SHOPBUILT EQUIPMENT FOR USE IN INDUSTRIAL ARTS INSTALLATIONS

SHOPBUILT EQUIPMENT FOR USE IN INDUSTRIAL ARTS INSTALLATIONS

By

Kenneth Glen Ekstrom

Bachelor of Science

Oklahoma Agricultural and Mechanical College

Stillwater, Oklahoma

1950

Submitted to the School of

Industrial Arts Education and Engineering Shopwork

Oklahoma Agricultural and Mechanical College

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

1952

SHOPBUILT EQUIPMENT FOR USE IN INDUSTRIAL ARTS INSTALLATIONS

KENNETH GLEN EKSTROM

MASTER OF SCIENCE

1952

THESIS AND ABSTRACT APPROVED:

Thesis Adviser and Head,
School of Industrial Arts Education
and Engineering Shopwork

Associate Professor,
School of Industrial Arts Education
and Engineering Shopwork

Dean, Oklahoma Institute of Technology

Dean of the Graduate School

ACKNOWLEDGMENT

The writer of this study wishes to express his sincere appreciation for the cooperation, advice, and assistance extended to him by Dr. DeWitt Hunt, Head of the School of Industrial Arts Education and Engineering Shopwork at Oklahoma Agricultural and Mechanical College, in the planning and completion of this thesis. The writer appreciates, also, the courtesies extended by Mr. Cary L. Hill.

Gratitude is extended to my wife, Zola Mae Ekstrom, for her inspiration, encouragement, and assistance throughout the preparation of this thesis.

K. G. E.

TABLE OF CONTENTS

DRAWINGS OF SHOPBUILT EQUIPMENT AND DEVICES

CHAPTER I

A PREFATORY STATEMENT

The material included in this thesis covers a well-defined period in the development in manual instruction. An effort has been made to consult the best available sources and select facts that seem to be significant in the development of the present industrial arts program.

However, an effort has been made to present facts in proper sequence to help the reader avoid misinterpretations. Definition of terms used in the description of the various phases of development of industrial arts will be presented in this study.

The content of this thesis is organized upon the concept that preparedness is the keynote to successful teaching. In the field of industrial arts, the need for planning becomes more acute because of the many differences in conditions under which shopwork is taught. The variety of activities performed in the various industrial arts subjects and the techniques used in presenting this information to the student are a challenge that has to be met by the instructor. In accepting this challenge, the instructor must incorporate all of the visual techniques that have been proven successful in the teaching of industrial arts. The training presented in industrial arts subjects should tend to discover the student's manipulative possibilities. To promote this, equipment should be designed and built in the school shop by the students. The student is presented with an assignment in which he may apply the manipulative abilities learned in shopwork classes. It is obvious that industrial arts subjects, when properly taught and motivated, develop clear and definite concepts, stimulate thinking and planning, and demonstrate to the student the need for systematic methods of procedure in the

solution of everyday problems.

The Problem Stated. The title is Shopbuilt Equipment for Use in Industrial Arts Installations. This study is made to obtain definite and firsthand knowledge of the values of shopbuilt equipment and to determine whether or not it may be of value in the industrial arts curriculum.

Shopwork is one of the oldest forms of manual instruction. Because industrial arts subjects are so widely offered, it is quite logical that attention be given to equipment constructed in this type of work. Shopwork teachers need factual proof in order to make improvements in the shop. The material in this study is presented for the purpose of providing the shopwork teachers with materials to improve the teaching situation.

The Purpose of the Study. This study of shopbuilt equipment is being made for the purpose of presenting items of equipment that would warrant construction in the school shop. All the equipment introduced is practical, useful, and common enough to justify its use in an industrial arts shop. The ability of the student was considered in each of the items of equipment. There is a great need for shopbuilt equipment, teaching aids, and other devices in the industrial arts program.

Specifically the purposes of the study are:

1. To classify the types of equipment that could be built in the shop.
2. To design shopbuilt equipment within the manipulative ability of the student.
3. To arrive at a satisfactory procedure for planning a shop with special reference to shopbuilt equipment.
4. To develop detailed drawings of equipment that has been proven useful

in industrial arts installations.

Need for the Study. In the ever expanding industrial arts program, the equipment required in the school shop is costly; therefore, any equipment or devices built by the students would be a substanial saving to the industrial arts department. Also, the equipment and devices built by the students aids in the improvement of the shop and the teaching situation. Due to the lack of published material on shopbuilt equipment for the school shop, this study has been made to provide the industrial arts teacher with drawings of suggested items of equipment that are practical, economical, and useful, and that can be constructed by students of junior and senior high school age.

Delimitations of the Study. This study does not evaluate all of the equipment that could be constructed in industrial arts shopwork classes. Equipment or devices that can be built by students, other than junior and senior high school age, will not be mentioned. A detailed discussion of intricate construction, complicated processes, maintenance methods, and mathematical problems have been omitted from the study. Impracticable equipment or devices have not been included in the detailed drawings in this thesis.

Research Technique. In the writing of this thesis, the library technique was relied upon for all available materials and facts necessary in presenting this study of shopbuilt equipment. Books and articles written by recognized educators were used as references in discussing the history of manual instruction. Magazine articles served as a guide for a few of the drawings and in addition the writer has supplemented the research with the experiences of instructors of shopwork subjects and personal experiences.

Definitions of Terms. In order to clarify the concepts represented by special terms used in this study, the following definitions are offered. The definitions found in existing literature are given proper references, otherwise the definitions are proposed by the writer.

Manual Instruction. The name applied to work for the training of the hands through shopwork activities.

Manual Training. Any form of constructive work that serves to develop the powers of the pupil through spontaneous and intelligent self-activity. The power of observation is developed through exacting demands upon the senses, the reason by constant necessity for thought before action, and the will by the formation of habits of patience and careful application. (13, page 15)*

Industrial Arts. A study of the changes man makes in materials to increase their values to meet needs of the appropriate usage of products made and of the social advantages and problems resulting from the making of these changes and products. (5, page 2)

Shopbuilt Equipment. The name applied to the equipment constructed in the school shop by either the instructor or by the students.

Student-Built Equipment. The name applied to equipment and devices built by students in junior high or senior high school industrial arts shopwork classes.

Visual Aids. Any specifically prepared drawing, illustration, model, motion picture, film strip, or any other device that will expedite learning through the sense of vision. (25, page 1)

Unit Shop. Shops which are equipped to teach one type of shopwork under one teacher. (15, page 18)

General Shop. Shops that are planned and equipped to teach two or more distinct types of shopwork at the same time under one teacher. (15, page 15)

This study should make available, to the industrial arts instructor, drawings of suggested items of equipment or devices that can be built by students in industrial arts shopwork classes.

---

*Credit to books and other written matter is given by the number of the publication in the bibliography and the page of the reference.

CHAPTER II

HISTORICAL DEVELOPMENT OF NON-VOCATIONAL SHOPWORK INSTRUCTION IN SECONDARY SCHOOLS SINCE 1850

Historically, shopwork instruction in American public schools has gone through many changes. In a life of a little over a century in America, industrial subjects in education have had an interesting evolution. A history of manual instruction will be presented to show its origin and its progress up to the present-day industrial arts program.

PART A

Historic Influences of Shopwork 1850-1917

Manual instruction has passed through many interesting movements in its history. The important influences that have affected this type of instruction will be discussed in the following paragraphs.

The Morrill Act. After much opposition and many failures, Justin S. Morrill, senator from Vermont, introduced a bill in 1857 providing for colleges for the benefit of agriculture and the mechanic arts. By this action, Morrill won the support of many friends. However, the bill, which was passed in the senate, failed to pass the lower house. In 1859, the bill again was introduced and passed by both houses but was vetoed by President Buchanan. In the next congress, the bill was passed and was signed by President Lincoln on July 2, 1862.

For each representative and senator representing a state, the Morrill Act gave a state thirty thousand acres of land. The money derived from the sale of this land was to be appropriated to the endowment,

support and maintenance of at least one college whose program was designated by the law. Anderson called attention to this quotation from the act: (1, page 152)

> Without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such a manner as the legislatures of the states may respectively prescribe.

The Morrill Act was amended in 1890, giving a supplementary appropriation of $50,000 to each state. The Nelson Amendment of 1907 extended these aids to the insular possessions of Hawaii and Puerto Rico. All of the state colleges and universities, offering its prescribed program, owe their present growth to the Morrill Act and its amendments.

The Russian Plan of Tool Instruction. Victor Della Vos is credited with developing the Russian system of effective manual instruction. An educational procedure for the development of technical and trade instruction was inaugurated at the Imperial Technical Institute of Moscow, Russia in 1868. The purpose was to train engineers and skilled workers for building Russian railroads. The system of instruction was formal in character. It consisted in the making of a series of exercise joints and models designed to give practice in those trade processes in wood and iron which should be learned by railroad builders. Bennett (4, page 47) made this statement:

> The outstanding fact concerning the system remains that it is the first to use scientific principles in analyzing the mechanic arts and basing courses of instruction on these analyses.

The Russian system drew wide acclaim for the methods used in the instruction of the workers in industry. The instruction included materials, tools and their care, drawing and exactness. There was some production

work on real jobs and articles but most of the products were of no value and none contained the element of boy interest.

In 1876, at the Centennial Exposition in Philadelphia, there was an exhibition of work which had been done in the Imperial Technical Institute of Moscow. Della Vos had an exhibit showing typical exercises used as a basis of tool instruction in both wood and iron. This exhibit attracted considerable attention. It particularly impressed John D. Runkle of the Massachusetts Institute of Technology, Boston, and Calvin M. Woodward of Washington University, St. Louis.

John D. Runkle recommended establishing, in Boston, a group of instruction shops in which should be taught all the mechanic arts for those who wish to enter upon industrial pursuits.

Calvin M. Woodward made his contribution to manual instruction by establishing, in St. Louis, a course of tool instruction for the high school level. This was the first attempt to include shopwork in secondary education.

By 1884 three other cities, Chicago, Toledo, and Baltimore, organized manual training schools. Private corporations furnished the funds with which to build the schools in Chicago and Toledo, but Baltimore established the first manual training school as an integral part of the public school system. Philadelphia and Omaha were next. After 1886 public manual training schools grew very rapidly in number, in size, and in influence.

The Home Sloyd System. As described by Good (11, page 374), sloyd is "a system of manual training first introduced in 1858 as a part of elementary instruction in Finland, involving bench woodwork and metalwork, wood carving, and basket weaving; it spread rapidly to Sweden and other

countries, including the United States." As late as 1870, countries such as Finland, Sweden, Norway, and Denmark used the sloyd system of training in the home. In these countries of the north, where the short winter day were succeeded by long, dark evening, the rural folk spent many hours within the four walls of their own cottages. And so, in early times, it became a custom on winter evenings for members of the family to gather around the stone hearth, each one busy with some form of useful handiwork. The father and sons, with a few simple tools, would work with iron and wood, making ax handles, hammer handles, metal rakes, metal pins for yokes, and other devices needed for farm use. They also made articles such as tables, benches, forks and spoons, and other useful household articles, often ornamenting them with simple carving.

As time went on, the rural folk were able to sell or trade some of their products of the home. The finding of a market for their handiwork soon transformed the home sloyd into a domestic industry. It often happened that certain villages became famous for particular kinds of work, and that every boy in the neighborhood was trained for that one branch of work. With the introduction of machinery, the home sloyd soon began to lose its popularity. Schools were established to aid Sloyd but they failed because they were operated about the same as the home with the emphasis on skill and the sale of products.

Educational Sloyd. Otto Salomon of Sweden was one of the greatest contributers to educational sloyd. There are three significant contributions that Salomon made to the educational sloyd. (4, page 64) They are as follows:

1. Making useful objects.

2. Analysis of processes.

3. Educational method.

All of the objects made in educational sloyd were to be useful in the home. Such items as brush handles, dish stands, coat hangers, ax handles, and cabinets were made in the sloyd classes of instruction. In 1882, many teachers from the United States went to Stockholm, Sweden to study instruction methods of the Naas system and shopwork given by Salomon. The instruction was presented to the students by individual teaching methods. Salomon believed that by meeting the problem of the individual differences in children and by encouraging each child to progress as fast as possible, more information could be learned and retained by the child. He organized sloyd in the school system on a pedagogic rather than an economic basis.

The method used in the educational sloyd developed by Salomon was quite different from that employed in home sloyd. Salomon's system was one of individual instruction for children from ten to fifteen years of age. Each child was provided with a set of tools. It was the child's duty to keep the tools sharp and in order. Thus, educational sloyd provided experience with a large variety of tools, while the home sloyd was principally concerned with the teaching of one skill and the management of a single tool.

Sloyd in America. An event which had much to do with the nature of manual training work in this country was the bringing of Gustaf Larsson from Sweden to introduce Swedish sloyd into the Boston schools in 1889. Up to this time, manual training had been crude and unorganized and inclined to copy the work of the Russian schools. Larsson's work began to conform to the principle of the Swedish sloyd. Useful articles

were constructed in the class instead of formal exercises and models. In addition to woodwork, drawing was taught to provide a knowledge of design which the student applied in the construction work. Larsson used individual instructional techniques in his classes instead of group instruction.

Transitions in Manual Instruction. During a period from 1876 to 1910, manual instruction passed through its greatest change. Beginning as a program that offered simple instruction in the use of the hands, and broadening its scope in the second phase when emphasis was placed on the art rather than the manual, it has advanced to its present prominent position where, known as industrial arts, it makes important contributions to both education and industry.

Manual Training. Through the influence of Calvin M. Woodward, upon whom Friese (10, page 13) bestowed the title of "the real father of manual training," money was raised from private sources with which to purchase the ground and build and equip a building for the St. Louis Manual Training School as a preparatory school for Washington University. The first manual training school in America was opened in 1880. Although the St. Louis Manual Training School was of secondary grade, it took over the Russian system which had been devised for the engineering students of college level. This statement is quoted from the book Industrial Arts in Modern Education: (2, page 85)

> The first shopwork in the United States to be based on an adequate analysis of the mechanic arts for either the engineering college or for the high school was patterned after the Russian system.

For a considerable period of time, manual training consisted of a series of formal exercises which were disciplinary in purpose. The

exercises performed were to develop neatness, accuracy, patience, love for labor, manipulative skill, honesty, and character. As a result, the manual training course consisted of manipulative activities and were dictated to the pupils. Instruction was given in woodwork, ironwork, basket weaving, sewing, and drawing. Through the influence of Calvin M. Woodward, manual training was offered as a primary and secondary school subject in many schools in the United States.

Manual Arts. There is no clear cut line between what is known as manual training and its successor, manual arts. In the Dictionary of Education edited by Good (11, page 32), manual arts is defined as follows:

> One of the earlier terms used to identify shopwork involving design and hand construction in various mediums with the purpose of developing art appreciation and manual skills.

There was a growing interest in the application of art principles to industrial products. The designing of projects to be made in the school shop became an important part of educational handwork. The newer term implied skilled hand occupations and also contained the thought of art and design. Charles A. Bennett emphasized the term "manual arts" in America in 1898 by applying the name to the Macy Manual Arts Building of Teachers College, New York. This new method of instruction stressed the project method. Manual arts extended its field to include design and craft. Woodwork and iron work were continued in the instruction but the training emphasis was placed on design and art.

