up on the basis of small groups starting each quarter--primarily to keep a continuous flow of Cadettes into the plant. One group started in July, 1944 and another in October, 1944. The period of training also was cut down to six months; two twelve-week terms with a week's vacation between terms. Urgent need was an important factor in this decision, but it was felt that the experience of the first term would enable us to do a satisfactory job in that time. While it is rather early to draw any conclusions on this score, all indications are that the new Cadettes already at work from the July group are adapting themselves to the work assigned them and will probably fit into the organization nearly as well as the first group in spite of the forty percent reduction in their training time.

RECRUITING AND SELECTION

Recruiting and selection of candidates was done under the direction of Mr. Warren Bruner, Coordinator of Cadette Training for the Airplane Division, on whose staff at times were several of the cadettes who had been students in the first program.

As before, numerous colleges, universities, and junior colleges throughout the country were contacted, and the names of many girls whose grades and choice of subjects indicated an aptitude for engineering work were obtained from them. The age limit was lowered to include those who would become 18 on or about the date of plant induction, and a goodly number of high school graduates were accepted.

The belief that recent high school graduates who had taken considerable mathematics would make better cadettes than some college graduates who had taken liberal arts, etc., was pretty well borne out by their scholastic performance. Some of the latter who had been accepted for the first program, having had no contact with mathematics courses since their sophomore days in high school experienced considerable difficulty with the technical courses; while a number of high school graduates in the current groups made outstanding records.

The candidates were selected on the basis of their school record and specific information furnished by their teachers, and most of them without a personal interview. Although many thought this a hazardous policy, actually the performance of the girls accepted in general surpassed by a considerable margin the performance of those selected by more tedious and more expensive processes for other such programs.

ORGANIZATION

The conducting of the program was divided between the Engineering and Personnel Departments of the Columbus Plant. Mr. Frank M. Mallett, Production Design Engineer, and former Ohio State faculty member, under Mr. J.M. Rice, Engineering Manager, had charge of all academic detail. Mr. Richard R. Crow, Director of Training in the Personnel Department was responsible for all administrative detail.

Both Mr. Mallett and Mr. Crow were frequent visitors to the campus during the entire program, one or the other, or both, being there for several days each month.

Most of the staff members spent several days at the plant just prior to the start of the program. Several had visited the Columbus plant and other plants in connection with the previous program, and were fairly well acquainted with the policies and organization of their engineering department.

The program at Purdue was under the supervision of Professor C.W. Beese, Director of War Training and Head of General Engineering, with Professor E.F. Bruhn, of the School of Mechanical and Aeronautical Engineering and formerly Project Engineer with Vought-Sikowsky, as Coordinator of Curriculum.

One hundred and sixteen girls arrived on the campus before classes started July 4th. Ninety-eight of these remained to finish the program on Dec. 23. Of the nineteen who did not stay, eight were forced to leave on account of health, two left of their own accord during the first week and three more withdrew during the program; six others were eliminated from the program by faculty and/or company.

Eighty-three girls reported on October 2 for the program which ended March 24, 1945. Of this group, five girls left voluntarily, while only one was eliminated for poor performance.

EQUIPMENT AND EXPENSES

The Cadettes had to buy their own text books, slide rules, drawing equipment, and shop clothing. Curtiss-Wright Corporation paid all other expenses, housing, and tuition, which entitled them to all the privileges of regular university students such as admission to athletic events, student health service, library, and Student

Union. Besides this, each cadette was paid ten dollars ($10) per week.

The group of 116 cadettes entering in July were housed in one wing of the Women's Residence Halls. By October the crowded condition of the halls made it necessary to place the girls coming in at that time, in vacant fraternity houses which were operated by the University. Each group had a House Mother who was responsible for keeping order.

CURRICULUM

First twelve weeks:

COURSE NO.	NAME	REC.	LAB.	SECTIONS
CW-I	Mathematics.	6	0	all
CW-II	Aircraft Drafting. . . .	0*	15*	all
CW-III	Materials and Processes.	2	0	all
CW-IV	Shop Tools and Practices	1	3	all
CW-V	Terminology & Principle of Flight	2	0	all
CW-VI	Mechanics (Statics). . .	4	0	all
	TOTAL HOURS	15 +	18 =	33/week

Second twelve weeks:

COURSE NO.	NAME	REC.	LAB.	SECTIONS
CW-VII	Aircraft	0*	15*	all
CW-VIII	Structural Analysis. . .	6	3	all
CW-IX	Aerodynamics	3	3	A,B,E,F
CW-IA	Mathematics.	4	0	C,D,G
		9 or 10 +	21 or 18 =	30 or 28/week

* Lectures from 2-5 hours/week; deducted from lab. time.

Cadettes were sectioned according to their performance on standardized algebra and trigonometry achievement tests which were given at the beginning of the program.

Those in the July group were placed in sections A, B, C, or D according to their performance on these tests. The October group were similarly placed in sections E, F, and G.

The material covered in Mathematics CW-I, Mechanics CW-VII and structural analysis CW-VII varied greatly in these sections. Sections C, D, and G did not take Aerodynamics CW-IX, but substituted another Mathematics course CW-Ia. In other courses all sections covered the identical material. As was expected their performance varied considerably.

It has been variously estimated that from 75% to 85% of all the work of engineering for the Aviation Industry is actual drawing board work, therefore, nearly half of the class hours in the program were devoted to drafting, namely 360 hours.

The Drafting courses CW-II and CW-VII were one continuous course, designated by two numbers for purposes of record and in order to fit into the two-term scheme. Since nearly all of the girls had no training whatsoever in this field, it was necessary to start with elementary problems.

The first six weeks (90 hours) were spent on the usual basic work, lettering, sketching, three-view drawings of simple aircraft parts, sectional and auxiliary views, and one week of ink tracing. Use was made here of five Purdue University motion pictures: "Capital Letters", "Sketching", "Sectional Views", "Auxiliary Views", and "Ink Work" with their work sheets.

Only six hours were scheduled for lettering exercises, since on a program of this length, plenty of practice is provided on the drawings.

No use was made of "Projection Exercises", or drill sheets, rather the principles were brought out in each especially designed drawing problem. Each drawing, from the very beginning was as complete as could be made, with all dimensions, notes, finish marks, etc. Exceptions had to be made from standard drawing practice to make the drawings agree with aircraft standards in general, and company practices in particular, specific examples being: full decimal dimensioning, all dimensions reading from the bottom of the sheet, a special adaptation of base line dimensioning, and the requirement of the aircraft industry which calls for absolutely complete dimensioning and notes so that there are no "loopholes".

The second six weeks were spent on "Aircraft Descriptive Geometry". The first two of these being devoted to simple point, line and plane relations.

Problems were divided about equally between abstract layouts and aircraft applications. Another week was spent on curved line problems and single curved surface intersections, including the "rolling tangent" method of development of non-conics. The balance of the time was spent on wing and fuselage layouts. One group drew a 1/10 scale lines drawing of a British Spitfire fuselage, the second group a mathematically developed fuselage having semi-ellipses for all station contours. In each case water lines and buttock lines were taken at from 2 to 5 inch intervals, both sets of lines faired, and canted sections taken at significant points on the fuselage. The entire second twelve week term was spent on detail and assembly drawings. Jobs included castings, forgings, sheet metal parts and assemblies, weld assemblies, details and assemblies built up of standard or semi-standard parts. For one assembly the students were required to solve a descriptive geometry layout involving a "third auxiliary" view to determine proportions for the drawing. Weld Assemblies were drawn from "off-scale" layouts prepared from Curtiss-Wright detail drawings of the C-46 Commando.

Castings, forgings and mechanical assemblies were drawn from the original layouts of the SNC-1 while sheet metal details were drawn from authentic layouts of the AT-9.

Throughout this term emphasis was placed on practical design, dimensioning, tolerances, interchangeability, drawing callouts, Bill of Material, Title Block, etc. Tests given during this term stressed these points rather than drafting ability which was the primary consideration during the first twelve weeks.

The company furnished six invaluable references: The Curtiss Engineering Manual, Drafting Supplement, Curtiss Aeronautical Materials Handbook, Production Design Supplement, two sets of standards books, one of which contained Army-Navy Standards, (AN) Army-Navy Design Standards (AND) and Naval Aircraft Factory Standards (NAF) the other contained Curtiss -D Standard sheets, Curtiss Design Standards (CDS) and Naval Aircraft Standards (NAS). Each cadette had her own assigned copy of the first three, and was responsible for keeping them up to date, while sufficient copies of the others were available. Every job in this term required continual reference to nearly all of these books, some jobs having several references to each of them. All drawings were made on printed sheets bearing the standard C-W title block; sizes ranged from $8\frac{1}{2}$" x 11" to 22" x 34", the majority being 17" x 22".

All drafting labs were held in one room. This room, 50' x 65' was equipped with sixty-three (63) 36" x 60" drafting tables (mostly Hamiltons) with parallel attachments. Flourescent lighting provided 40-45 foot candles at table top when all sunlight was excluded, hence eye strain was a minor problem.

An unusual practice was followed, partly because of schedule difficulties, that of changing instructors in various cycles. During the July and October terms an instructor met his class three times per week, and another man met it the fourth time, with all instructors changing sections monthly. In the January term the monthly change was the only one. Despite some disadvantages of this scheme, it is believed that the effect of students having to adjust themselves to the resultant range of personalities prepared them better for the working conditions they would encounter at the plant.

The following descriptions of the other courses are condensed from the official course descriptions:

CW-III - Aircraft Materials and Processes: Aircraft materials, alloys of steel, aluminum and magnesium; tests, properties, uses, heat treatment, corrosion, forming, shaping and joining.

CW-IV - Shop Tools and Practices: Operations and tooling methods with lectures and shop practice in the following topics: lathe operations, milling operations, turret lathes and screw machines, aircraft sheet metal, dies and press operations.