Industrial Arts. A new concept of the nature and purpose of what has become known as industrial arts was clearly enuciated by Charles R. Richards and Frederick G. Bonser. Charles R. Richards is known for his advocacy of the change in name from manual training to industrial arts.

For a period of eight years, 1903-1911, Richards was one of the editors of the Manual Training Magazine published in Peoria, Illinois. It was in an editorial published in 1904 that he advocated the adoption of a new name to replace manual training. The following condensations of Richards' editorials, quoted from a recent book by Bawden (3, pages 23-24), will serve to give his viewpoint.

> As evidence of a change in our point of view we are leaving behind the purely disciplinary thought of manual training. As long as constructive work represented an instrument to train the mental powers through the hand, manual training constituted a workable and fairly suggestive title. . . We are beginning to see that the scope of our work is nothing short of the elements of the industries fundamental to modern civilization. . . Instead of devoting our attention to miscellaneous and more or less meaningless projects, we seek in an orderly way to develop insight into the basic industries of our times, and knowledge of some of the steps through which these have reached their present form. . . Behind every other subject in the curriculum is a body of ideas of fundamental meaning and importance. The industrial arts stand for one of the most vital and important phases of modern civilization. We should discard the term "manual training," as both inappropriate and misleading. The term "industrial arts" indicates a definite field of subject matter. The word arts is inclusive of both the technical and esthetic elements, and the qualifying word points specifically and comprehensively to the special field of our material.

The suggestion was timely and it was favorably received. Influential speakers and writers approved, and teachers began to use the new term. Today, the term "industrial arts" has replaced almost completely the former term "manual training."

Frederick G. Bonser is known for his contribution to the development of industrial arts as it is today. Bawden makes the following statement about Bonser: (3, page 26)

> So far as records show, Bonser never held a position as a teacher of any type of shopwork or drafting. He was never employed as a supervisor or director of industrial arts in a school system. He was not the author of a textbook on the technical details of tools, materials, and operations of shop teaching. And yet he deserves a prominent place in this galaxy of leaders because of his outstanding contribution to the development of industrial arts as we know it today.

Bonser spent his entire professional career in teacher training institutions. Here, he had the opportunity to inspire many teachers and administrators with his own envolving conceptions and ideals of education. If any one factor was responsible for the extent and the quality of Bonser's influence on the trend of events, it was undoubtedly the crystallization of his ideas into the popular definition of industrial arts. Bonser's definition of industrial arts is as follows: (5, page 2)

> Industrial arts is a study of the changes man makes in materials to increase their values to meet needs, of the appropriate usage of products made, and of the social advantages and problems resulting from the making of these changes and products.

Industrial arts, as a school subject, affords opportunities for educational growth adapted to the nature and abilities of the individual pupil. Industrial arts should be a part of the general education program, as this training provides a period of self-expression for the students in all grades.

The early history and influences surrounding the growth of industrial arts during the period 1850-1917 have been presented in Part A. The historic influences that have affected the industrial arts program since World War I will be discussed in Part B.

PART B

Historic Influences Since World War I

Developments in manual instruction, since World War I, have been brought about by necessity. The need for industrial training was aggravated by the rapid development of industry. The recognition of individual differences and a training program to meet the needs of the students has developed the present industrial arts program.

The Smith-Hughes Act. The Smith-Hughes Act, sponsored by Hoke Smith and Dudley Hughes, senator and representative from Georgia, was signed by President Woodrow Wilson on February 23, 1917. The act must be recognized as a milestone in the development of federal aid for vocational education in the states. Subsequent legislation giving further aid for vocational education has been based upon the Smith-Hughes Act.

Purpose of the Smith-Hughes Act. The Smith-Hughes Act was given careful consideration in its development. It was passed after many hearings before congressional committees. In delineating the purpose of the act, McCarthy (14, page 39) made the following statement:

> The purpose is set forth in the Act in clear, concise language. The first purpose is to provide for the promotion of vocational education. The Smith-Hughes Act has served this purpose well. Other purposes of the Act are to provide for cooperation with the states in the promotion of such education in agriculture and the trades and industries; to provide for cooperation with the states in the preparation of teachers of vocational subjects; and to regulate the expenditure of money appropriated for this purpose.

Particular criticism has been directed to the trade and industrial section of the act. The criticism has come from general educational groups. The educational groups contended that if this training were offered as a secondary school subject, students would be required to devote too much of their time to manipulative activities.

In support of the trade training program, the National Committee to Study the Need for Federal Aid for Vocational Education insisted that the needs of the student and adult whose desire to be equipped and trained for jobs in industry be recognized. The committee recommended that students who choose trade preparatory training be given three continuous hours of shopwork. The extended period of shopwork was felt to be mandatory because it duplicated the actual work procedure the student

would encounter when he was employed in industry.

The Smith-Hughes Act also provided for schools and classes for those persons that had withdrawn from school. Evening classes were also provided for workers over sixteen years of age who were employed in industry.

Since the passage of the Smith-Hughes Act, aiding acts have been added. These acts are: George-Reed Act, 1929; George-Ellzey Act, 1934; George-Deen Act, 1936; and the George-Barden Act, 1946. The divisions for which these acts provide federal aid are vocational agriculture, home economics, trade and industrial education, and distributive occupations.

Extent of the Program of Vocational Education. Vocational subjects have shown a steady increase in enrollment. In 1949, enrollments in all types of federally aided vocational classes numbered 3,094,646 students. (7, page 1) The enrollment in all the trade and industry classes numbered 801,913 students. (7, page 1) This number included evening classes, part-time classes, all-day classes, and day unit classes.

Relationships of Subsidized Vocational Shopwork and Industrial Arts. The terms "trade and industrial shopwork" and "industrial arts shopwork" are often-times misunderstood. A clarification of these terms should be made: subsidized trade and industrial shopwork is supported by state and federal funds, while industrial arts shopwork is provided for in the general education curriculum. Much of the confusion arises in the lack of distinction between the fundamental purposes and aims of industrial arts in contrast with vocational industrial education. While industrial arts and vocational industrial education have common characteristics, they are two distinct and independent phases of secondary education. They must be so recognized if either is expected to render its maximum

service in the educational program. In pointing out the position of each of the two fields, Ericson (6, page 248) makes the following comparisons.

	CHARACTERISTICS OF INDUSTRIAL ARTS	CHARACTERISTICS OF SUBSIDIZED VOCATIONAL INDUSTRIAL COURSES*
1.	A definite phase of general education based on values derived principally from manipulative activity and study of materials.	A specialized program for the purpose of preparing the students for remunerative employment.
2.	Emphasis placed upon exploration and participation rather than skill and efficiency.	Development of skill is emphasized.
3.	Open and valuable for all students whether talented or not.	Students selected with reference to aptitude for the work.
4.	Pupils of all ages eligible.	Available to students of high school age and older.
5.	Aims best served through a variety of experience with tools and materials representing many industries and crafts.	Concentration on one trade or occupations.
6.	Equipment need not match industrial conditions.	Equipment should basically be parallel to industry.
7.	Classes held for single class periods except in special classes.	Work carried on three or more hours per day in trade practice and related subjects.
8.	Not reimbursed through special federal funds.	Reimbursed through state and federal funds.
9.	Teachers primarily prepared in teacher-training institutions (may have trade experience).	Teachers selected from trades and given professional teacher training.
10.	Course content, length of time, etc., determined by school representatives.	Course content and duration of courses arranged through advisory committees from industry, labor, and schools.

*This title changed slightly by the writer of this thesis.

11. Projects are chosen with reference to student interests.	11. Work assignments based upon practices in the trade.
12. Standards of accomplishment based upon pupil growth rather than skilled work.	12. Standards of workmanship judged in the light of demands of the trade.

A study of this comparison shows that industrial arts shopwork is concerned with satisfying man's innate desire to construct with actual materials. The industrial arts program furthers the development of an intelligent understanding of the current industrial civilization and the problems which have resulted from it. These ends are achieved through contacts and experiences with a wide variety of industrial products, manipulative experiences, and tools of manufacture. Trade and industrial shopwork is directed toward specific occupational training. The purpose of this program is to train pupils to earn a livelihood in a socially recognized trade or industrial field.

Industrial Arts Enrollments. In 1949, the secondary schools in the United States, which include grades seven through twelve, had 6,907,833 pupils enrolled in subjects offered in all curriculums. (8, page 29) 1,726,959 students or twenty-five per cent were enrolled in industrial arts subjects. (8, page 18) Since the enrollments in industrial arts are not reported separately for seventh and eighth grades, it is not possible to differentiate between these two grades and the last four secondary school grades. However, it is recognized that industrial arts is usually a prescribed subject for boys in grades seven and eight.

Among the industrial arts subjects, the largest enrollments are found in general shop, woodworking, and mechanical drawing, respectively. The three subjects account for three-fourths of the enrollment in the industrial arts field.

It has been established that about 30,000 teachers of industrial arts are participating in the primary and secondary school curriculums.

Trade and Industrial Enrollments. Vocational trade and industrial education is usually offered in the last two years of high school. In many instances, the programs are federally aided. Frequently these programs are organized under the provisions of state plans and receive state aid. The number of pupils enrolled in trades and industries, all-day trade courses, may be estimated at a plus or minus 250,000. (7, page 19) In this program, the number of teachers totaled 7,890. (7, page 73)

The largest identified enrollment in the trade subjects are in machine shop, automobile mechanics, electrical work, cabinet making, carpentry, and printing.

The Development of the General Shop. Since the close of World Ward I, a new concept of shopwork instruction for general education purposes has gradually envolved, which differs sharply from the traditional industrial arts program. It is the general shop idea and it has proved itself both educationally and psychologically. So successful has been the general shop concept that leaders in industrial arts education today are thinking more and more along the lines of the general shop methods of instruction.

The General Shop Defined. A definition of the general shop is given by Newkirk (15, page 15) which is stated as follows:

> Shops that are planned and equipped to teach two or more distinct types of shopwork at the same time under one teacher are general shops.

Wilber (26, page 108) has this definition of the general shop.

> A general shop is distinguished from the unit shop by the fact that activities in two or more industrial areas are carried on simultaneously.

The general shop offers excellent opportunities to the students in junior high and senior high school. The unit shop is one which deals primarily with the tools, processes, materials, and information of a single occupational area. Examples of a unit shop would be a cabinet making shop, a machine shop, or a sheetmetal shop. Such shops are usually found in the larger secondary schools.

Newkirk and Johnson (16, page 200) suggest the following subjects be taught in the general shop. These subjects are woodworking, metalworking, drafting, graphic arts, electricity, ceramics, plastics, and home mechanics. Another recommended list of subjects is given by Wilber. (26, page 258) This list includes woodworking, metalworking, electricity, power and transportation, graphic arts, ceramics, and textiles. The general shop subjects are presented from grades seven through twelve. In the smaller school, a combination of three or more subjects can utilize the equipment that is available. Examples would be woodwork, electricity, metalwork, and drafting. By teaching this combination of subjects, the minimum of equipment would be needed, although, experiences could be gained by the students in four different fields.

Advantages of the General Shop. The general shop is a relatively new concept in teaching industrial arts. The general shop is the solution to many of the industrial arts problems in smaller schools. The general shop is valuable as an educative and a finding course for vocational students. In this shop, students may gain experiences upon

which to base the selection of a trade. The aims and basic teaching content of the general shop are in harmony with the best practices in the industrial arts field. Newkirk (15, page 18) listed the following characteristics, which to a large degree are responsible for the popularity of the general shop in presenting the industrial arts program.

1. It is well adapted to the organization of industrial arts content in the light of the general education, exploration, and guidance aims of the junior high school.

2. It permits students to be treated as individuals with due respect for their differences in interests and abilities.

3. It enables a student to discover his abilities and aptitudes through manipulation of a wide range of materials, tools, and processes that go with them.

4. It offers an economical way to gain experience in many activities.

5. It makes possible an adequate industrial arts program for the small school.

6. It stimulates the setting up of a well-planned shop and a carefully organized teaching content.

7. It increases teacher efficiency.

Wilber (26, page 108) listed the following characteristics which seem to be common to most true general shops.

1. Activities in two or more industrial areas are evident.

2. A large number of industrial materials are used.

3. The teacher is versatile in many areas.

4. Equipment is diversified rather than specialized.

5. Breadth of experiences is considered more important than depth in any particular field.

The opportunities offered in the general shop curriculum far surpass the unit shop offerings. The experiences gained through the contacts with tools and processes provide for the student a better opportunity to satisfy their many interests and desires.

The influences and developments in the industrial arts program since World War I have been presented in Part B. In Part C, a discussion will be made of present trends of industrial arts in the school systems.

PART C

Industrial Arts of Today

The trend in the industrial arts installation seems to lean toward the general shop idea. However, many of the schools still have the unit or one activity shop. Educators are beginning to realize the value of multiple unit instruction and are changing the shop curriculums to meet the needs of the students. Since the interests and abilities are so varied at the junior high school and senior high school level, it is necessary that the schools change the curriculums in order to provide a broader variety of work for the students. The student needs experiences with many kinds of materials, tools, and procedures.

Industrial Arts in the Junior High School. The interests of the students in grades seven, eight, and nine are varied. It is difficult for the student to give long continued attention to any one subject. There are 1,257,134 pupils enrolled in the junior high schools of the United States. Of this number more than half are required to take industrial arts. In the broad sense in which a complete program of industrial arts is now conceived, it becomes an essential element in the educational program of all the junior high school boys. The method in which the program is presented may vary to conform to the local administrative organization and physical environment. Industrial arts, as a part of general education, provides for the junior high school pupil information regarding industry and workers, helps to satisfy the desires to create

useful things, develops interests and abilities in home repair and maintenance, provides opportunity for cooperative effort in groups, and illustrates and vitalizes the academic subjects.

Industrial arts must not be confined to materials if it is expected to make full use of the interests that prevail among junior high school students. To confine the efforts to a narrow field of materials is out of step with the rapidly expanding use of industrial materials. Interests in industrial affairs, in general, is pronounced in youth of junior high school age. The students are beginning to realize their individuality and the importance or desirability of associating themselves with recognized enterprises of social significance. The students find themselves surrounded by great organizations for manufacturing, for processing materials, for transportation, and for communication. The desire for the possession of the products of industry becomes a strong motivating force in the life of a junior high school student.

Industrial arts in the junior high school should be of an exploratory character. There is something about working with tools and materials that hold the interests of the students. The general shop has become an accepted organization for the junior high school. The characteristics of the general shop are differentiated from the traditional type of one-activity shop and are indicated by the following quotation from Newkirk and Stoddard. (17, page 11)

> The general shop is a broad group of educative industrial arts activities embracing techniques of shop organization and teaching methods which enables a community, whether large or small, to present a unified core of content, based on life needs, as summarized in these aims: developmental experience interpretive of the major phases of the world's industrial work, "handy-man activities," consumer's knowledge and appreciation, guidance, hobbies, social habits, and (for a very small per cent) vocational preparation.

The general shop offers the teacher the opportunity to be of more

than ordinary service to the students. The teacher can utilize the time spent in the general shop more effectively by teaching a variety of subjects.

Objectives of Industrial Arts in the Junior High School. An unusually good statement of the objectives of industrial arts at the junior high school level is formulated in the publication Industrial Arts: Its Interpretation in American Schools. (21, page 41) The objectives are as follows:

> The junior high school provides a period of exploration and guidance preliminary to choice of a career or vocational training. Industrial arts, as a part of general education, in these years (a) provides information regarding industry and workers; (b) reveals employment opportunities offered by industry; (c) satisfies the boy's and girl's desire to create useful things; (d) develops hobby and handy-man interests and abilities; (e) contributes to the tastes and judgement of the prospective consumer; (f) develops interests and abilities in home repairs and maintenance; (g) affords practice in safety related to the school, home, and industry; (h) gives opportunity for cooperative effort in groups; and, (i) illustrates and vitalizes the academic subjects.

The subjects taught in an industrial arts course should be carefully chosen by the instructor. The course must meet the needs of the students. In accomplishing this goal a variety of experiences should be presented. The general shop, with several activities in progress at one time, accomplished this goal. The use of tools, methods, materials, safe methods, shop improvements, and many other functions should take a definite pattern in the shop to meet these objectives.

Most of the educators are in agreement with the objectives of the junior high school. Newkirk and Johnson (16, page 193) propose the following eight objectives for junior high school industrial arts.

1. Develop the ability to plan and complete projects, using a variety of tools and construction materials in a workmanship manner.

2. Give experiences that will increase understanding of modern

industry and that will lay the foundation for and help determine vocational interests.

3. Develop the ability to read and make working drawings, charts, and graphs.

4. Develop the ability to recognize quality and design in products of industry.

5. Develop the ability to maintain and service in safe and efficient manner the common products of industry.

6. Provide an objective medium for expression in mathematics, science, language, arts, and social science.

7. Develop an interest in crafts as a valuable medium for creative expression in leisure time.

8. Give experiences that will develop social understanding and ability to work effectively with others either as a leader or as a member of a group.

General Shop in the Junior High School. The type of industrial arts shop that should be installed in a given school to meet the local educational needs, depends upon the enrollment, time allotment, and the number of industrial arts teachers. It is generally accepted by school administrators that the general shop should be installed in the junior high school. The major educational consideration is to give the students of industrial arts a broad course including a variety of experiences as a part of the general education. In view of the many demands for the industrial arts teacher to render a broader service than has been expected in the past, it is to offer a course which meets the aims of present-day education. With reference to the general shop program, Newkirk (15, page 19) emphasizes that:

> A well-planned, organized, and supervised general shop program does enable a school, whether it be large or small, to offer a really effective course in industrial arts.

The number of shops in the junior high school will determine the program offered. In a small junior high school which employs only one

shop teacher, it is recommended that general shop be included in the curriculum. The general shop offers a wide variety of activities in which the student can receive training. In the larger junior high school, with two or more shop teachers, two or three comprehensive general shops should be made available. The general shops would consist of comprehensive woodwork, expanded metal work shops, printing and graphic arts, electrical occupations, or a general industrial drafting department. With these types of shops, the student is able to choose a field of his choice.

The choice of the type of shop and subjects will depend upon the administration, the qualifications of the instructor, and the equipment available.

Industrial Arts in the Senior High School. Nearing maturity, students in the senior high school frequently are expected to make decisions that they must abide by for the rest of their lives. Industrial arts, as a part of the general education in the senior high school curriculum, can aid all boys in making a wise decision. By seeking out the innate talent and indicating his aptitude in fundamental skills, industrial arts helps the student to determine in advance what work he is best fitted to do. The emphasis on skill and technical information in the industrial arts shop guarantees that he will begin employment without a handicap. Even if the student's interests prove to be purely academic, the training he will receive in industrial arts will give practical worthwhile experience, benefiting him as an adult in his way of living or his enjoyment of an intelligent hobby.

Objectives of Industrial Arts in the Senior High School. Industrial arts in the senior high school becomes more specialized in nature. The broad objective of industrial arts in the senior high school is general

education. Yet as the work becomes more advanced, it becomes more specialized with emphasis on skill and technical information. Struck (20, page 33) makes the following statement concerning industrial arts in the senior high school.

> Industrial arts at the senior high school levels tends to become increasingly technical and decreasing exploratory in nature.

The objectives of industrial arts in the senior high school are the same as those at other grade levels, but the emphasis is changed to meet the needs of the more mature students. Wilber (26, page 42) lists the following eight objectives of industrial arts for the senior high school.

1. To explore industry and American industrial civilization in terms of its organization, raw materials, processes and operations, products, and occupations.
2. To develop recreational and avocational activities in the area of constructive work.
3. To increase an appreciation of good craftsmanship and design, both in the products of modern industry and in artifacts from the material cultures of the past.
4. To increase consumer knowledges to a point where students can select, buy, use, and maintain the products of industry intelligently.
5. To provide information about, and -in so far as possible- experiences in the basic processes of many industries in order that students may be more competent to choose a future vocation.
6. To encourage creative expression in terms of industrial materials.
7. To develop desirable social relationships, such as cooperation, tolerance, leadership and followship, and tact.
8. To develop a certain amount of skill in a number of basic industrial processes.

Each of these objectives of industrial arts can be found in generally accepted statements of the objectives in education. Industrial arts is,

therefore, a group of experiences planned to supplement the general education program. It brings into action procedures and devices which create and maintain interests by supplementing word pictures of objective experiment and performance. There is an interesting story connected with every industrial product, including certain fundamental knowledge and understanding of natural laws in the use and care of tools. In good workmanship, there is a study and comparison of materials, workmanship, structure, design, finish, and judgement where mere talking about things will not suffice. There is a feeling of pride and confidence in the mastery of material things. Definite habits of procedure, knowledge of conventions, and elements of skill are involved. These elements are essential in modern education.

Types of Shops in the Senior High School. Senior high school industrial arts courses require well-equipped shops. In these shops, students acquire definite work habits, information, skills, attitudes, and interest in the advanced work in the high school shops. Newkirk (15, page 18) makes the following suggestions for the small high school.

> The general shop is heralded as containing the solution of the industrial arts problem in small schools. It has proved valuable as an educative and finding course for vocational students who have no shop experience upon which to base the selection of a trade. The aims and basic teaching content of the general shop are in harmony with the best practices in the industrial arts field.

In this type of shop, the students may choose the field of speciality. For larger high schools, Newkirk (15, page 18) recommends:

> The unit shop plan of organization is widely used for large schools where the teaching staff, enrollment, and finances available permit the use of five or six unit shops.

The degree of skill developed in industrial arts shopwork will be determined by student application of the experiences encountered in the

course. An application of these skills may be used in the construction of useful equipment for the shop.

Since its beginning in the home, manual instruction has passed through an interesting cycle. Artisans trained their sons in the skill of the hands, and the instruction given was crude and vague. A few years later, manual instruction was introduced in the schools. The students worked from models and they were required to perform a group of formal exercises. Instruction consisted of manipulative activities which were dictated to the student, therefore, the student had no opportunity to use his initative or originality. As the result of the inadequacy of this kind of manual work, the present industrial arts program was developed. Many changes have been developed in the physical facilities occupied by industrial arts departments. In Chapter III a discussion will be presented of the physical arrangements and instructional techniques that are used in the industrial arts shop.

CHAPTER III

PHYSICAL ARRANGEMENT AND INSTRUCTIONAL TECHNIQUES IN THE INDUSTRIAL ARTS SHOP

Industrial arts, as a secondary school subject, presents a challenge to the teacher who has chosen this field as his life's work. For the competent and energetic teacher, unlimited possibilities are present. The development of a successful program will depend upon a well equipped shop and upon the application of the various teaching techniques. It is the purpose of this chapter to present material that will serve as an aid in the equipping the industrial arts shop and in the choice of instructional techniques. The techniques presented have been proven sound through use in industrial arts installations.

PART A

Physical Facilities in the School Shop

Sooner or later almost every industrial arts teacher is faced with the problem of planning or reorganizing a school shop. The project may range all the way from working with the architect, in deciding the size, shape, and general layout for an entirely new shop, to rearranging a present shop. The problems in each case will differ. In the case of a new shop, certain controls over size, shape, and other essential features is possible. When working with a room already completed, the general structural details must be accepted and taken into consideration in any rearrangement. Because of the almost unlimited variations which will be present in planning or replanning a shop, definite procedures cannot be established or followed. In this section of the chapter, an attempt, however, will be made to enumerate some of the important factors to be

considered in the physical arrangement of, and the instructional techniques used in a school shop.

Size and Shape of Shop. Several factors influence the size and shape of the school shop. Wilber (26, page 253) states that the two important considerations affecting the size and shape of the shop are:

1. The enrollment for the largest class which is anticipated.

2. The nature of the activities to be carried on in the shop.

Experience has indicated that at least fifty square feet of floor space per student should be provided. However, consideration should be taken as to the size of the projects to be constructed in the shop, and the activities to be performed in the shop. Elroy W. Bollinger, at the Seventh Annual Oklahoma State Industrial Arts Clinic, held at Oklahoma A. & M. College, recommended in the planning of a shop that "Every student should be provided, whenever possible, with at least seventy-five square feet of floor space (depending on the character of the program) in which to work."

This space does not include general storage facilities, special lecture, and demonstration facilities or extensive visual education facilities. Ordinarily, fifty per cent more student stations should be provided in a shop than the number of students in an average size class. While these recommendations are considered ideal, often times the accomplishment of them is never achieved.

The shape of the shop should be considered in the planning. Whenever possible the shop should be rectangular in shape. Very narrow rooms or "L" shaped rooms should be avoided. Difficulties arise when operating a shop with hidden areas. All activities should be visible by the instructor at all times to prevent confusion in the shop class.

Bollinger further suggests:

> The shop room should be rectangular and should have the ratio of width to length of 1:2. With this ration, efficient arrangement of equipment may be made.

In the construction of a new shop building, due consideration should be given to these suggestions, however, the present facilities for the industrial arts teacher will determine the action taken.

Selection and Placement of School Shop Equipment. The type, amount, and characteristics of equipment in a school shop will have a significant effect on the program which can be developed. If the equipment is adequate and well suited to the requirements of the teacher and students, meeting the objectives of the course will be greatly facilitated. If, on the other hand, the equipment is inadequate or of a type not suited to the needs of the program, the achievement of desired purposes becomes difficult if not impossible. The choice of equipment will depend on a number of important factors which must be considered before planning and purchasing can begin.

Prior to selecting equipment, the instructor should consider seriously such factors as the underlying purposes of the program, the type of shop organization (general or unit), the size of class anticipated, the size of the room to be used, and the amount of money available for equipment purchases.

There are two classifications of equipment for the school shop, hand tools and machines. In specifying and choosing hand tools, there are several factors which should be considered. Among the more important of these are suggested by Wilber. (26, page 302)

1. Buy standard tools made by a well known and reputable manufacturer.
2. Buy tools that fit the students.

3. Buy only what is needed.

4. Buy diversified types and sizes.

If the instructor, in selecting shop equipment, follows these suggestions, there would be an elimination of useless equipment in the school shop.

Machine tools should be purchased on the basis of the purpose for which they are to be used. For example, a unit shop may require heavy, production type machines, whereas, a general shop will probably require only a machine of medium or light weight. Many of the medium weight and light weight machines are now capable of withstanding the strain of classroom use, and in most instances, they meet adequately the needs of the school shop. Some important factors to be considered in the choice of machine tool equipment have been developed by a group under the leadership of Elroy W. Bollinger. The recommendations of this group, which are quoted from Wilber's recent book, are as follows: (26, pages 304-309)

Functional Features

1. Machines should be of the unit type in order to provide maximum efficiency, safety, and flexibility of arrangement.

2. Machines should be designed and used for only one type of work.

3. Automatic feed and control devices obscuring the principles of a machine should be avoided for industrial arts classes except for reasons of safety.

4. Machines should be mounted on individual bases, preferably enclosed on all sides to the floor to facilitate cleaning both the machine and floor.

5. The equipment provided in a laboratory should be of a size or capacity which will take care of the bulk, but not necessary all of the work which anyone would like to do.

Safety Features

6. Essential safety features, such as circular saw guards,

jointer guards, and belt guards should be designed and supplied as an intergral and not as a seperate item of equipment.

7. All moving parts of power-driven machines must be guarded or enclosed except those used directly in the operation involved.

8. All hand operated machines that present hazzards, such as squaring shears, punch presses, paper cutters, etc., should be provided with effective guards.

9. All moving parts of motor-driven equipment, whether guarded or not, should be free of projections, such as set-screws, knobs, keys, etc.

10. Guards, when used, must be simple in design and positive in action and must interfere as little as possible with the operation of the machine. Guards that adjust themselves automatically to the work being done are to be preferred over manual types.

11. All grinding equipment should be provided with shields of plastic or laminated safety glass.

12. All motors should be equipped with overload protective devices of the thermal-relay or circuit-breaker type. This device should be incorporated in the case with the motor switch control.

13. The size, capacity, and power of any machine should be determined with reference to the age, strength, height, and mentality of the pupils who are to operate it. It is questionable, for example, if any machine in a junior high school laboratory need be driven with a motor exceeding one horse power.

Design Features

14. The average elbow height of individuals who are to use a bench or machine should be the reference point in specifying the operation level of said bench or machine.

15. All machine tools should have individual motor drives, controls and stands.

16. Power for any machine should be adequate to operate the equipment under its full rated capacity without unreasonable overloading of the motor.

17. 'V' type belts are usually to be preferred to flat belts from the standpoint of power transmission and general efficiency. Flat belts, if used, should be of the endless type and may be preferred as a protective measure because of

slippage on excessive overloads. This is particularly true where machines may be locked by jamming, as in the case of an engine lathe or milling machine.

18. All reciprocating or revolving machine parts that work at high speeds should be balanced and counter-balanced to reduce vibrations to a minimum.

19. Machine standards should be sturdy and rigid in order to provide a solid base free from weaving and twisting for the machine it supports.

20. All handles, wheels, and mechanical controls should be of easy access to the operator, be arranged not to interfere with each other, and be electroplated with an anti-corrosive metal.

21. Speed controls should be convenient, safe, positive, and of a range sufficient for the work for which the machine was designed and the experience level of the operators:e.g., beginning printing press operators require an unusually slow press speed.

22. The use of detached knobs, wrenches, etc., for adjusting and operating a machine should be avoided as far as possible.

23. Machine parts, such as saw blades, drill spindles, mortiser bits, etc., should be easily and quickly adjusted and interchanged without damage to the parts.

24. Machine or cabinet bases should not interfere with the movements or comfort of the operator; e.g., toe room should always be considered in the design.

25. Machines should be designed to allow the maximum amount of working space around the point of operation.

26. Power machines should be provided with switches placed within the operator's natural reach and vision while the machine is in operation but so located that accidental switching is avoided.

27. Motor-driven machines of one horse power or less should be equipped with a toggle or push-button type switch operating in a vertical position and placed within natural reach of the operator.

28. The quality and kind of materials used in the construction of machines for school use should be comparable to that used in machines for industry.

29. Sealed roller or ball bearings should usually be considered preferable to other types of bearings.

30. Collectors for shavings, dust, etc., should be an integral

part of the machine. The machine should, however, lend itself to installation of a central dust-collecting system.

31. Where possible, motors should be housed within the machine, but made easily accessible for maintenance.

32. Flexible molded rubber power cords should be supplied and used in connection with all portable and semi-portable equipment.