CW-V - Aircraft Terminology and Principles of Flight: Nomenclature; elementary principles of flight; structures; installations; organization of engineering department and duties and responsibilities of each division.

CW-VI - Mechanics (Statics): Composition and resolution of forces; equilibrium of coplanar forces; trusses and frames; friction; centroids and center of gravity; moment of inertia of area.

CW-VIII - Structural Analysis: 6 class hours per week: Stress and strain relations; elastic properties of materials and use of tables in ANC-5; general principles regarding loads on airplanes, torsional stress and strain; shear and moment diagrams for beams; moment of inertia of area; bending and shear stress in beams; simple column theory - Euler's equation; design of steel and aluminum tubes and streamline tubes as columns; elementary theory of combined stress; properties of unsymmetrical sections; elementary theory of the semi-tension field beam. 3 laboratory hours per week: Tension test of aluminum alloy sheet, design of simple tension strap and single pin connection; strength check of typical fittings; center of gravity of airplane; centroid of fuselage and wing sections moment of inertia of fuselage section; principal axes and corresponding moments of inertia of unsymmetrical sections; of shear and moments on fuselage and wing.

CW-IX - Elementary Aerodynamics: Airfoil theory; lift; drag; moments; airfoil characteristics; induced drag; effect of aspect ratio; simple blade element propeller theory; propeller performance characteristics; sea level performance.

CREDITS GRANTED

Following the completion of the first six months program in December 1944 the credits granted amounted to twenty-six semester hours. This would be roughly ten percent below the average credit earnings for regular engineering students in the same amount of time.

EMPLOYMENT

Upon their scheduled arrival at the plant from one to two weeks after the closing of the term at Purdue, the cadettes were all assigned to the Liaison group. In order to absorb such a large group quickly some of the girls were temporarily assigned to ink tracing. As rapidly as possible all were put on "Engineering Change Order Incorporation". In this field they received a maximum of experience in a short time, for their job was to make all the changes necessary to keep shop drawings up to date. From this group transfers were made as rapidly as the cadettes indicated mastery of "E.O. Incorporation", some being shifted to Shop Contact, or Checking, both within the Liaison group. Large numbers transferred to the various Design Groups, Structures, Weights, Aerodynamics, Service Engineering, Industrial Arts, etc. Each girl was given opportunity to express her preference, both before and after entering the plant, and these preferences were largely respected if she was qualified for the group.

Just before leaving Purdue, each Cadette was rated by each instructor on the standard company form. These ratings, the grades received at Purdue, and the ratings of leadmen or supervisors formed the basis of selection for the transfers.

CONCLUSIONS

Based on the previous ten-month program as well as the program just finished several rather definite conclusions can be drawn.

1. Mathematical background appears to be a reliable index for selection of such a group for this type of technical work.

2. Age is apparently not too significant, since many of the best cadettes were in the youngest age group. However, morale and disciplinary problems increase with the younger groups.

3. Many girls are capable of handling technical work. This fact is accepted at Purdue, where a considerable number of girls are usually enrolled in the Engineering School.

4. The coordination between courses which can be readily accomplished in a program of this type is a great help to all teachers concerned.

5. The specific goal toward which all courses were directed was a great advantage. The fact that many of the cadettes were not interested in college credits, and that normal college disciplinary agencies are relatively ineffective under these circumstances made it necessary for each instructor to "sell" his own course. This experience should be valuable to the instructor in his regular teaching.

REPORT OF THE BIBLIOGRAPHY COMMITTEE

Professor H.H. Fenwick, Chairman
University of Louisville
(For the period May to November, 1945)

NEW AND REVISED BOOKS AND MANUALS

Author	Title	Edition	Publisher	Year	Pages	Price
Ames, T.K.	A Portfolio of Alphabet Designs for Architects, Designers, and Craftsmen	-	John Wiley	-	32 plates	$2.50
Blair, J.M.	Practical & Theoretical Photography, Lantern Slides, Stereoscopic Pictures, etc.	-	Pitman	'45	243	2.50
Dale, R.B.	Drawing for Builders	-	John Wiley	-	166	2.50
Dalzell, J.R.	Building Trades Blueprint Reading, Parts I & II	-	Am. Tech. Society, Chicago	'45	-	2.00 Ea.
Davis, D.J. & Goen, C.H.	Aircraft Mechanical Drawing	-	McGraw-Hill	'45	247	2.50
DeGarmo, E.P. & Jonassen, Finn	Technical Lettering Manual (with work sheets)	-	MacMillan	'45	20	1.00
Finch, J.K.	Topographic Maps and Sketch Mapping	-	John Wiley	-	150	2.25
Grant, H.E.	Special Set of Orthographic Projection Problems	-	H.E. Grant, 62 W.State St. Milwaukee, Wis.	-	7	.15
Greitzer, S.L.	Elementary Topography and Map Reading	-	McGraw-Hill	'44	148	1.60
Hoyt, E.D.	Perspective simplified	-	John Wiley	-	130	1.50
Johnson, W.H. & Newkirk, L.V.	Modern Drafting	(I)	MacMillan	'45	197	1.72
Katz, H.H.	Aircraft Drafting	(I)	MacMillan	'45	392	4.75
Lange, D.C.	Shades and Shadows	-	John Wiley	'45	134	2.50
Levens, A.S. & Edstrom, A.E.	Problems in Engineering Drawing Series	1	McGraw-Hill	'45	25} 52} plates	2.70
Lobeck, A.K.	Military Maps and Air Photography	-	McGraw-Hill	'44	252	3.50
Quier, K.E.	Engineering Drafting Problems	(I)	Harper & Bros.	-	16 plates	2.50
Radzinsky, H.	Making Patent Drawings	(I)	MacMillan	'45	112	3.50
Rigast, A.K.	Mechanical Drawing (Instruction sheets)	-	MacMillan	'45	-	1.20
Sloane, R.C. & Montz, J.N.	Elements of Topographic Drawing	(II)	McGraw-Hill	'44	251	3.00
Svensen, C.L.	Machine Drawing	(III)	D. Van Nostrand	-	280	2.50
Van Gieson	Electrical Drafting	-	McGraw-Hill	'45	140	1.50
Wagner, A.M. & Arthur, H.R.	The Machinist and Draftsman Handbook	-	D. Van Nostrand	'45	701	4.50
Williams, E.L. & Spencer, H.C.	Technical Drawing for High Schools (with work sheets)	-	MacMillan	'45		
	Book #1				29 plates	1.80
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(Continued on page 21)

VALUE OF PRODUCTION ILLUSTRATION

by

Ralph T. Northrup
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Perspective drawing is one of the oldest methods of expressing the ideas of man and his relationship to other men and things man intended to build. Perspective, both freehand and mechanical, has been used for many purposes by artists, architects, artisans and engineers since the beginning of history; and more recently by aircraft workers and members of the Armed Forces.

In recent years, as new objects and mechanisms became more complicated and more details were needed by the shop to produce them, it became increasingly difficult for the draftsman and engineer to portray the necessary knowledge by means of a mere picture; thus, orthographic projection was developed and the pictures employed by the early artisans ceased to be used to any great extent by modern industry.

Due to management pressure to reduce drawing costs, photographs soon replaced the mechanical and freehand perspective. Because the pictorial drawing could not be used to show everything that could be shown on the orthographic, and because of management indifference, engineers and draftsmen soon failed to appreciate the value of the picture as an aid in interpreting the orthographic.

PERSPECTIVE USED IN ARCHITECTURE

The outstanding profession where perspective has been consistently used is architecture. Here, it has always been necessary to have a picture of the finished structure. For many years orthographic projection has dominated the industrial field in controlling production. Perspective illustration, on the other hand, has proven of great value in times of stress, such as war.

Since the days of the early graphics, we have been conditioned to perspective, isometric and oblique drawing, and more recently to axonometric with its attending dimetric and trimetric projection. The isometric and oblique drawings have not met with great favor by many people in recent years due to the distorted pictures rendered when illustrating circles and ellipses on the isometric and oblique planes and when forward edges fall congruent with receding edges.

America's entry into World War II brought an ever-increasing demand for the design and production of new airplanes and armament. It soon became apparent that some method of speeding up the learning process in respect to a knowledge of orthographic projection, which is exact and scientific, or some simple graphic substitute, had to be found, as thousands of men and women began to enter the production lines inadequately equipped with graphic knowledge. Real mechanics were scarce and skilled instruction still more scarce.

Yankee ingenuity revived the old means of graphic presentation, that of perspective, as an aid in understanding the construction of an aircraft, both inside and out. The term "industrial production illustration" was given to it, although some call it "illustrated job tickets."

Credit should be given to Douglas Aircraft and Vultee Aircraft for the renewed emphasis placed upon perspective as a means of graphic representation for production in industry. The development of production illustration work at the Douglas plant is of interest. "In August, 1939, a complete picturization of the proposed manufacturing breakdown and its progressive, detailed fabrication, plus a position breakdown plan, on a mechanically moving assembly line, was included for the first time in a military airplane bid. It received very favorable comment from Washington and proved a boon to the production design and tooling departments.

"In anticipation of the present rush of war orders, with the resultant expansion, mechanically moving lines, and lack of trained personnel, a group known as the production illustration department was immediately organized. The first duty assigned to that department was to study and break down into manufacturing production units the DB-7 twin-engined attack bombers."

WIDE FIELD FOR PERSPECTIVE

The valuable time saved by the substitution of one perspective sketch for pages of written words and many complicated orthographic drawings has been well demonstrated, both in the preparation of materials used in controlling production and in their final interpretation by the workmen. Under normal conditions, it is possible to make almost all of the installation, assembly and subassembly drawings in perspective and approximately 50% of the detail drawings.