33. The need for periodic lubrication should be reduced to a minimum through such means as sealed bearings packed in grease or oil. Parts needing periodic lubrication should be fitted with snap-cover oil cups or alemite zerk fittings located for ease of identification and servicing.

34. Machines should be cushioned, preferably with rubber mountings furnished as an integral part of the machine.

35. Machines should be designed to operate with a minimum noise factor. At no time should the noise of any machine exceed 70 decibels.

36. Machines embodying sheet-metal construction should be treated with a noise-absorbing or dampening medium glued or sprayed on inside surfaces.

37. Machines should be painted a distinctive color sufficiently light to have a light-reflection factor of at least 40, be without glare, easy to clean, and of neat appearance.

38. 'Local' lighting should be incorporated as an integral part of machines wherever possible.

39. Simplicity of construction and design should be considered desirable in all equipment.

In planning a shop it is advisable to work out a floor plan area by shop subjects. There should be considerable unity among the general subjects; this can be achieved by careful consideration of their placement to one another, even though each is planned as a unit. The placement of equipment in the shop is determined by the activities to be performed. Heavy equipment, such as saws, lathes, etc., should be placed in open areas where there is adequate room for operation. Also, machines and equipment should be arranged to provide lanes of travel to all areas in the shop.

Lighting in the School Shop. Sufficient lighting is essential in an industrial arts shop. Studies indicate that in rare instances can sufficient daylight be provided in all parts of the room to furnish adequate illumination for the various types of industrial arts work. It, therefore, becomes necessary to depend on artificial lighting. From twenty to fifty per cent of the time, artificial lighting is required in the average school shops. The basic recommendations for adequate school lighting are as follows: (22, page 35)

1. There should be adequate illumination for every student and work station.
2. Lighting equipment should be selected and installed to avoid eye strain.
3. Lights should be placed to avoid sharp shadows on working areas.
4. Adequate general illumination is more desirable than individual lighting only.

The three systems of lighting used in school shops are local lighting, general lighting, and general lighting plus. Local lighting provides an individual light for each student or each machine and work area. Such lighting alone is not good in the school shop as it causes excessive eye strain resulting from the number of eye adjustments necessary when looking from a dark area to a lighted area. General lighting provides for lighting the entire shop area rather than individual work places. It eliminates dark areas in the shop and increases the eye comfort of the students. General lighting plus is a combination of local lighting and general lighting and is advantageous where work requires special lighting.

The table (22, page 36), on the following page, indicates average desirable lighting standards recommended by the Illuminated Engineering Society and by Elroy W. Bollinger.

LIGHTING STANDARDS FOR SCHOOLS

Location	Minimum operating Foot-Candles of General illumination	Recommendations of Bollinger*
Classrooms- on desks and blackboards; study halls, lecture rooms, libraries- on desks and tables	20	30
Offices- on desks	20	30
Sewing rooms, drafting rooms, art rooms and other rooms where fine detail work is to be done- on the work.	45	50-100
Shops, laboratories- on the work	25	30-50
Auditoriums, assembly rooms, cafeterias, and other similar rooms not used for study.	10	20
Locker rooms, corridors, stairs, passageways, toilets, and all indoor areas traversed by students	5	20

*Given in the 1951 session of the Oklahoma State Industrial Arts Clinic

Safety in the School Shop. Regardless of the size of the school shop, safety should be included in the shop program. Planning a safe shop is one thing and maintaining a safe shop is another. Due to the variety of materials, tools, machines, and processes, certain precautions have to be considered. Such items as storage facilities, floors, machines, materials, tools, processes, and methods concerning these items should be taught with an emphasis on safety. DeWitt Hunt, Head of the School of Industrial Arts Education and Engineering Shopwork, Oklahoma A. & M. College, has this to say regarding school shop safety.

> The school shop is an industrial plant in miniature and almost all of the problems and activities found in a manufacturing enterprise apply in some measure to safety in the school shop environment. The industrial arts teacher must be aware of these problems of safety in the factory and must interpret them in the light of the needs of the students in his shop.*

*In an unpublished paper presented before the American Vocational Association in Milwaukee, Wisconsin, December, 1948.

To maintain safe conditions in the school shop, there must be cooperation between the teacher and his students. Safe and effective selection and location of equipment will not suffice to produce safe working situations in industrial arts classes. Effective instruction will be discussed as the most important phase of any industrial arts program.

PART B

Methods of Instruction in Industrial Arts

A satisfactory method of instruction should provide opportunities for the development of initative and originality in the pupil. It should stimulate interest and cause the student to want to accomplish the established goals. There are many methods of instruction which can be used effectively in teaching industrial arts classes.

Demonstration. Probably one of the first methods to be used and still among the best methods available is the demonstration. It is not only an effective technique of instruction but one which can be used for a class, for a group, or with an individual. In discussing the class demonstration as a method of instruction, Ericson writes: (6, page 46)

> The demonstration then is probably the teacher's greatest asset in arriving at fundamental skills and practices and in the shortest possible time. It may well be said that, for the average school shop, the quality and quanity of work produced will depend greatly upon the instructor's use of the demonstration.

The demonstration can be very effectively used in shopwork instruction as a method of presenting information on skills and processes. The effectiveness of the demonstration is an important

factor in the school shop. In reference to this fact, Wilber (26, pages 115-116) suggests the following.

> In order to be effective, however, a demonstration must be well planned, but also must be skilfully performed. There is no better way in which a teacher can build prestige with his students than by his ability to prepare and present skilful demonstrations. Conversely, there is nothing that will lower a teacher in the esteem of the class more quickly than even an occasional failure or lack of finesse in demonstrating. It is of the utmost importance, therefore, that every teacher master thoroughly the art of giving a demonstration and then practice until near perfection is achieved.

Merely knowing "what to do" can never assure a good demonstration, however, it is equally true that without such knowledge it is highly improbable that a good lesson will result.

There are many advantages of the demonstration. Those given by Struck (19, page 348) are as follows:

1. The visual sense perception comes to the end of the sense of hearing.
2. The demonstration is adaptable to greatly varying circumstances.
3. It is objective and concrete.
4. It can be readily employed in unison with other methods.
5. It combines theory and practice closely.

A combination of the demonstration with other techniques provides for the teacher a wide variety of opportunities in presenting shopwork subjects. New equipment or devices may be introduced by this method of instruction.

If the demonstration is to be effective, much preparation and previous planning must have taken place. Some of the more important preliminary steps are suggested by Wilber. (26, pages 118-120)

1. Determine need for demonstration.
2. Review and plan procedure.

3. Obtain materials needed.

4. Check the machines if used in demonstration.

5. Check and prepare hand tools.

6. Obtain and prepare any necessary visual aids.

7. Practice the demonstration.

8. Have partly completed project at hand if they are needed to facilitate the lesson.

The foregoing list could serve as a check list for the instructor. Nothing is more likely to spoil the demonstration than to get part way through and find some essential tool had been forgotten.

A proper procedure should be followed by the instructor in presenting a demonstration. According to Karch and Estabrooke (12, pages 60-64), the following factors are important and should be used to govern the procedure during the demonstration.

1. Explain the objectives to the students.

2. Mention the important points to look for.

3. Explain new terms.

4. Present the material step by step.

5. Teach only the best procedure for each step.

6. Do not perform work for students.

7. Do not quit too soon.

8. Beware of related information.

9. Stress safety rules and precautions.

10. Select students to aid with demonstration when possible.

The demonstration is an effective, manipulative method of teaching. Shop instructors use this method to accomplish the task of introducing students to the various activities in the shop.

Projected Pictures. A visually aided presentation is more effective than a completely verbal one. Even though this is a true statement, many teachers disregard it. Many misunderstandings and wrong concepts result from verbal instruction when unaided by concreteness. In recent years, the value of pictures in teaching has been greatly increased by technical progress, especially in the fields of motion pictures, slide films, and projection techniques.

The advantages inherent in all visual impressions are to be found in the various types of projected aids. Weaver and Bollinger (25, page 180) expresses the advantage of visual instruction as: "The students can see what the teacher means." It is human to learn more through the sense of sight than through any of the other senses, therefore, any idea that is visualized aids the learning process. The following features of projected aids are classified by Weaver and Bollinger (25, page 180) as follows:

1. Better retention of visual impressions.
2. Interesting manner of presentation.
3. Economy of teaching and learning time.
4. Flexibility in use.

The use of projected aids should reduce the period of training and produce better informed students. A few carefully selected aids are far better than those chosen at random.

Models. A model is a replica either in miniature or in an enlargement and is an effective teaching aid for use in the industrial arts shop. Some teachers believe the models, particulary working models, are the most effective form of teaching aid. In using the model, the student not only can see it but he can touch it and operate it, therefore,

it makes learning easier.

Models vary greatly in form, depending on the purpose for which they are designed. In one case, a simple enlargement of the original object will be adequate for the purpose, while in other situations, an elaborate working model may be required. Classification of models, as presented by Weaver and Bollinger (25, pages 103-117), are as follows:

1. The cut-out or cross-sectional model
2. Working model
3. Enlarged model
4. Reduced model
5. Scale model
6. Transparent model
7. Mock-up

The examples given should stimulate teachers of industrial arts to make adaptations to the ideas. The teachers should devise aids suitable to their particular needs.

Other Types of Teaching Techniques. To present a discussion on all the teaching techniques used in industrial arts would be an extremely voluminous task. A partial list of the more commonly known visual aids are as follows:

1. Textbook
2. Blackboard
3. Bulletin board
4. Exhibits
5. Charts
6. Posters
7. Cartoons
8. Graphs
9. Progress chart
10. Responsibility chart
11. Flash card
12. Display boards
13. Information sheets
14. Assignment sheets

15. Job sheets
16. Trade literature
17. Commercial displays
18. Photographs
19. Sketches and drawings
20. Reference materials.

There are countless techniques which may be applied in the instruction of industrial arts subjects. Application of these techniques is necessary in any teaching situation. Many visual aids can be built by students and teachers in industrial arts departments. Some equipment may also be built by them. In Part C a discussion will be presented concerning factors controlling student-built equipment. A list of possible equipment that can be built by students of industrial arts will be included with this discussion.

PART C

Student-Built Equipment

Equipment that is built in the school shop can serve as an incentive for the teacher and the student. Even a simple device or teaching aid constructed by the student will promote greater interest and a desire to improve the industrial arts shop. However, the instructor should not be insistent and dominant with this type of activity. The making of a successful piece of equipment provides the student with an opportunity to feel the pride of accomplishment and the consequent rise in self-esteem which is denied by or difficult to attain in some other activities.

Equipment Built in the Industrial Arts Shop. The versatility of a school shop is determined by the equipment. Due to the variety of activities performed in an industrial arts program, there appears an urgent need for a variety of equipment. The instructor and the

student play a vital role in the development of this equipment. Various methods may be used in the development. Group participation is one method of development and individual participation is another. Regardless of which method is used, careful supervision is required by the instructor. Before construction begins, a careful plan as to construction details, tools, procedures, and materials must be formulated. The item under consideration should meet the following criteria.

1. It meets the objectives of the course.
2. It has the interest of the class.
3. It is within the students ability.
4. It is well designed.
5. It is useful.
6. It can be completed in a reasonable time.
7. It is practical and economical.
8. It allows the students to cooperate together on a common problem.

If the item of equipment meets the criteria just proposed, its construction may warrant consideration. However, to accomplish this, the student should not be denied the privilege of working on a project of his own choice.

Design of Shop Equipment. The equipment for the school shop should be of uniform design and should conform to the already established design within the shop. In order to start successfully upon a design, it is necessary to know what qualities a good industrial article should possess. The equipment designed for the industrial arts shop should meet the following requirements, as quoted by Varnum (23, page 9).

1. It must be of service to the community or to the individual.

2. It must be made of desirable material.

3. It must possess beauty of proportion, outline, and color.

Shop designed equipment and devices must meet certain standards. Elroy W. Bollinger, at the Seventh Annual Oklahoma State Industrial Arts Clinic, suggested that any equipment or device built in the school should be as follows:

1. Attractive and of good design.

2. Useful.

3. Sturdy and durable.

4. Economical to construct.

The design of the equipment should be carefully chosen by the instructor. Uniformity should prevail in his choice of the design.

List of Possible Student-Built Equipment. A suggested list of equipment and devices is always helpful to the industrial arts teacher. The following list includes items of equipment that can be constructed in the industrial arts shop. (Production jigs not included)

Art Metal Work
- Stakes
- Forms for bowls

Bench Woodworking
- *Bench hook
- *Miter box
- Saw horse
- Single work bench
- *Work bench for cabinet shop
- *Four man work bench
- *Heavy duty work bench
- Screw and nail cases
- Clamp racks (portable)
- Clamp racks (non-portable)
- Clamp stands (for gluing)
- Lumber rack (portable)

*Items designated by asterisk (*) in this list have been drawn by the writer and the drawings will be included as a portion of this thesis.

Exhibit Cases
- Center-of-the room cases
- Wall cases
- Bulletin boards
- *Magazine display and storage cabinet

Finishing
- Storage can for paint brushes
- Concrete storage case for finishing supplies
- *Sanding block
- *Sandpaper cutting frame
- *Finish room turntable

Forging
- Shovels and pokers
- Home-built forge

Foundry
- Small foundry flask
- Wood rammers
- "Venturi" tube burner for furnace
- Cast iron pots
- Cupola for melting iron
- Melting furnace
- Sand blast equipment

General
- Illuminated department office signs
- Four-wheel dolly
- Daylight projector for 16 mm films

Guards
- Separate cover guard for circular saw
- *Plastic saw guard
- Splitter guard for Delta Unisaw
- Eye shield for grinder
- *Band saw guard
- Shaper guards
- *Push stick for table saw
- *Push block for jointer (long stock)
- *Push block for jointer (short stock)

Industrial Drawing
- Blueprint frames
- Orthographic projection frames
- Ammonia fume developer
- *Portable drawing board
- Wall-chart case
- Drawing storage case
- Drawing boards
- Drawing board storage case
- *Drawing table
- *Chalk holder for lettering guidelines

Miscellaneous
- Steady-rest for wood turning
- Drill stands
- Off-bearing roller for surfacers or power hack saws
- Ball-end for metal spinning
- Kick-wheel built by Dr. Frank of Sapulpa, Oklahoma
- Responsibility boards
- Kardex file
- Notebook Kardex file
- Storage box for Stanley charts
- Wood vise saw filing clamp

Office Equipment
- Desk
- Book case
- Filing case
- Wastepaper basket
- Desk lamp
- Desk chair

Plastics
- Electric oven
- Bending-heating devices

Printing
- Galley
- Galley rack

Photography
- Printing frames
- Enlarger

Tool Racks
- Individual tool holders
- Band saw rack
- Band saw storage bin
- Wall storage tool cases
- Floor stand tool cases
- Combined tool cases with blackboard as door
- *Portable circular saw rack
- *Dado head holder
- A-frame tool holders, (portable)
- *Jointer blade holder
- *Band saw cutoff fence
- *Lathe tool rack (portable)
- *Band saw clamp

Welding
- Welding table for acetylene welding
- Welding table for electric welding
- Portable acetylene welding cart

The instructor should take considerable time in choosing the student-built equipment for the shop. The equipment should be chosen

as to design, materials, use, and construction detail.