Some idea of the advantages can be gained from the fact that at Consolidated Aircraft, in the making of assembly drawings for engine cowling panels, it was found that after doing the side and bottom cowl panel drawings in the conventional manner, a saving of 75 hr. of engineering time over either of the previous two drawings was realized when the top cowl panel was done in perspective. Furthermore, the drawing was made by a girl, a former commercial artist, with two months' experience in aircraft drafting.

Production illustration, besides helping to produce aircraft, is also being used in graphically representing catalogue illustrations, arsenal gun charts, instruction charts, service and repair charts, advertising, piping diagrams, wiring diagrams, installation diagrams, equipment arrangement diagrams for factory and office, patent office drawings, textbook illustrations, structural unit assembly drawings, etc.

General Motors, Sperry, North American Aviation, Curtiss-Wright, Stinson Aircraft, and Ford are all using this method. Following through on the design and construction of some device or mechanism in a general way, will serve to show how industrial production illustration is used by one of these organizations.

An expert in production illustration usually sits in on the conferences of the engineers and designers when the specifications are discussed and the important features of the design, such as size, type, style, function, cost, etc., are decided. He takes notes and translates them into a pictorial sketch giving a general view of the proposed appliance. Changes suggested at further conferences are incorporated into the illustrator's drawing, which is finally approved for production.

This brings the engineer and technician to the point of deciding how the device can be made to the best advantage in the plant space available. If the object is extremely large it must be manufactured in sections that can be handled conveniently. This leads to the production breakdown illustration which shows the object broken into parts, such as shafts, gears, housings, cover plates, bolts, nuts, etc.

After the breakdown illustration is completed, the engineers take over and design the various parts. Following the designing, each part is further broken down and properly illustrated. Finally, production illustrations are drawn for every station on the assembly line.

This is probably one of the most important uses of the perspective illustration, especially in the aircraft field, as it has saved much time in assembly operations. Assembly drawings are highly colored to show specific work that is to be done at a given station. Pictorial illustration is also used in writing the service manuals which show assembly and disassembly of the various mechanisms making up a final assembly

In giving instruction in the method of pictorial illustration, the tendency is to teach orthographic projection before attempting to master the theory of perspective. This training should emphasize both mechanical and freehand orthographic drawing because one must have a knowledge of the so-called scientific method of representation, dimensioning and sectioning three-dimensional objects before one can visualize adequately and represent designed mechanisms perspectively. Because some of the construction work of production illustration is done freehand, some training in freehand sketching should be given.

SUGGESTED COURSES OF STUDY

Assuming the student has acquired a basic knowledge of orthographic projection, a good course in industrial production illustration should encourage the mastery of several construction procedures to help the student to develop a satisfactory proficiency therein.

In the course on engineering pictorial illustration at Wayne, freehand sketching, the theory of axonometric drawing, with its attending features of isometric, dimetric and trimetric projection, is taught. This is followed by instruction in oblique projection, and, as a final step, the theory of perspective drawing by the two methods of visual ray and vanishing points. At Ford's trade school, an additional emphasis in training is placed upon the mastery of the sun-view projection machine. This machine permits the making of a pictorial illustration of an object or assembled mechanism directly from the finished object or from the orthographic drawings of the object.

Care should be taken to give the student a knowledge of the advantages and difficulties of projection in order that he will be able, when required, to choose the best method of portraying a given object. The distortion which is so noticeable in isometric is greatly reduced when using dimetric and trimetric projection.

More recently, a special triangle has been used in the making of isometric drawings. This triangle is similar to the one manufactured by Air-Vu, and may be made from celluloid or plywood. The sides of the triangle are in the ratio of 3, 4 and 5, or multiples of these numbers. This will cause the small angle to measure 36° 52', which is more nearly mathematically correct for representing objects pictorially in isometric. It also avoids having receding edges fall congruent with forward edges. Measurements of length on the object should be made, using the 3/4 scale on the architect's scale. This, also, will give a pleasing reduction ratio which approximates the V 2/3 times actual size which would be accomplished using the so-called isometric scale.

In making exploded or disassembled views, it was found convenient to project one piece to large proportions and then draw the other parts freehand in order to save time. In teaching perspective the student should begin with the visual ray method, then work with vanishing points on the horizon and finally deal with vanishing points for inclined lines.

In order to emphasize the third dimension of the finished picture, various forms of shading are taught. This is done through problems requiring line shading, block shading, sponge shading, crooked line shading, stippling, smudge shading and airbrush work. Recently a new sulfide reduction paper, both in the form of Bristol board and tracing vellum, has been introduced by Craftint. This makes shading possible by using a reducing chemical directly on the craftint paper following the making of the drawing.

The paper is covered by two series of parallel lines, one at right angles to the other and printed in invisible ink. Light or dark shadings are brought out with a single or double-strength developer which may be applied either with a pen or brush. When the Craftint tracing vellum is used, prints may be made from the tracing in black and white or blue form for shop use.

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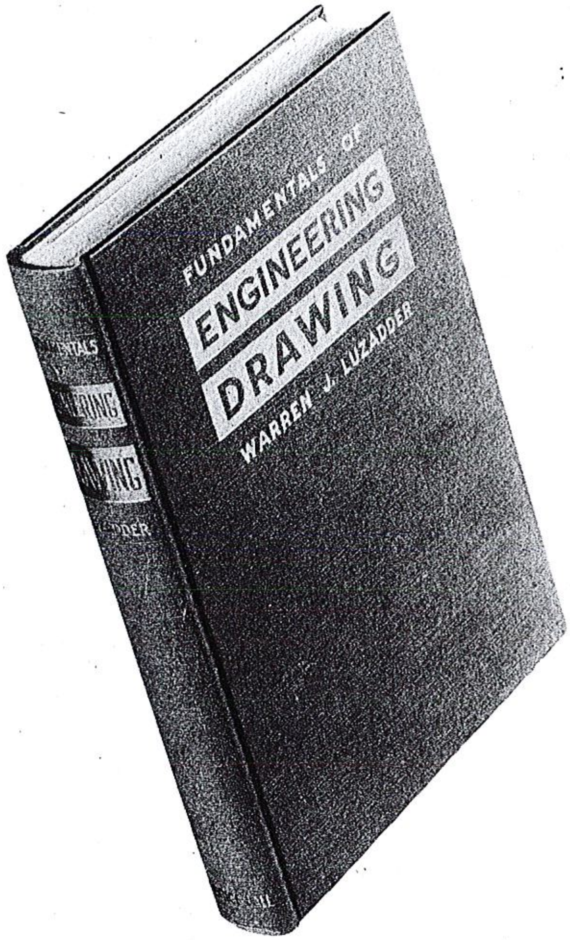

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By WARREN J. LUZADDER

Department of Engineering Drawing, Purdue University

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VISUALIZATION OF MOTION BY PIVOTED CUTOUTS

by

H.H. Katz, Engineer
Republic Aviation Corp.

It has been said that a successful designer is born with a love for mechanics and a measure of inventive ability---added to these qualities; a retentive memory, a mind trained to observe closely and an ability to clearly illustrate his ideas. In most instances the idea may be created in the sketch form, developed and analyzed by means of layout studies, and finally presented for manufacture in the production drawing---all within the scope of the graphic language.

Problems in the design of mechanisms sometimes require a clear visualization of motion and it is here that the graphic studies may be assisted and coordinated with non-graphical methods. When the problem concerns motion in one plane the cutout method described in this article may be conveniently constructed at the drawing board. Motion in more than one plane requires actual three dimensional models and are obviously difficult for the draftsman to construct without leaving the drawing board for the work bench. Most aeronautical mechanisms may be considered as motion in one plane, and often when complex motions occur they may easily be broken down and analyzed as component motions in single planes.

Successful non-graphical methods of presenting actual motion serve two functions: first, as an aid to the progression of the design it enables the engineer to acturately define and prove the desired motion, and secondly, it facilitates the demonstration of the idea to others. Often in industry a potentially good idea gets no further than the idea stage because an orthographic or pictorial sketch is presented with an oral description of motion to those not trained, or without justifiable time, to study the problem and the solution.

Like many non-graphical methods of visualization, the problem first originates on the sketch pad and

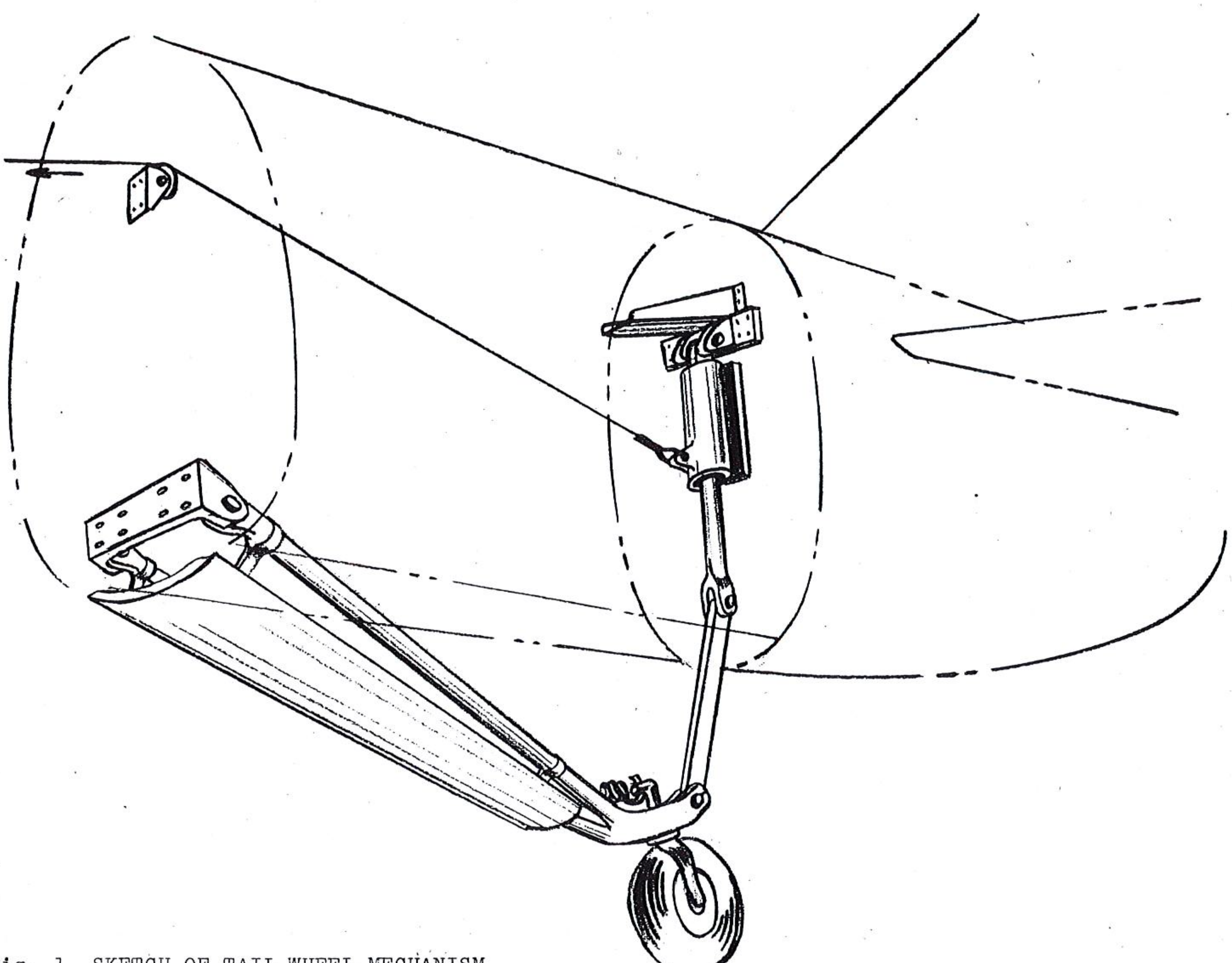

Fig. 1 SKETCH OF TAIL WHEEL MECHANISM

drawing board. For example, the tail wheel mechanism shown in Fig. 1 was first conceived in the rough sketch. The allowable working area was approximated casually. After the sketch had passed through the customary analysis, an exact mechanical layout was drawn, Fig. 2. This process is sometimes reversed (depending on the nature of the design in relationship to adjacent structure) wherein a mechanical layout of existing structure or mechanism is drawn first, a careful study of conditions made, and then rough idea sketches of proposed structure and mechanism follow. In this latter process a more exact approximation of the design (clearances, functions, etc.) may be proportioned in the sketch. The principals of the sketch are then incorporated on the mechanical layout.

METHODS OF VISUALIZATION

Motion may be visualized by imagination, but this method is not exacting and too often proves misleading when various directions are involved.

Intermittent stages of the mechanism's travel may be drawn on the layout from the open to closed or other significant points---the eye following the alternate positions. Any location in the course of travel may be determined by the simple application of the compass. Radii are scribed about stationary pivoted points, and reciprocating distances are established on direction centerlines. The length of connecting links and other members are set off on the radii and direction lines. This system is very popular in the engineering drafting room and often within itself offers an adequate representation of motion. Regardless of the final method employed to visualize motion the above method is necessary to describe maximum and minimum or open and closed positions on the production drawing. It has the disadvantage of becoming a complex layout when numerous components are applied---coordination is difficult, and keen constructive imagination (for both engineer and observer) is required to help "see" the motion.

Actual movement may be produced by drawing or tracing the outline of a link, actuating arm, or other component on thin transparent paper (such as onionskin), then super-imposing the tracing over the basic layout, Fig. 3. Coinciding pivot points on the tracing and basic layout are matched and a needle point or stylus is then carefully passed through the points and into the drawing board. The tracing is now moved to determine the course of travel of the component and it relationship to adjoining members. When it is necessary to record a particular location of the component on the basic layout, the tracing is moved to the desired position and held secure, the needle point is then passed through significant points on the centerline of the