The arrangement of the physical facilities and the application of accepted teaching techniques are important factors in the school shop. The method of arrangement in the shop must be carefully planned, therefore, prior planning is necessary. Teaching aids have been proven an effective means to stimulate learning. The construction of any aid or device by the student will promote a better understanding of the school shop and its facilities. A suggested list of equipment to be built in the school shop is included in this chapter. Detailed drawings of some of these aids and devices that have proven satisfactory in industrial arts installations will be included in the following chapter.

CHAPTER IV

SHOPBUILT EQUIPMENT AND DEVICES

The responsibility which rests on an instructor who has been assigned the task of planning the industrial arts shop of a school is an important and challenging one, and the task demands considerable thought and insight. The equipment in an industrial arts installation is costly, therefore, any equipment or shopbuilt device that can be constructed by the students would be of value to the institution. However, there are certain advantages of student-built equipment that should be taken into consideration by the industrial arts teacher. The advantages of student-built equipment are listed as follows:

1. The equipment can be constructed when the need for the equipment arises.
2. The student may apply the manipulative abilities learned in industrial arts shopwork classes.
3. Equipment aids in the improvement of the facilities in the shop.
4. A great number of industrial processes and materials are used by the student.
5. Student gains experience in planning.
6. Construction costs of equipment are less than purchase price.
7. Design of equipment can be regulated by the industrial arts instructor.
8. Individual or group participation may be applied in student built equipment.
9. Student-built equipment provides new student interests.

10. Equipment can be used and appreciated by all students in the shop.

The advantages of student-built equipment have been presented, and at the same time, certain disadvantages should be mentioned. Some of the disadvantages of student-built equipment are as follows:

1. Construction processes may be beyond the manipulative ability of the student.
2. Equipment may be poorly constructed (bad joints, etc.).
3. Student must spend time from his own work.
4. Design is often not good; crude in appearance.
5. If equipment is too large, students loose interest.
6. Materials are not available in the shop to construct items of equipment.
7. Purchased equipment is better designed and constructed.
8. School shops are not equipped for production work.

With due consideration to the advantages and disadvantages of student-built equipment, as listed in the foregoing paragraphs, the writer will present drawings of equipment and devices that can be built by students in industrial arts installations. The design and use, construction materials, and special recommendations will be presented on each of the drawings.

Bench Hook

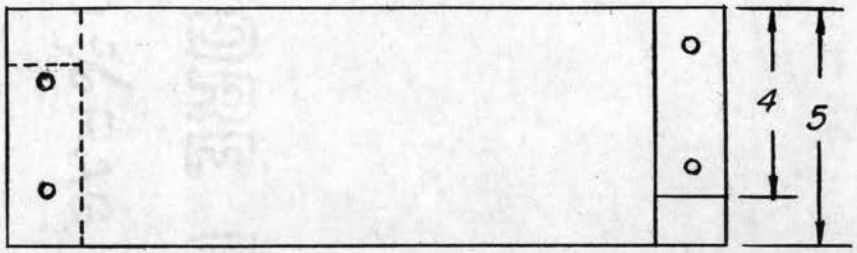
The bench hook (page 52) is a simple device that is very useful in the school shop and it should be a required part of the equipment used by the students.

Design and Use. The design of the bench hook varies somewhat from the conventional type of hook. Taking into consideration that some students are left handed, the conventional hook is difficult to use, whereas, this bench hook was designed to be used by either right or left handed students.

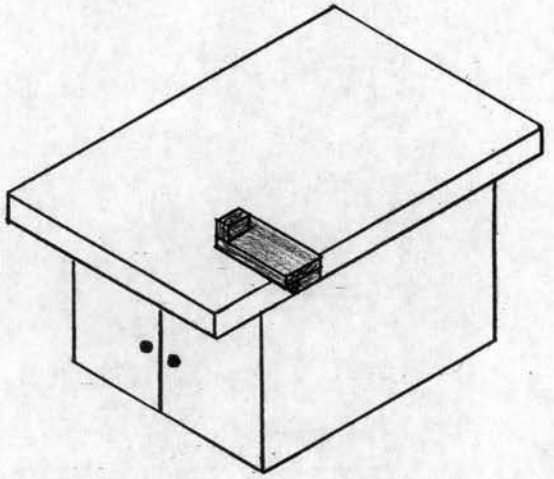
Construction Materials. The body of the bench hook is made from a piece of pine 3/4" x 5" x 10". The two stops are made from a piece of pine 1" x 1 1/2" x 10", and they are held in place with glue and 1/2" dowels.

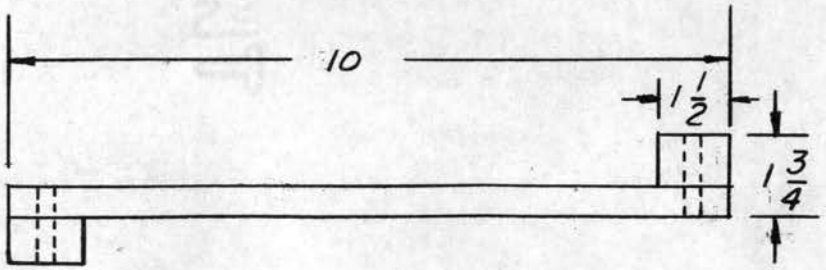
Special Recommendations. The bench hook should be one of the basic projects in junior high school woodwork. After the student has constructed the bench hook, he should store it where it would be accessible for use at all times.

BENCH HOOK



USE $\frac{1}{2}$ DOWELS AND GLUE
TO FASTEN STOPS





Miter Box

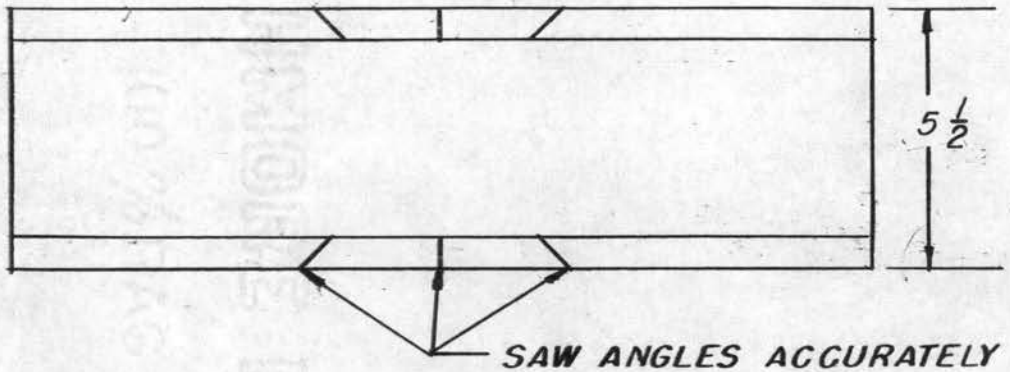
The miter box (page 54) is of simple construction and can be used in the school shop by students who must have some sort of guide when fitting mitered corners.

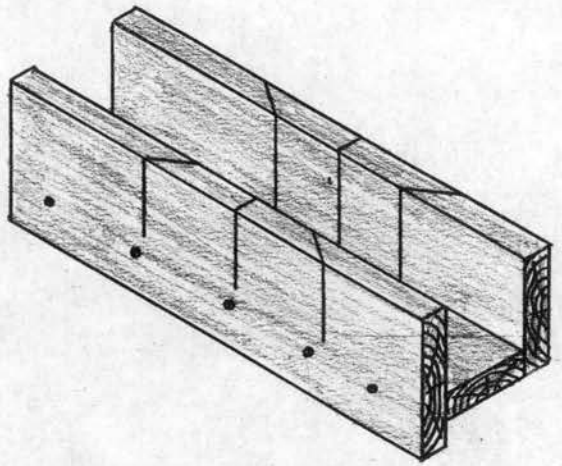
Design and Use. The miter box was designed to fit over the edge of the woodwork bench, thus, permitting the student to use the miter box without clamping it to the bench. The miter box may be used by the students to insure better joints in the projects they build in the school shop.

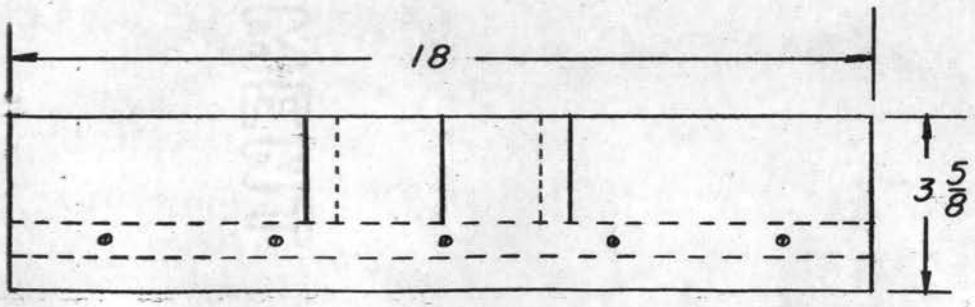
Construction Materials. The front of the miter box is made of a piece of hardwood 3/4" x 3 5/8" x 18". The back is made of a piece of hardwood 3/4" x 2 3/4" x 18", and the bottom is made of a piece of hardwood 3/4" x 4" x 18". The front and back are fastened into place with screws.

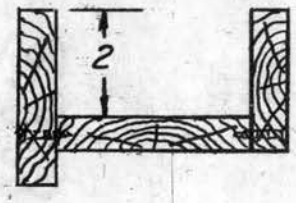
Special Recommendations. The miter box should be constructed by students in both junior high and senior high school shopwork classes. This will enable the student to have a miter box for his own use and it should be stored in his locker with his other materials.

MITER BOX









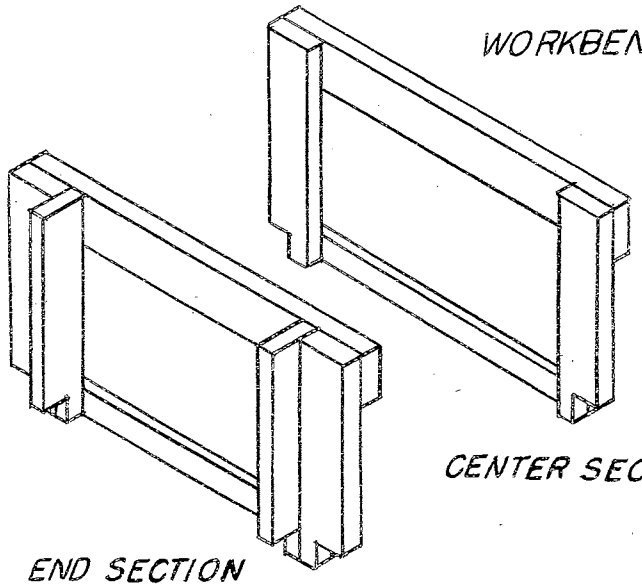
Workbench for the Cabinet Shop

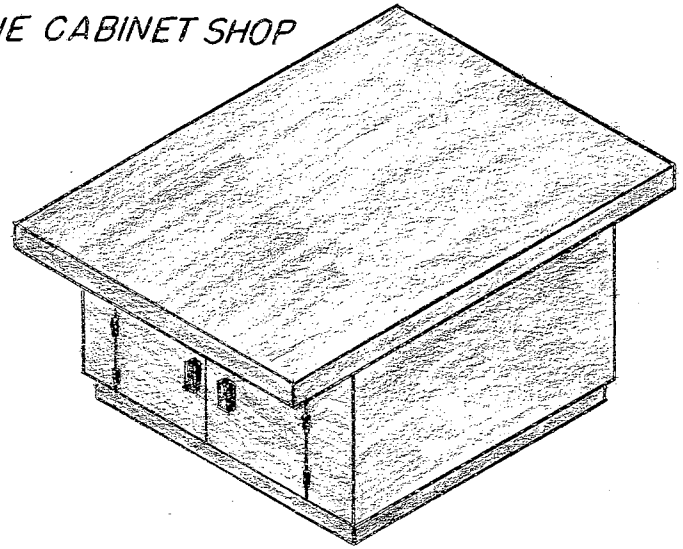
Storage of materials and projects presents a problem in the school shop and with this thought in mind, the writer designed and constructed the workbench for the cabinet shop (page 56). The bench is large enough to provide ample working space for two students. The ends of the bench are enclosed with doors which provides storage space for materials and projects and the doors may be locked to insure safety of the materials used by the students.

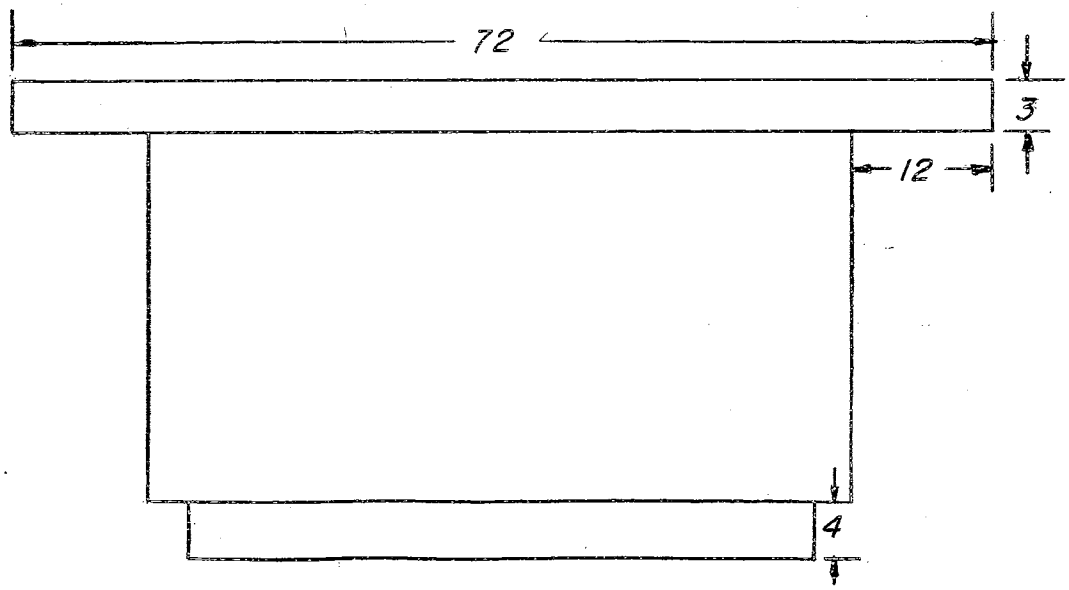
Design and Use. The bench is modern in design. A recessed enclosed base is used to allow for free movement around the bench. The enclosed base eliminates any scrap or waste from collecting under the bench and this factor greatly aids the shop housekeeping program. This bench is designed for the woodshop but can very easily be adapted for use in the general shop. Vises may be mounted on alternate corners for use as a woodwork bench.