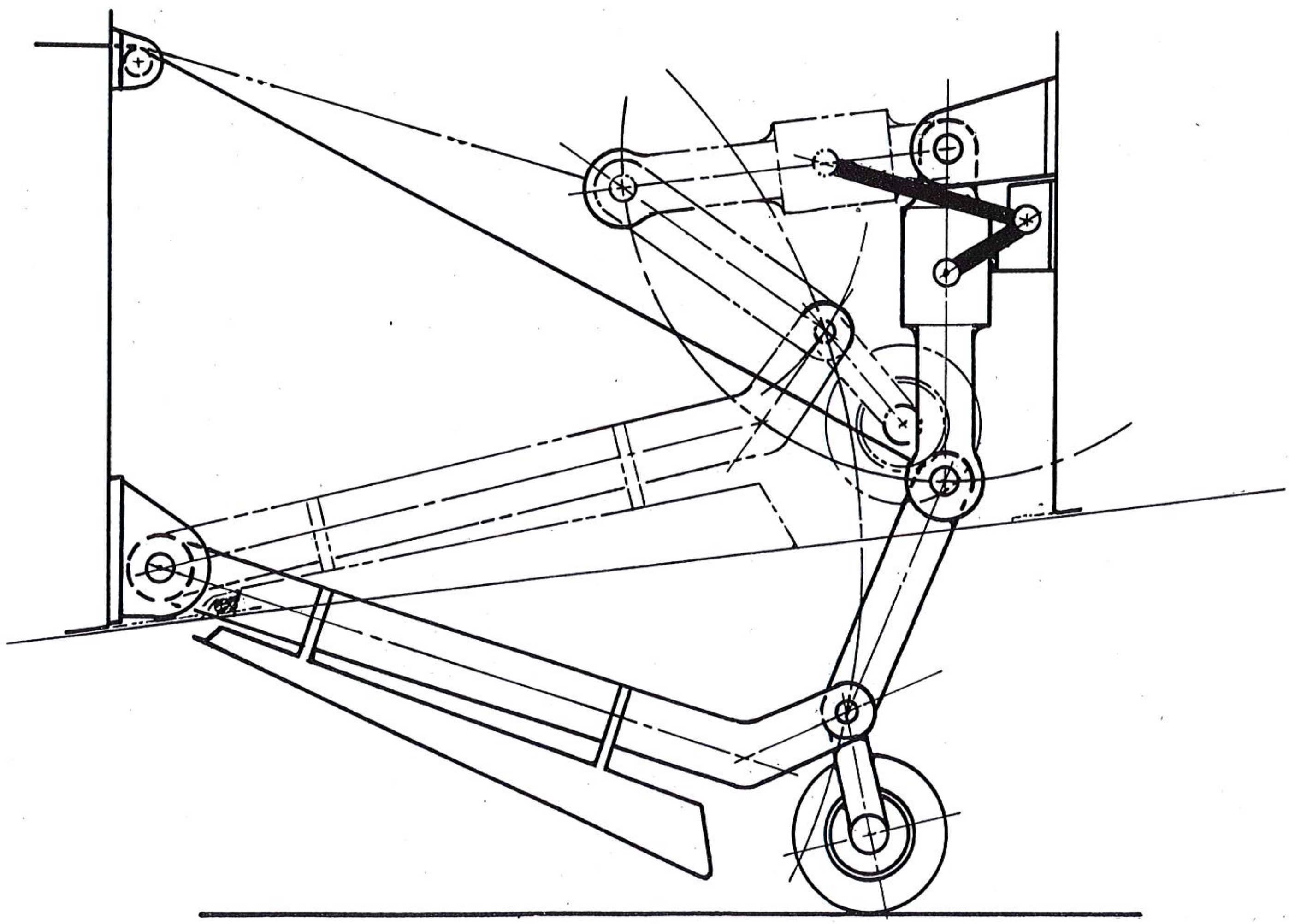

Fig. 2 MECHANICAL LAYOUT OF TAIL WHEEL MECHANISM

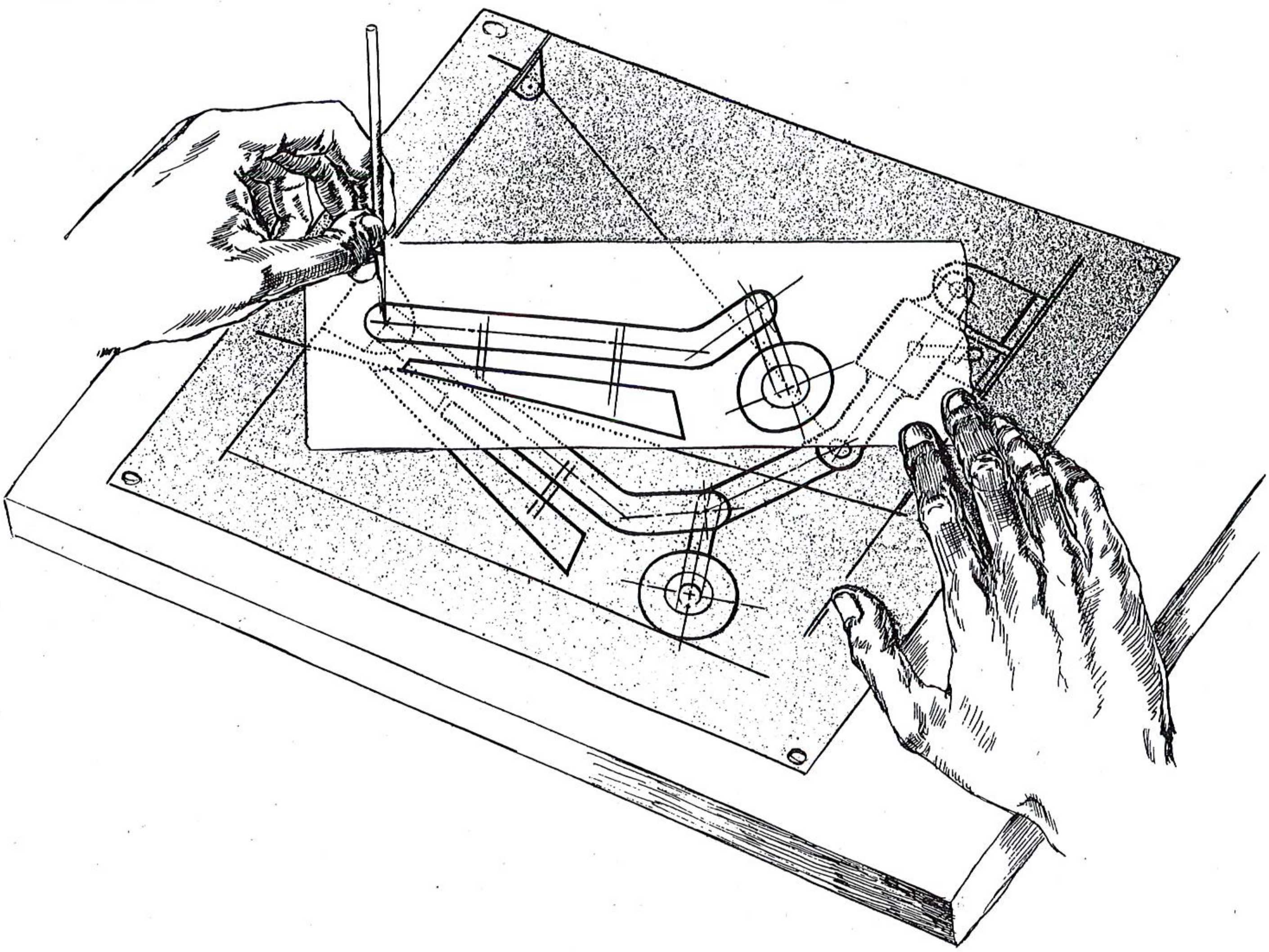

Fig. 3 SUPER-IMPOSING ACTUAL MOVEMENT ON BASIC LAYOUT

tracing into the layout. The tracing is removed and the small prick holes on the layout are connected with centerlines thus becoming the basis for the drawing of the intermediate position.

CUTOUTS

With the use of cutouts, representing the shape of the mechanism's components, motion in one plane becomes actual, and movement of the design easily visualized, Fig. 4. Materials and tools require practically no expense---they may usually be found laying about in the drawing bench drawer, or on the office boy's or clerk's desk. Some of the things needed include: scissors, paste, single edge razor blade, stencil cutting knife, bow dividers, thumb tacks, rubber bands and an awl.

In this system, the outlines and centerlines of the components are drawn on a heavy paper cardboard, or other suitable material, and sizes taken from the basic layout. The various shapes are cutout with a scissors, single edge razor blade, or stencil cutting knife. The stencil knife, or sharp pen knife, is easily controlled and offers the best results. Some stencil knives are manufactured with swivel blades, facilitating the otherwise irritating process of cutting on curved lines, Fig. 5.

Do not attempt to pierce heavy cardboard with the first application of the knife. Scribe the line lightly, this initial groove will act as a guide for repeated strokes, each cutting progressively deeper into the material until it has been pierced.

The cutouts may also be obtained from thin sheets of Plexiglas or a similar transparent plastic. Successful cutouts have been made from thicknesses ranging from .020 to .041 inches, the heavier gages used when greater rigidity or "built up" units are required. The plastic sheet may not be as accessible as cardboard, but it is easier to cut and also because of its transparency, offers the advantage of bringing to view the movement of underlying members.

The transparent sheet is placed over the basic layout and the different shapes are traced with the aid of a stylus, straight edge, and dividers. The point of the tracing instfument scribes or cuts into the surface of the plastic. Circles and circular arcs may be scribed with the dividers, straight lines and

(Continued on page 27)

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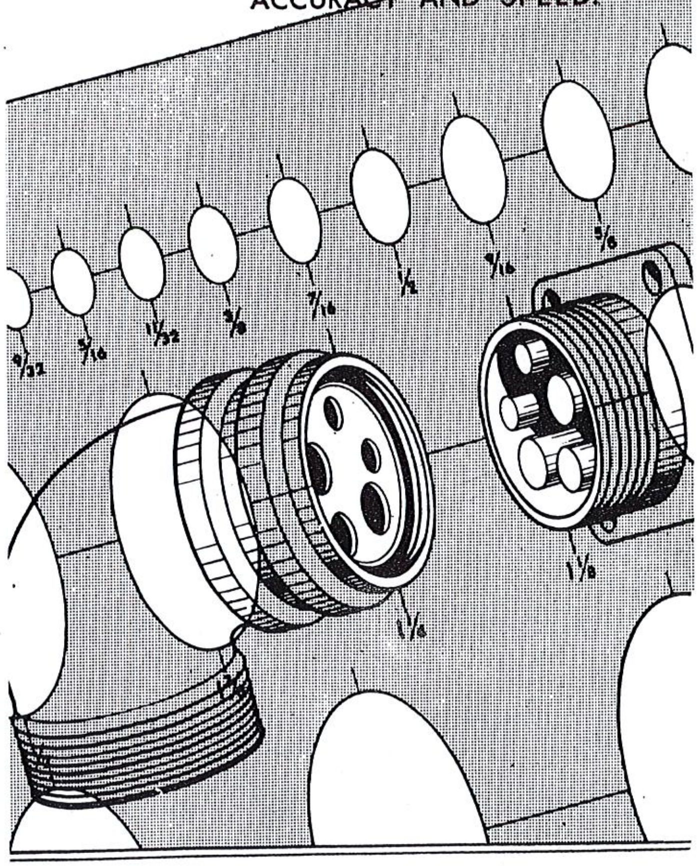

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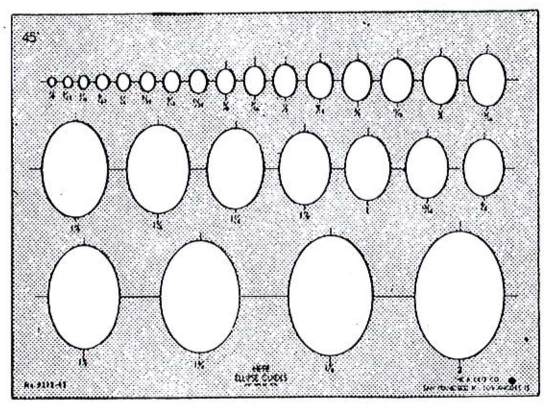

THE 45° TEMPLATE — 1/3 ACTUAL SIZE

SIZES OF ELLIPSES

Templates of 60°, 55°, 50°, 45° and 40° have ellipses from 1/8" to 3/8" increasing by 32nds, then by 16ths to 1", then by 8ths to 2".

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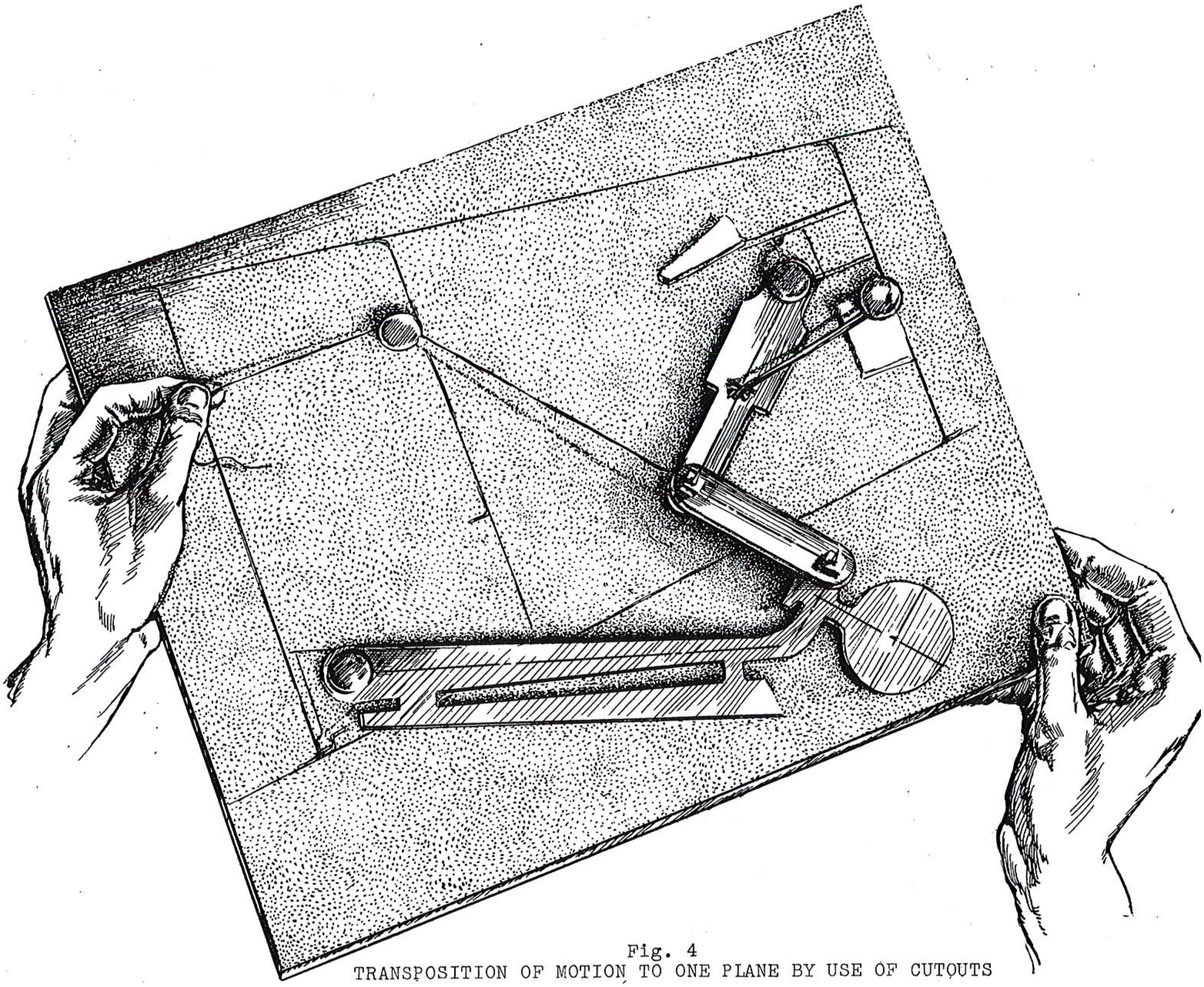