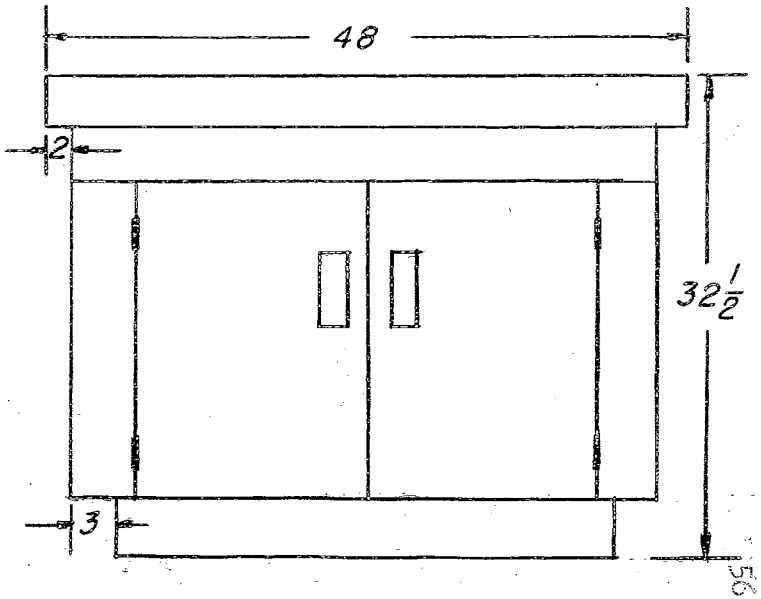
Construction Materials. The materials for the bench can be purchased at a minimum of cost. If desired, the framework may be made of used 2" x 6" fir or yellow pine. The sides are made of 1/2" plywood, and the corners of the sides are mitered to prevent end grain from showing. The top is made of 2" x 3" maple which is held together by five 1/2" rods. The rods are threaded on both ends to permit tightening and to hold the pieces that form the top in place. The hinges are bolted to the framework and the bolts are riveted to prevent removal of the doors. A hasp is attached to the doors in the same manner.

WORKBENCH FOR THE CABINET SHOP









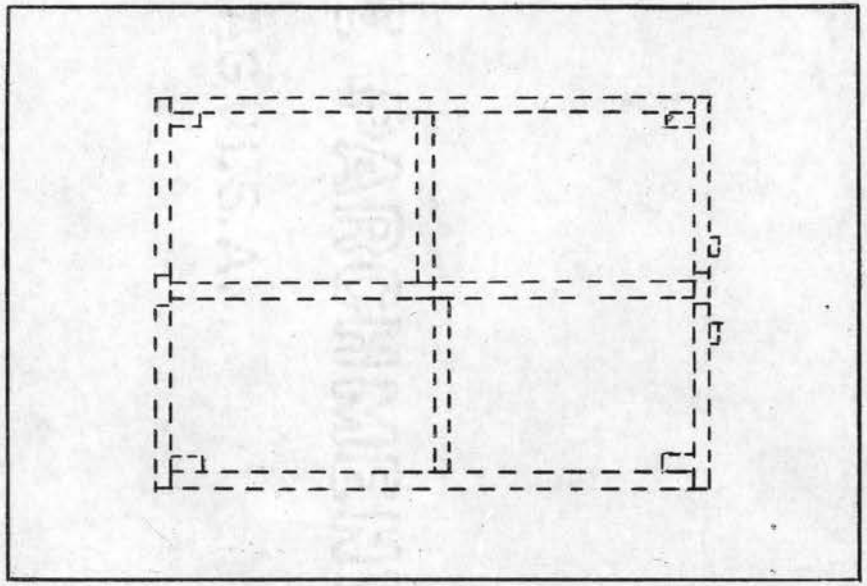
Four-man Workbench

The four-man bench (page 58) is especially adapted to the general shop. Locker space is provided in this bench for four students, and each compartment may be locked if so desired.

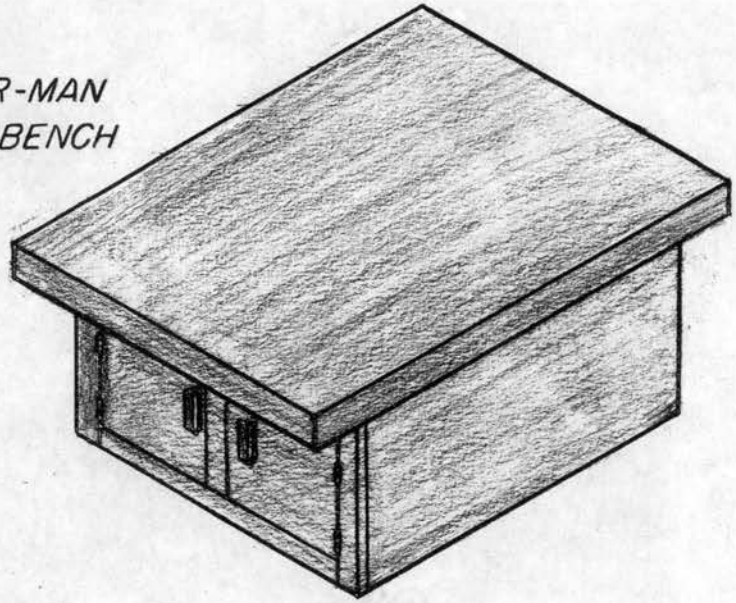
Design and Use. The four-man bench is of modern design and serves as a work station for four students. It is designed to be used in a woodshop or the general shop. Vises are mounted on all corners of the bench, therefore, four students may work at one time. The locker space provides a place to store the students materials and projects.

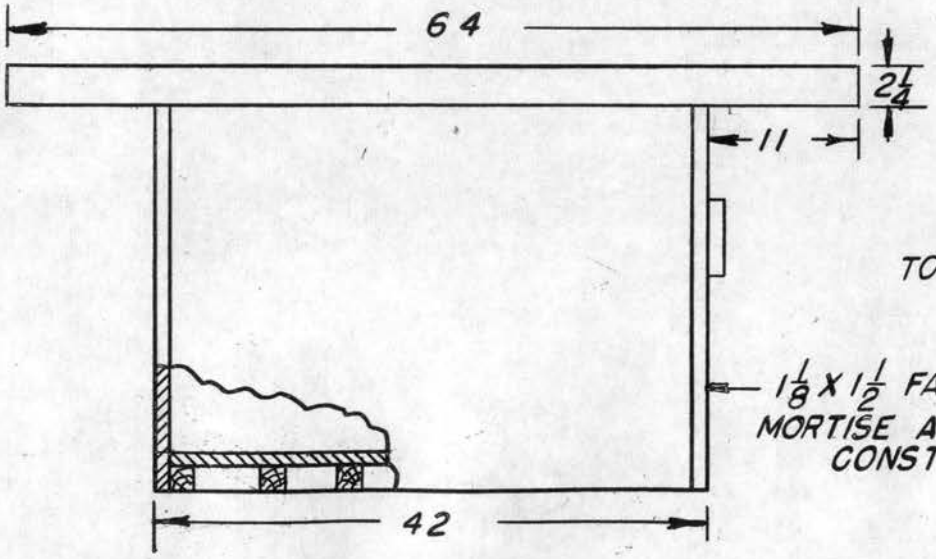
Construction Materials. The framework of this bench is made of pine. The faceplate may be made of 1 1/8" x 1 1/2" pine with mortise and tenon construction, however, hardwood is recommended for the faceplate. The sides, floor, and partitions are made of 3/4" plywood and the top is made of 2 1/4" maple pieces glued to form a solid piece.

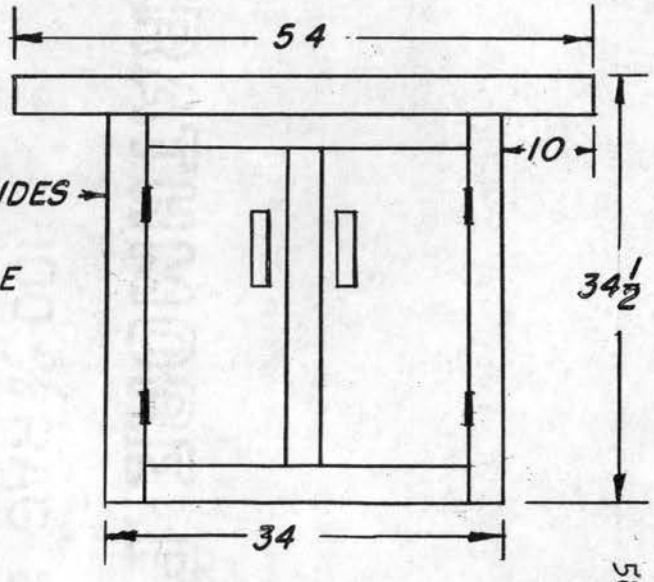
Special Recommendations. It is recommended that the four-man bench be built by students in senior high school industrial arts shopwork classes. In the construction of the bench, the students may apply methods used in industry.



FOUR-MAN
WORKBENCH







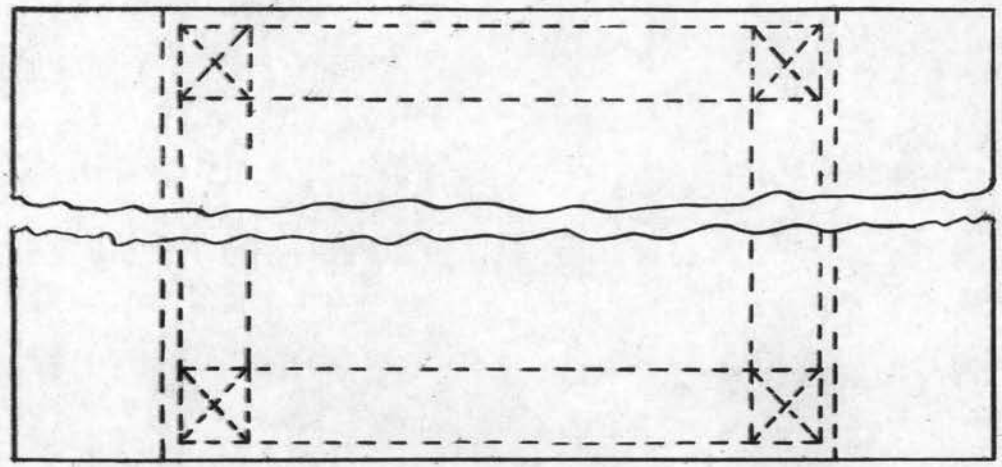
Heavy-duty Workbench

The heavy-duty workbench (page 60) is an item of equipment that is very useful in the school shop. The bench serves as a work station for two students. It is durable and it is easily constructed by students of junior or senior high school age.

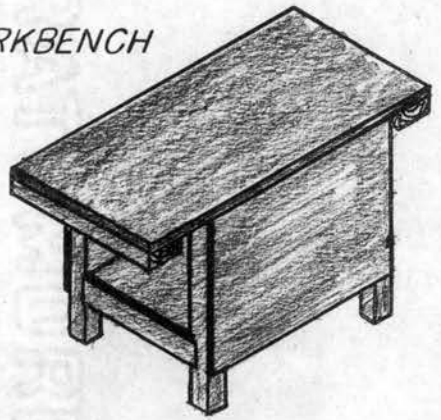
Design and Use. The heavy-duty workbench is simple in design, and is easily constructed in the school shop. This bench can be used in a woodshop or in a general shop. It can be equipped with woodworking or machine vises, depending upon the area in which the bench is located.

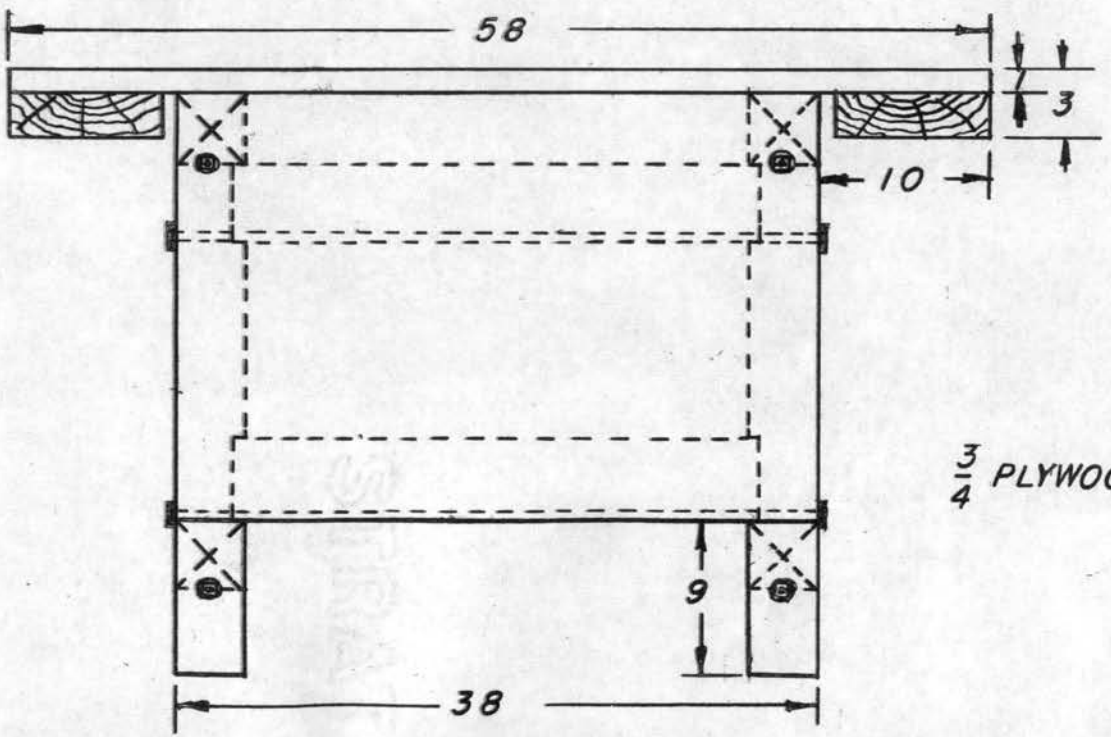
Construction Materials. The legs and the cross-members of this bench are made of 4" x 4" fir. The sides and bottom of the bench are made of 3/4" plywood and are fastened in place with screws. The top is made of 1" maple boards glued together to form a solid piece. The 2" blocks are secured to the top with screws and glue to provide for mounting of the vises. The rods used to hold the bench together are made of 1/2" steel bars.

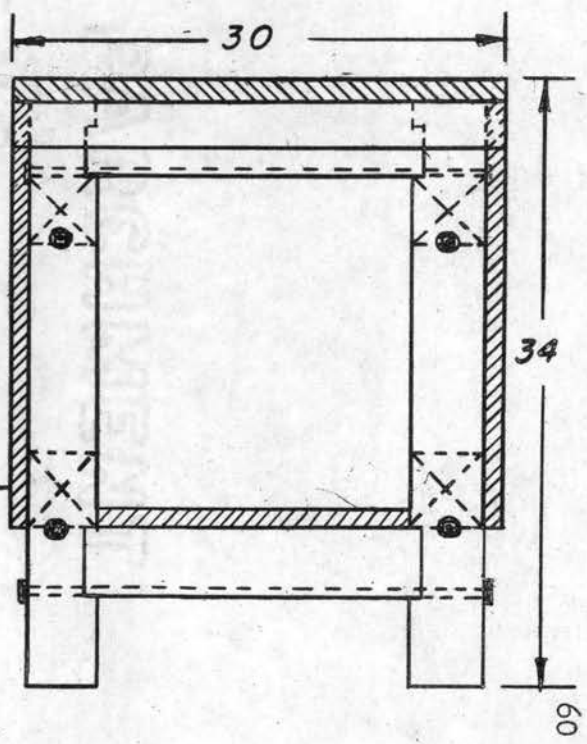
Special Recommendations. The heavy-duty workbench is an ideal item of equipment to construct in the advanced classes in senior high school. Manipulative abilities of the students are advanced enough to warrant construction of this bench in the classes. The construction should be planned as a class and then group assignments made by the instructor in the shop.



HEAVY-DUTY WORKBENCH







$\frac{3}{4}$ PLYWOOD

Magazine Display and Storage Cabinet

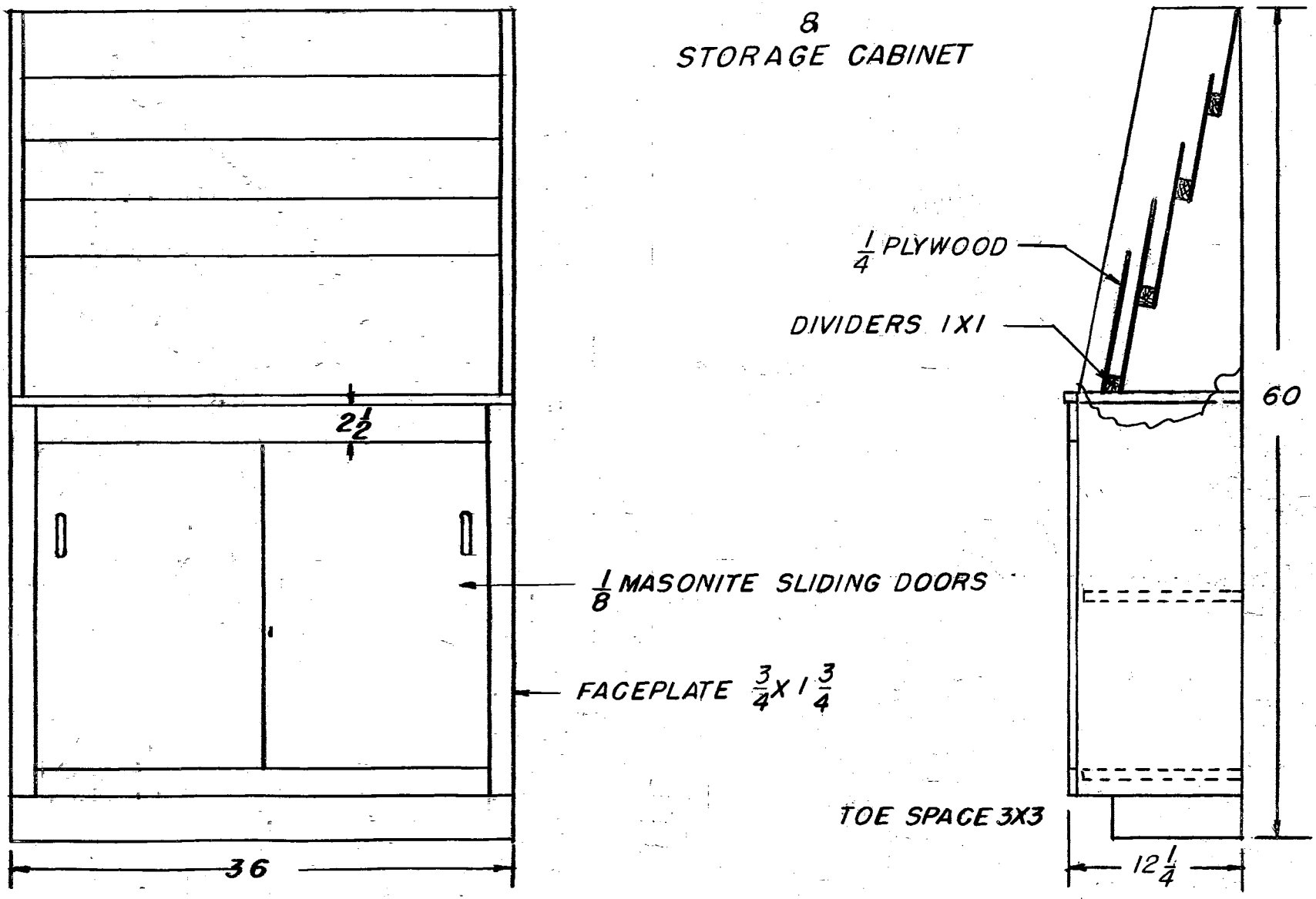
Some method of displaying magazines and publications pertaining to the activities performed in the shop should be available in each shop. If this provision is made, the students can study and plan their work more efficiently. The magazine and storage cabinet (page 62) serves this purpose of aiding the students.

Design and Use. The magazine display and storage cabinet was designed for the purpose of providing a place for displaying published material and at the same time, providing a place to store excess magazines and supplies. The cabinet may be placed in the classroom or the planning room in the shop or wherever the students will have free access to its contents.

Construction Materials. The materials needed for the construction of the magazine display and storage cabinet can be purchased locally. The sides and shelves of the cabinet are made of 3/4" pine. The dividers are made of a piece of pine 1" x 1" x 34 1/2" and a piece of 1/4" plywood is fastened to them to provide a separator for the magazines. The doors are made of 1/8" masonite and finger holes are used instead of handles.

Special Recommendations. This cabinet can be built by students of junior high school age under the close supervision of the industrial arts instructor. The length may be altered to meet needs in the industrial arts shop.

MAGAZINE DISPLAY & STORAGE CABINET



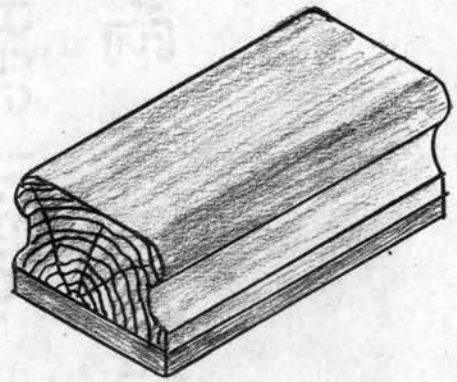
Sanding Block

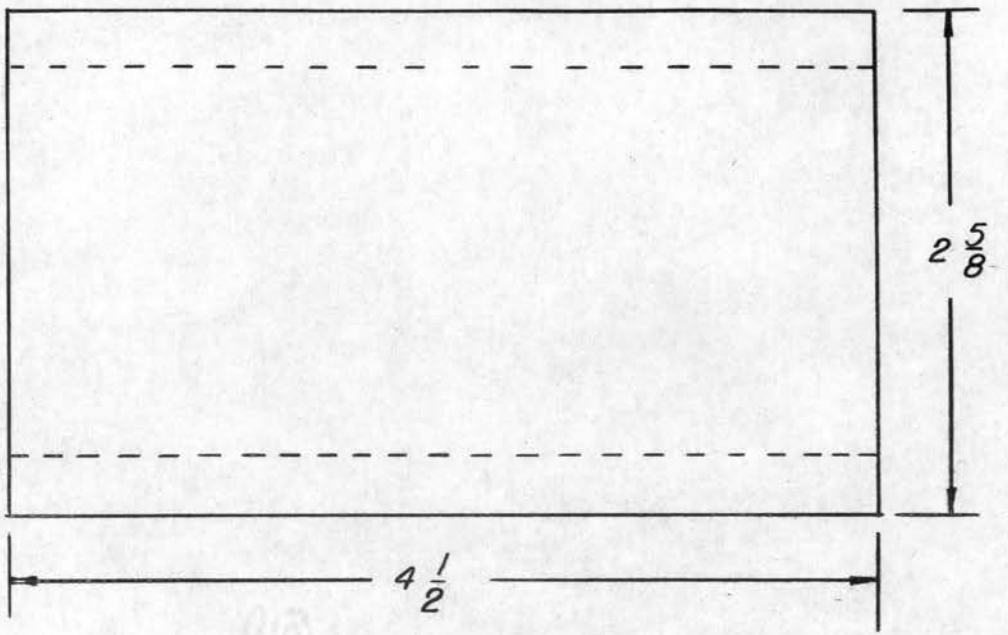
To insure even sanding, the sanding block (page 64) is recommended. This block permits the student to sand the project efficiently.

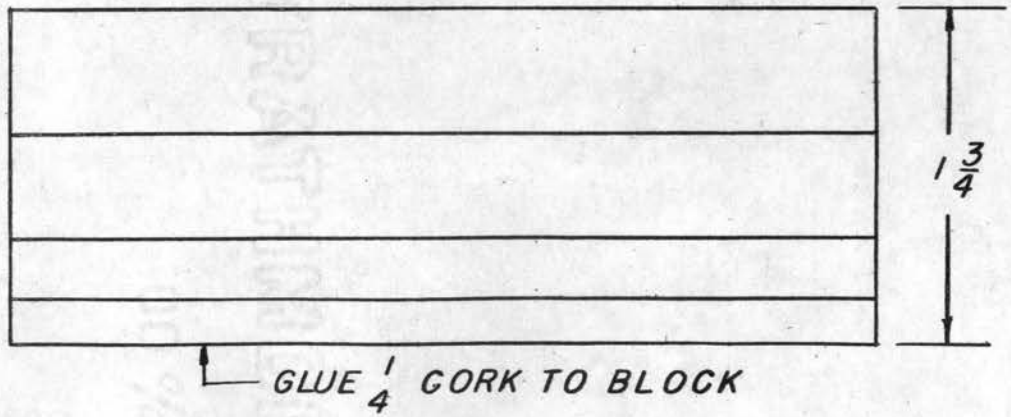
Design and Use. The sanding block is designed to fit comfortably in the hand. When the sandpaper is folded around the block, the grooves on the edges serve as a method of holding the paper in place and as a fingerwell for holding the block when sanding. The cork is a cushioning pad for the sandpaper.

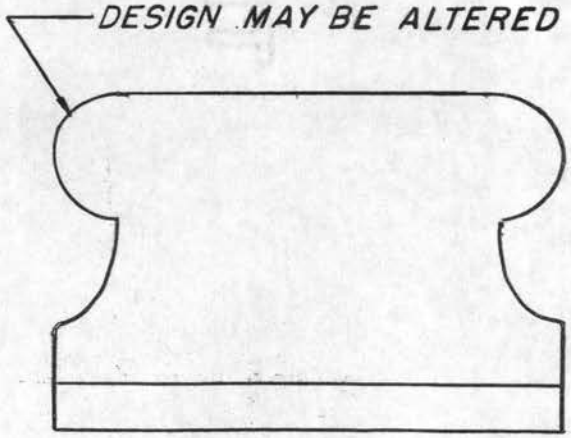
Construction Materials. The body of the sanding block is made of a piece of white pine 1 1/2" x 2 5/8" x 4 1/2". The pad for the block is made of a piece of 1/4" cork 2 5/8" x 4 1/2" and is secured in place with glue.

SANDING BLOCK









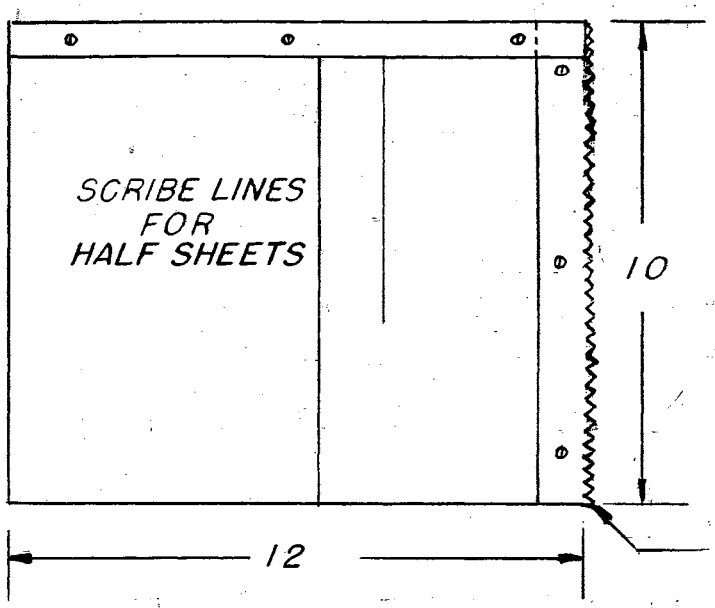
Sandpaper Cutting Frame

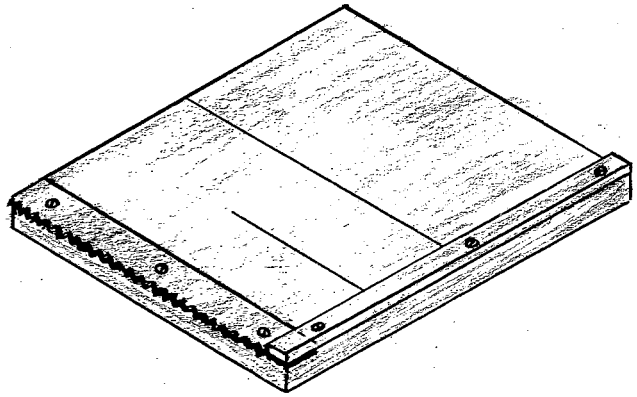
The use of a sandpaper cutting frame (page 66) is a satisfactory method for cutting sandpaper in the school shop. This device serves as a time saver for the industrial arts instructor.

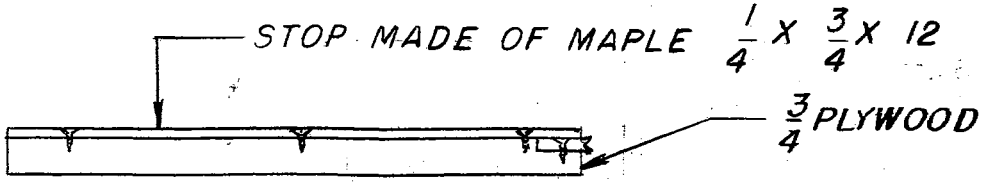
Design and Use. The sandpaper cutting frame was designed for the purpose of cutting sandpaper and may be used by the student or the instructor. Generally, sandpaper is cut into four parts for use in the school shop, therefore, this frame has been designed with lines scribed on it showing the half of the sheet which permits accuracy in dividing a sheet of sandpaper into four parts.

Construction Materials. A piece of 3/4" plywood 10" x 12" is needed to make the sandpaper cutting frame. The stop is made of a piece of maple 1/4" x 3/4" x 12". The cutter is made from a piece of an old saw blade and is 1" x 12". The stop and saw blade are secured with screws.

SANDPAPER CUTTING FRAME







Finish Room Turntable

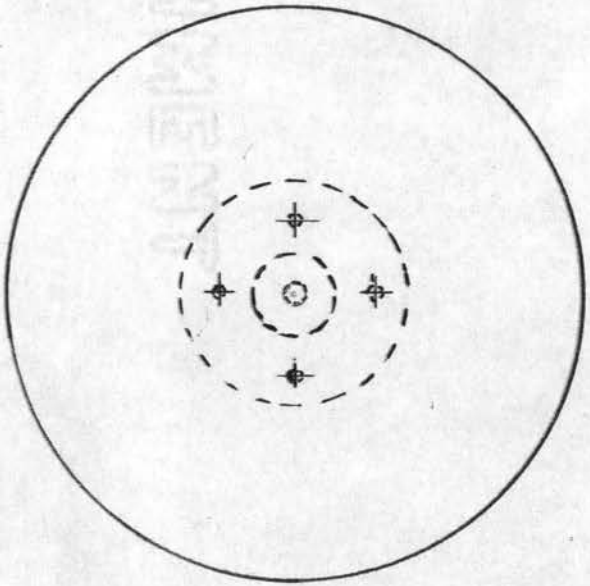
The finish room turntable (page 68) is a useful and practical device for the industrial arts shop. It is particularly adapted to the small finish room.