Fig. 4
TRANSPOSITION OF MOTION TO ONE PLANE BY USE OF CUTOUTS

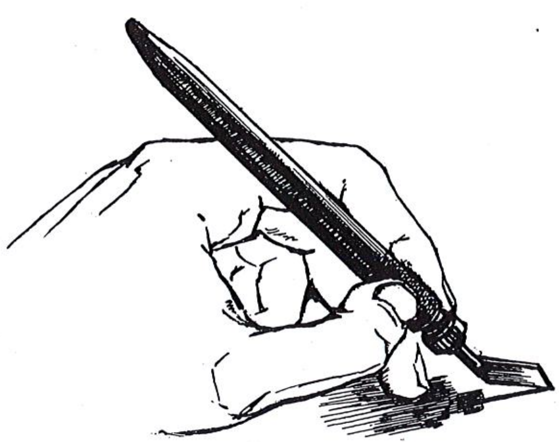

Fig. 5 STENCIL KNIFE WITH SWIVEL BLADE

(Continued from page 25)

irregular curves with the stylus guided against a straight edge or irregular curve. After the shapes have been scribed into the surface, they may be snapped free from the sheet by applying a slight pressure and bending. Experimentation is necessary to determine the depth of the impression into the plastic sheet and the degree of pressure required to snap it free.

Centerlines and points may be scribed by exerting a minimum pressure with the scribing instrument, so that they may be visible on the cutout but not grooved deep enough to crack the piece in bending.

MOUNTING THE CUTOUTS

When all the cutouts have been obtained, they are placed on a "back-board" of heavy cardboard, plywood, masonite, or some other substantial surface. Mounting the cutouts on the backboard rather than directly on the drawing board, allows for a portable mounting and keeps the drawing board free of numerous thumb tack and needle

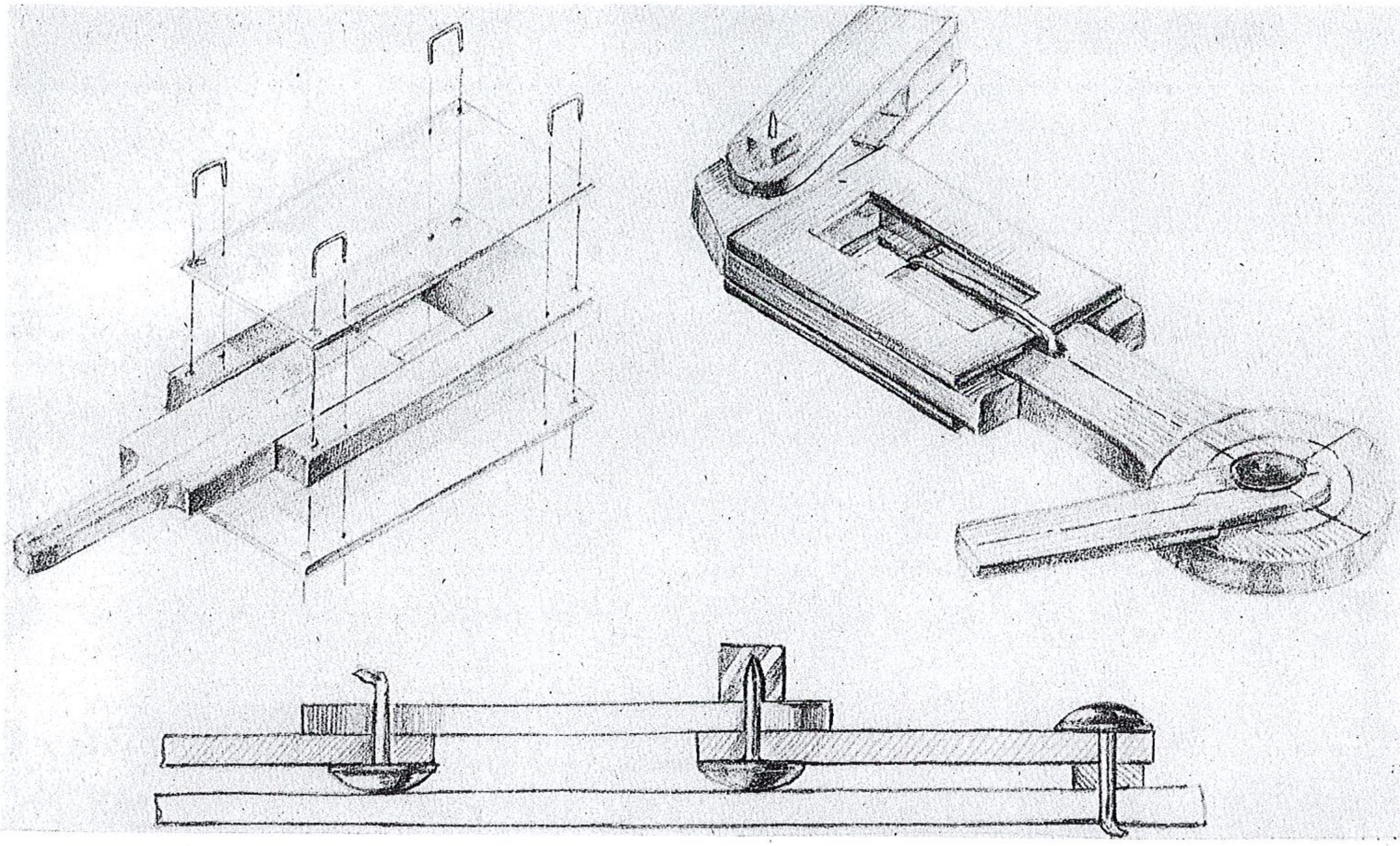

Fig. 6 DEMONSTRATION MODEL AND DETAILS OF PIVOTED CUTOUTS

holes. The portable mounting allows the design to be shown without bringing the parties concerned to the drawing board. Also, the designer can refer to the mechanism's motion on the portable board, while he is developing the design on the drawing board.

If the nature of the model warrants accuracy and precision, the outline of adjacent and connecting members, and the exact mounting points and conditions should be carefully drawn on the back board. This permits the proper locating of the cutouts, and the establishing of clearances. It is sometimes more convenient to draw the back board detail on thin cardboard or heavy paper and staple or tack this drawing to the masonite, plywood, or heavy cardboard back board.

Stationary pivot points may be acquired with thumb tacks or common pins punctured through the components and into the back board. The tack should not be applied too tightly, enough "play" will allow the cutout to move freely. This may be accomplished by simply piercing the contact point on the cutout with a stylus or pencil point so that the tack enters the hole freely. The tack then is pushed partially into or through the back board, gaged not to bind the movement of the cutout. Rotating joints may be constructed by reversing the thumb tack, the head of the tack now bears on the back board while passing through two or more cutouts. Here again, the joint should be loose enough to move freely. If necessary a nut may be made by cutting a small cube from a hard eraser, and applying it to the tack point, or by simply tapping the point of the tack over slightly with a hammer, after its placement.

The effectiveness of the pivoted cutout is dependent on the ingenuity of the designer. Many ingenious schemes and arrangements have been devised to help demonstrate motion in one plane. For example, spring action might be innovated in the model by fastening a rubber band to two points. Reciprocating motion of a shock absorber may also be produced with the aid of a rubber band as described in Fig. 6. Plastic sheet stocks may be used in conjunction with regular cardboard models to show motion that otherwise would be concealed. Various thicknesses may be built up by stapling or glueing layers of cardboard together, this procedure is common in the construction of guides and stops. Guides on moving members are easily constructed by glueing a cardboard of the desired shape to the member, often a thumb tack will also prove adequate.

(Continued from page 21)

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SURFACE ROUGHNESS DESIGNATION SYMBOLS

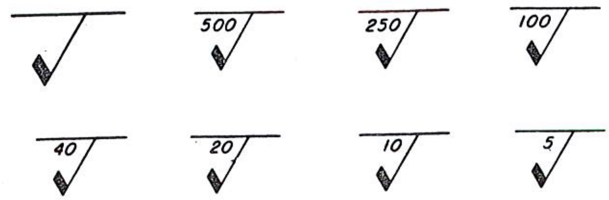
by

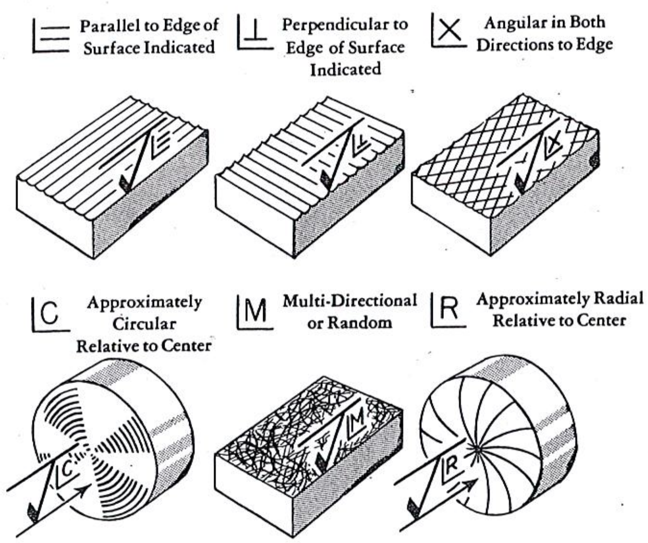
J. A. BROADSTON, Armament Engineering
North American Aviation, Inc., Inglewood, California

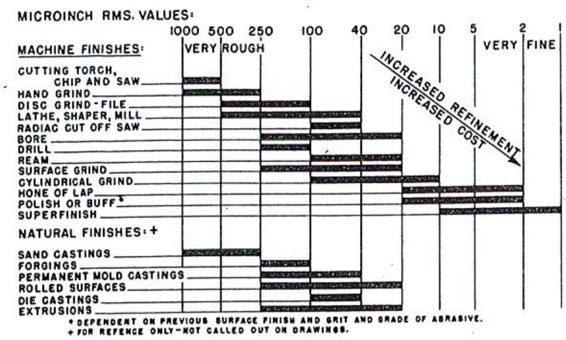
FINISH MARKS

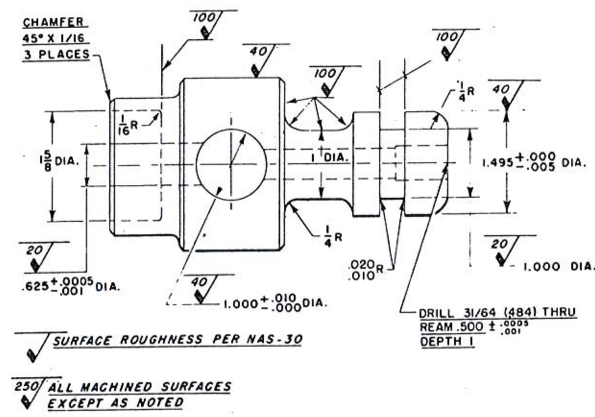
The finish mark has received much consideration during the past fifteen years and is still a topic of interest to Engineers and Drawing teachers.

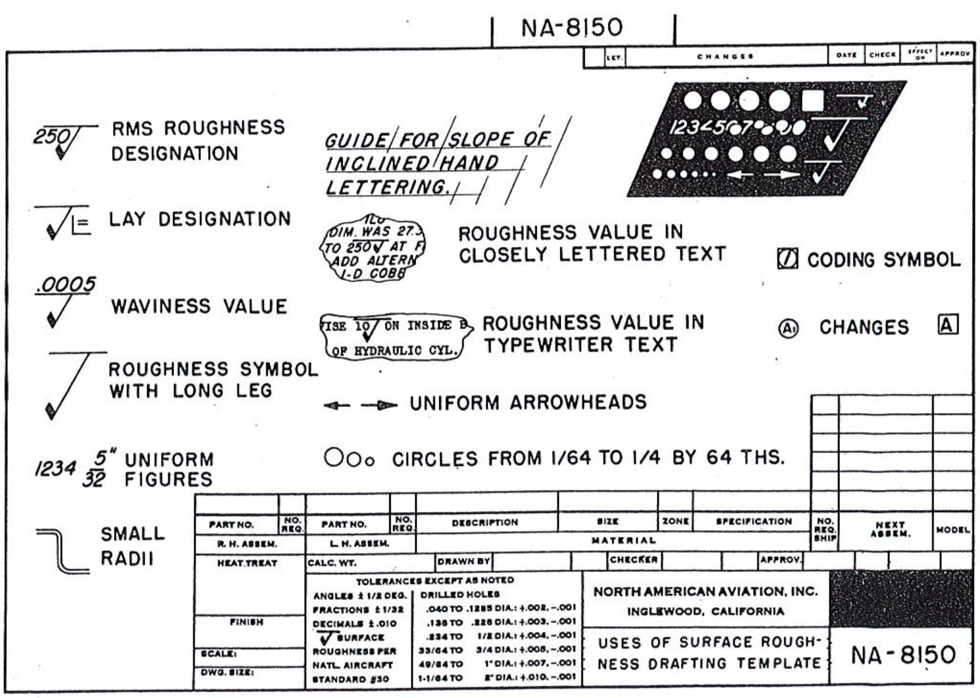
Mr. J.A. Broadston has furnished the drawings shown on the use of the DISTINCTIVE SURFACE SYMBOL. They are from his text "Control of Surface Quality."

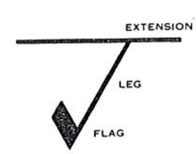












A NEW ATOM SORTER

...AND A TRUTH IT REVEALS

Westinghouse Electric & Mfg. Co. Photo

MOST men would call it new—this mass spectrometer which, by measuring the distance a charged particle can jump, reveals the energy required to break up a molecule, the location of petroleum deposits, or the distribution of "heavy" atoms in a living body. Yet the designer himself would be the first to tell you that this atom sorter depends on discoveries made by Dalton 140 years ago, on researches at least 40 years old, and on a simpler instrument devised in 1918.

Thus it is and thus it will always be. It isn't what you have; it's what you do with it that counts. So it is with the qualities in men. All men have the desire to succeed. All men possess energy and latent abilities. But some men are purposeful . . . take measured and directed steps toward their goal . . . develop the *habit* of achievement. Others do not.

Here is the *great* difference between men. Educators know this and never ignore any opportunity to fan into flame the spark of achievement that resides in the breast of *every* boy they meet. The opportunity to discharge this responsibility is always present in the teaching of mechanical drafting. Here the world of future manhood draws close and touches the world of boyish fancy. Here within reach of youth's enthusiasm lie the disciplines which lead to achievement in any field. Here, standards and values of honest craftsmanship can be set . . . to serve for a lifetime.

To grasp this opportunity, instructors who are true *educators* insist that their students be provided with the finest drawing instruments it is possible to afford. Not simply because pride of ownership is valuable at this time; not simply because good instruments will serve their owner all his life; but because instruments carelessly chosen lead to a subject carelessly regarded, and betray a lack of sincerity any boy is quick to detect. *Good* drawing instruments are an investment that is repaid many times over the years of a more productive life.

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(*Printed in U.S.A.*)

PROJECTIONS

Professor J.N. Wood, Circulation Manager of the Drawing Journal reports subscriptions to the Journal increased 20% during the past year. The cash balance on hand in June 1945 was about doubled that of the same month in 1944. Thanks to the fine work of Professor J.N. Arnold, Advertising Manager, and Professor Wood.

* * * * *

Dr. O.A. Hankammer, has succeeded Dr. William Bawden as Head of the Industrial Education Department, Kansas State Teachers College, Pittsburgh. Dr. Hankammer was drafting instructor at the College. Dr. Bawden was granted retirement.

* * * * *

Professor Albert A. Lacour of the Department of Mechanical Engineering of the Technological High School of Atlanta, Georgia has retired from active teaching.

* * * * *

The staff of the Drawing and Descriptive Geometry Department of the University of Wisconsin have worked up a unique and interesting examination in Drawing to be given at the end of the semester. Professor R.R. Worsencroft supplied the editor with a copy.

* * * * *

Mr. E.W. McClendon has joined the Engineering Drawing staff of the Agricultural and Mechanical College of Texas. He is a graduate of this Institution in Aeronautical Engineering and has been with Douglas Aircraft Co., Inc. for the past three years as a draftsman and designer.

* * * * *

Professor Henry E. Harris who was in charge of Engineering Drawing for Oberlin College the past three years during their Navy training program has accepted a position as Assistant Professor of Engineering Drawing at the Ohio State University.

* * * * *

The Bibliography Committee composed of Professor H.H. Fenwick, of the University of Louisville, Professor F.M. Warner of the University of Washington, and Professor E.F. Tozer of Northwestern College are certainly keeping us well informed of new and revised books. Observe their report in this issue of the Journal for a listing of high school and college books. Please send Professor Fenwick a list of your magazine articles and new and revised books.

* * * * *

Laurence Parker, who for more than 21 years has been in charge of the Kansas Trade and Industrial Program, resigned July 15, 1945. He will be in charge of the advertising and wholesale division of the Leonard Potter Hatcheries with offices at Pittsburgh. O.H. Beaty, who for five years has been assistant supervisor of Trade and Industrial Education is acting supervisor.

* * * * *

Foy E. Walling for the past three years head of the Power and Lighting Drafting section of the Electrical Engineering Division of Consolidated Steel Corporation Ship Yard of Orange, Texas has taken up duties as an instructor in the Engineering Drawing Department of the Agricultural and Mechanical College of Texas.

* * * * *

Professor C.M. Miller, Director, Kansas State Board for Vocational Education has been kind enough to place the editor of the Drawing Journal on their Vocational Education Newsletter mailing list. Will the high school drawing teachers of the various states please request that publications from your state be sent the editor.

Professor Miller was among the Vocational Educators from over the nation who attended a recognition dinner given recently at the Nicollet Hotel, Minneapolis, Minnesota for Dr. C.A. Prosser, Dean of Vocational Educators. Dr. Prosser resigned September 20, 1945 as director of the Dunwoody Institute, Minneapolis.

* * * * *

Dr. Carl L. Svensen, Member-secretary, Texas State Board of Registration for Professional Engineers has just been re-appointed by Governor Coke Stevenson to a six year term. Dr. Svensen was first appointed in 1937 for a two year term and re-appointed in 1939 for a six year term. He has been on the board since its inauguration in Texas.

Svensen served as president of the National Council of State Board of Engineering Examiners during 1944.

Official notification that the 53rd annual meeting of the S.P.E.E. will be held in the Jefferson Hotel, St. Louis, Missouri, June 20 - 23, 1946 came October 15, 1945. Washington University will be the host Institution. With official word that the S.P.E.E. will meet in 1946 Drawing teachers should start making preparations to attend the Drawing Summer School to be held in St. Louis before, during and after the annual meeting.

Have you started planning your drawing display for the Drawing Summer School? Professor Ralph S. Paffenbarger of Ohio State is in charge and is desirous that all Drawing Departments both college and high school have full sets of each semesters work for all courses taught with copies of all quizzes and instructional material used in each course. He is anxious to have course outlines and explanations of movies and other special teaching aids used.

Plans are under way to have special display rooms for this material and it should be one of the most educational features of the summer school.

* * * * *

W.E. Street, Head of the Engineering Drawing Department, Agricultural and Mechanical College of Texas, spoke to more than 500 officers and enlisted men of the McCloskey General Hospital of Temple, Texas on October 23 and 30, 1945 on the Drafting Profession and its Advantages and Disadvantages. This is part of an educational program of Texas A. and M. College in cooperation with the Educational Division of the McClosky Hospital. This is an amputation hospital of the Southwest and the men are very appreciative of the efforts to acquaint them with the job opportunities in the various occupational areas.

* * * * *

It takes 30 tons of blue prints to make a battleship.

* * * * *

Radio correspondence courses in Drafting have proven so successful that Professor Justus Rising of Purdue University started his second course by Radio last spring. He can be counted on for new ideas for he has been influential in developing new and objective Drafting tests and pioneered in Drafting movies.

* * * * *

Offices of Administration for the Drawing Summer School of S.P.E.E. to be held in St. Louis during June of 1946 are:

Director - Dean A.S. Langsdorf, Washington University

Secretary - Professor R.W. Bockhurst, Washington University

Chairman of Faculty - R.P. Hoelscher, University of Illinois

Organization of the School - Justus Rising, Chairman - Drawing Division of S.P.E.E., Purdue University.

The Executive Committee of the Drawing Division is actively preparing a Program for the Summer School with the general theme divided into three sections as follows:

Pre-convention period - What Training in Graphics Does Industry Require of College Men.

Convention period - What Training in Graphics Do College Departments Require of Students.

Post-convention period - How Shall Graphics Be Taught to Meet These Requirements.

* * * * *

Professor Alfred N. Appleby, College of the City of New York, renews his subscription for two years to the Drawing Journal.

Have you sent in your Drawing Journal subscription for the ensuing year?

* * * * *

Professor H.B. Howe, Renesselaer Polytechnic Institute writes that a good job is being done and expresses his congratulations.

* * * * *

Clifford L. Yard, Dobbs Ferry, New York, says "I eagerly look forward to each issue of the Journal and thoroughly enjoy reading every article. I hope my working schedule will be reduced sufficiently that I may prepare an article or two for the editor's consideration." The editor will be glad to receive articles for consideration from anyone.

* * * * *

Charles T. Hatchett, electrical engineer, coordinator for Trade and Industrial Education of Lamesa Public Schools of Texas, took up duties as an instructor in Engineering Drawing at the Texas A. and M. Collect October 1, 1945.

* * * * *

D.B. Roberson, Texas A. and M. graduate and special instructor in A. S. T. P. Drafting of this Institution, went with the Public School System of Corpus Christi last summer. He will teach Drawing in Senior High School and the Corpus Christi Junior College.

Professor George Duerksen, East High School, Wichita, Kansas has a class of advanced drawing students who have completed all the assembly and parts detail drawings for a 13" Engine Lathe. Several complete sets of prints have been furnished to the Vocational Machine Shop and they are in the process of making patterns for parts that are to be cast. The lathe contained 78 separate parts aside from regular stock items.

* * * * *

Have you expressed your wishes in connection with the proposed MEMORIAL TO PROFESSOR THOMAS EWING FRENCH as outlined on the GUIDE LINES page of the May Journal for 1945?

* * * * *

Drawing teachers are interested in other fields and as proof of this, examine the GUIDE LINES page for Professor H. C. T. Eggers, University of Minnesota, Mathematical solution of the ellipse problem. He sent the solution in within a few days after receiving his May Drawing Journal.

* * * * *

Engineering Standards Committee of General Motors Corporation is giving considerable thought to a standard symbol for surface roughness.

* * * * *

A number of people have inquired of the editor when revised copies of the American Standard - "Drawings and Drafting Room Practice" would be ready for distribution.

Professor F. C. Higbee, Head of the Engineering Drawing Department, State University of Iowa, Iowa City, Iowa has been active directing the work of this committee.

* * * * *

Professor W. Harold Taylor, Professor of Drawing, University of Alabama has written several articles during the past year for The 'Bama Beam' an Engineering magazine of that institution on the value of Drawing and its place in the curricula. A good idea that should be practiced by Drawing teachers.

Fred W. Martin is the new drawing and shop teacher for the Corpus Christi, Texas Naval Air Station High School. He lives on the bay where fishing is good. Martin formerly assistant band director for Texas A. and M. College helped to teach drawing during the E.S.M.W.T. program at A. and M.

* * * * *

Professor Sam M. Ford, head of the Industrial Education Department and Drawing teacher of the Conroe, Texas Independent School District for the past several years has accepted a position at Reagan High School of Houston. He is in chargé of Vocational Drawing for the Houston system.

* * * * *

Professor W.L. Ward, Drawing teacher in Robert E. Lee High School and Lee Junior College of Goose Creek, Texas is located in an industrial center where high school graduates with drawing are in demand. He has been cooperating with oil companies for several years in training of people in drafting.

* * * * *

Professor W. F. Adams of the Electrical Engineering of Texas A. and M. College has transferred to the Engineering Drawing Department for the fall semester 1945-46.

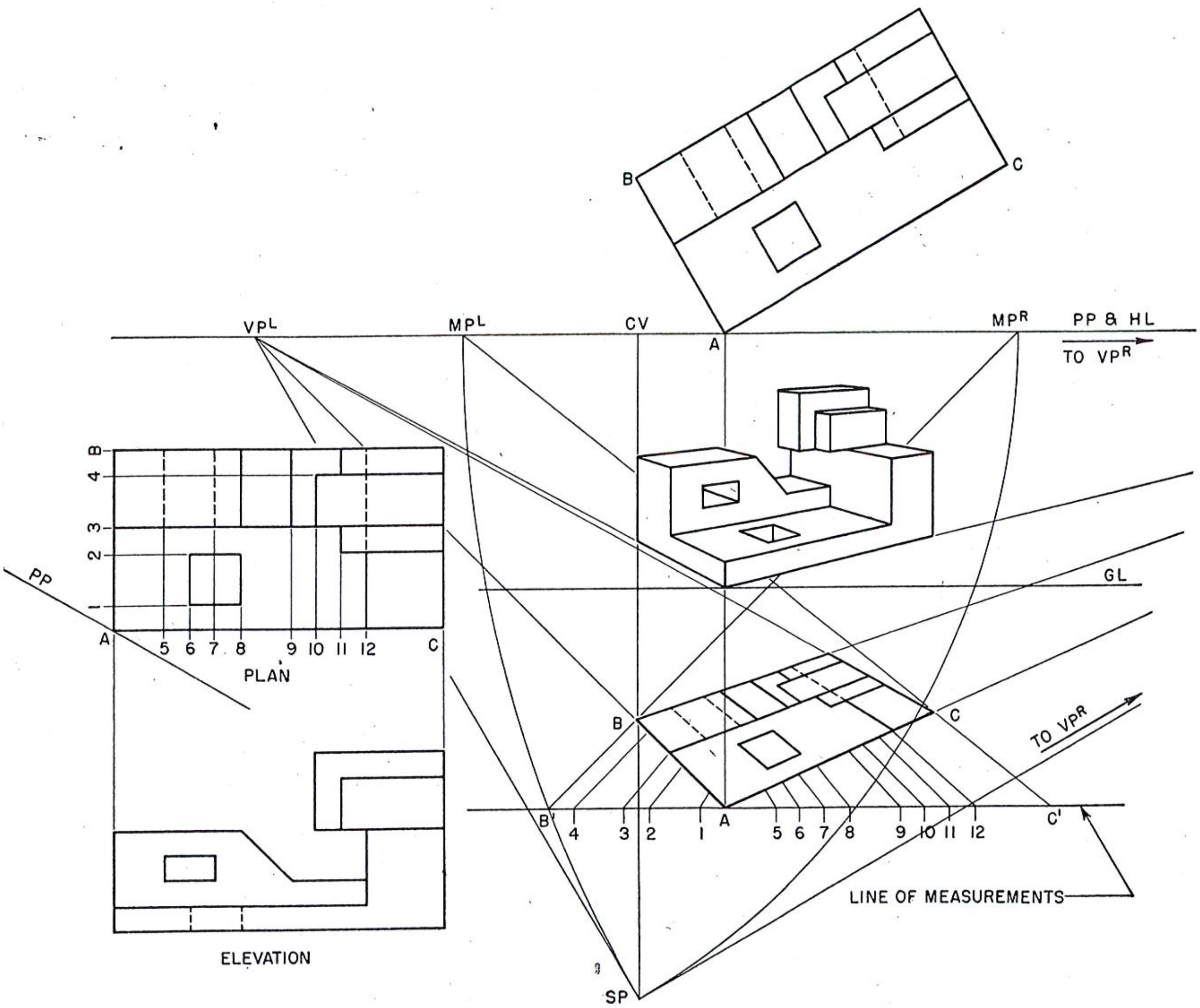
* * * * *

H.C. Brown, Dallas High School Drawing teacher and Director of Education at North American Aviation Corporation of Grand Prairie, Texas for the past three years is the new Director of Training for Braniff Airways, Love Field, Dallas, Texas.

* * * * *

Professor L.C. Christianson, formerly of the Mathematics Department of Texas Technological College is the new teacher of Drawing and Descriptive Geometry at Texas Christian University.

We Repeat—



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