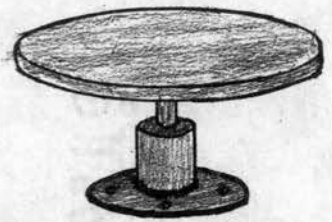
Design and Use. The turntable is designed for use in the industrial arts finish room. It is a simple device that may be constructed by students in shopwork classes. Small projects may be placed on the turntable and revolved to facilitate finishing. One advantage of the turntable is that the object that is being finished does not have to be handled until the finish has been applied.

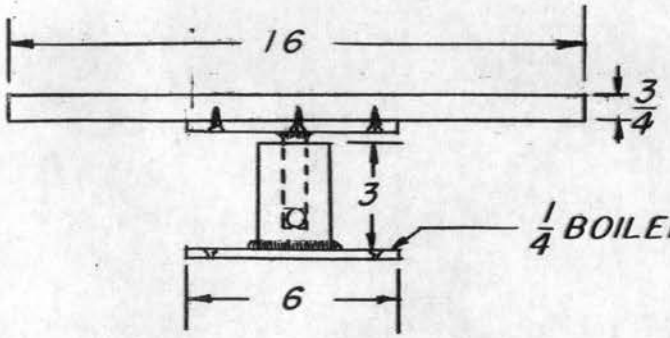
Construction Materials. The materials required to build the turntable can be purchased from a salvage yard. The base is made of 2" bar steel 3" in length. The base and the flange are made of 1/4" boiler plate 6" in diameter. A piece of 3/4" shafting 2" in length is welded to the top flange, and the 2" bar steel is welded to the base. The top is made of 3/4" plywood 16" in diameter and is secured to the top flange with screws.

Special Recommendations. It is suggested that the finish room turntable be made by students in the senior high school industrial arts shop.

FINISH ROOM TURNTABLE







TOP MADE OF $\frac{3}{4}$ PLYWOOD

BASE WELDED TO VERTICAL MEMBER

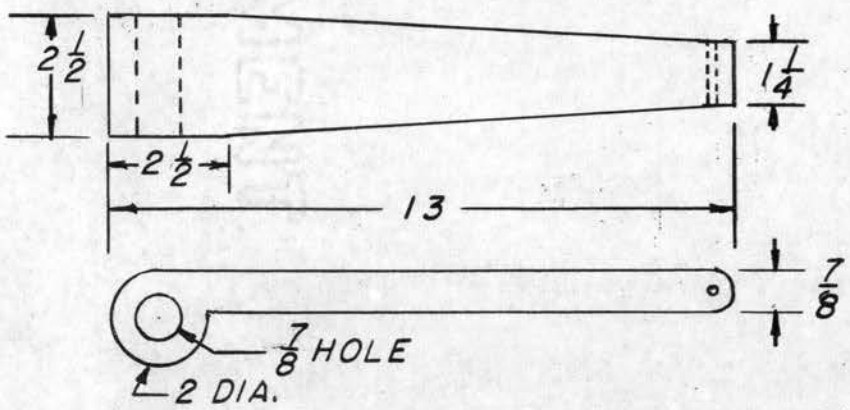
Plastic Saw Guard

The table saw is one of the more dangerous tools used in the school shop, therefore, proper guarding is essential when the saw is in use. The plastic saw guard (page 70) furnishes the protection needed.

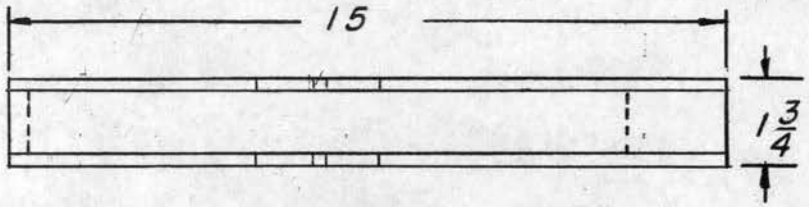
Design and Use. The plastic saw guard was designed to be used on a 10" Delta saw, however, it may be adapted to other makes of table saws. The original plastic saw guard was designed and constructed by John B. Tate, industrial arts instructor at Oklahoma Agricultural and Mechanical College, Stillwater, Oklahoma. This guard provides full visibility since the plastics sides are transparent.

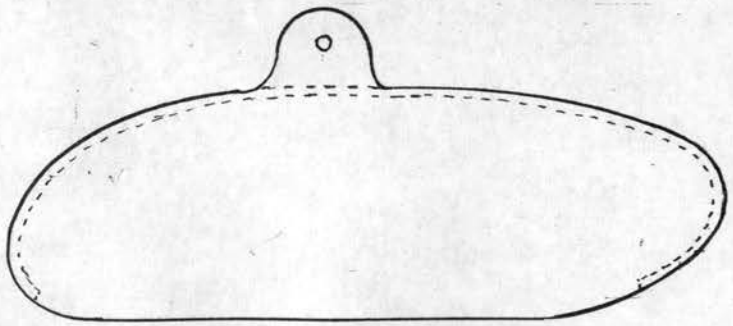
Construction Materials. The plastic cover is made of 1/4" plastic. The sides are made of two pieces of plastic 1/4" x 6 1/2" x 15" and the arm which holds the guard is made of a piece of maple 2" x 2 1/2" x 13".

Special Recommendations. It is suggested that every table saw used in industrial arts installations be equipped with plastic saw guards. This guard can be made by students learning plastics in the junior high and senior high school.



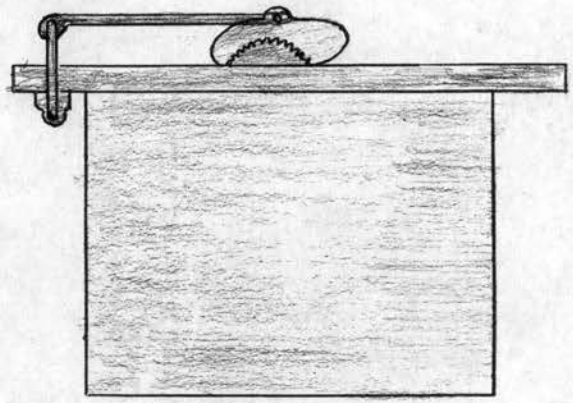
DETAIL OF ARM





DETAIL OF PLASTIC COVER

PLASTIC SAW GUARD



COVER MADE OF 1/4 PLASTIC

ARM MADE OF MAPLE

Band Saw Guard

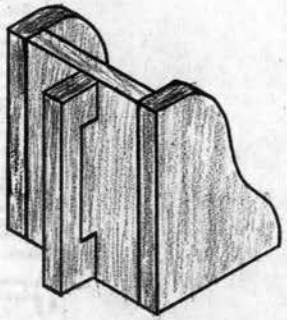
The band saw guard (page 72) is as important as the motor which drives the saw. It serves as a safety device for use on the band saw.

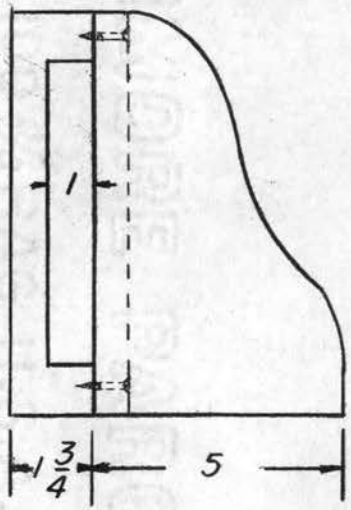
Design and Use. The band saw guard was designed to keep the exposed part of the band saw blade covered when the operator has finished using the saw. This prevents students from coming in contact with the blade while they are not operating saw. Manytimes students do not notice that the saw blade is moving, therefore, they accidently get their hands in the blade.

Construction Materials. The sides of the guard are made of two pieces of plywood 3/4" x 5" x 8 1/2" and the back is made of a piece of plywood 3/4" x 5 1/4" x 8 1/2". The handle is made of a piece of maple 3/4" x 1 3/4" x 8 1/2" and it is secured by two screws.

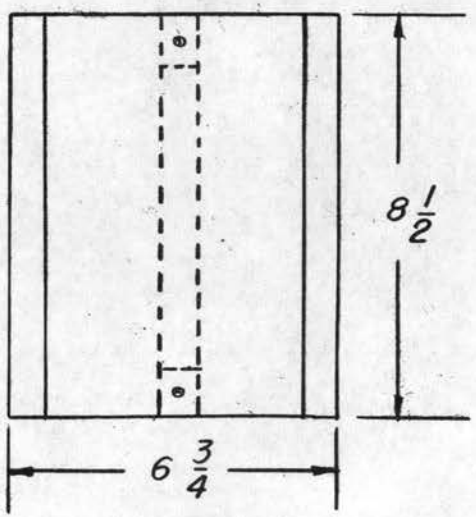
Special Recommendations. This guard can be made by either junior high or senior high school students. It is suggested that decalcomanias be used on the band saw guard. The decalcomanias may be ordered from the National Safety Council, 20 North Wacker Drive, Chicago 6, Illinois.

BAND SAW GUARD





GUARD MADE OF $\frac{3}{4}$
PLYWOOD OR PINE



Push Stick for Table Saw

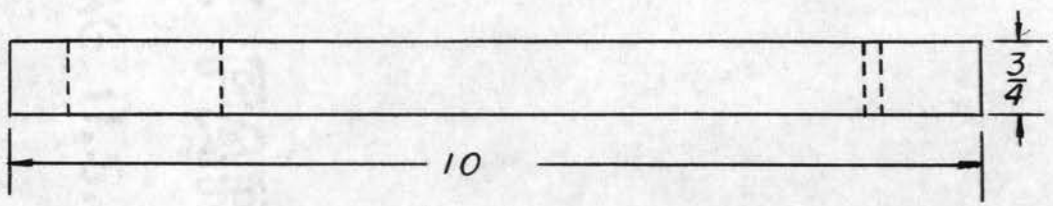
The push stick (page 74) is an important safety device for use when ripping material on the table saw. Practicability of the push stick makes it an ideal device to use in the school shop.

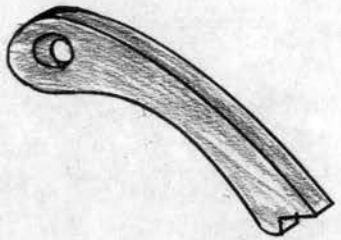
Design and Use. There is a striking difference in the design of this push stick from that of the conventional type. This push stick was designed for use on the 10" Delta saw and the hole in the handle permits hanging it on the guidebar of the saw frame. This permits free access for use and assures that the push block will be kept with the table saw.

Construction Materials. The push stick may be made of material normally discarded in the school shop. It should be made of a piece of maple 3/4" x 3" x 12". The edges of the push stick should be rounded, sanded, and free of splinters.

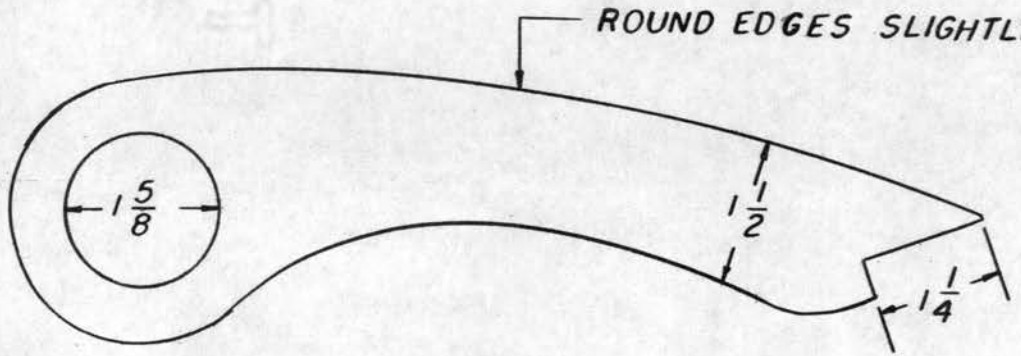
Special Recommendations. The push stick is a "must" in the industrial arts shop and emphasis on the use of this simple device should be stressed by the industrial arts instructor. The push stick can be used for all ripping jobs. When short stock is ripped, the stock is pushed through with the push stick. This is a safe practice when the splitter guard is used. When ripping long stock, a helper is needed to take the stock from the saw.

PUSH STICK FOR TABLE SAW





SAW PUSH FROM A PIECE OF
MAPLE $\frac{3}{4}$ X 3 X 12



Push Block for Jointer (long stock)

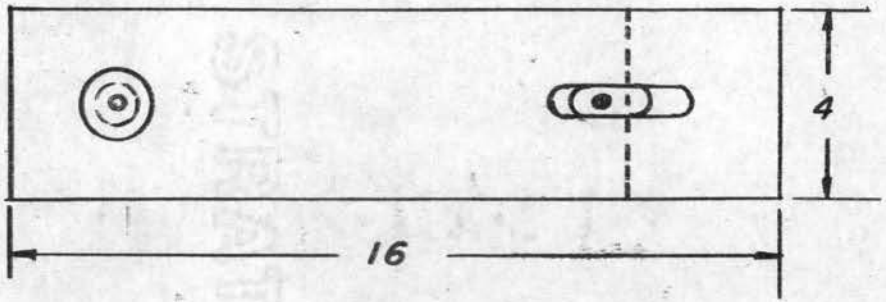
The push block (page 76) is as important as the guard which covers the knives of the jointer and it should be used whenever the jointer is in operation.

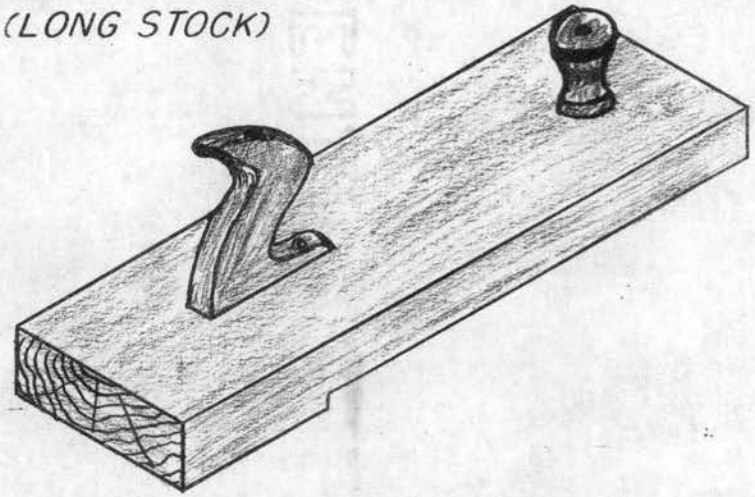
Design and Use. This push block was designed for jointing long stock. By using the handle and the knob, equal pressure may be applied when jointing a board. The push block is an essential item of equipment to use for preventing accidents when using the jointer.

Construction Materials. The push block is made of a piece of pine 1 3/8" x 4" x 16". The handle and knob are the same as those used on a #5 jack plane and they can be purchased from various companies.

Special Recommendations. It is suggested that students be required to use the push block when operating the jointer. The push block may be built by the junior high or senior high school student in his shopwork classes.

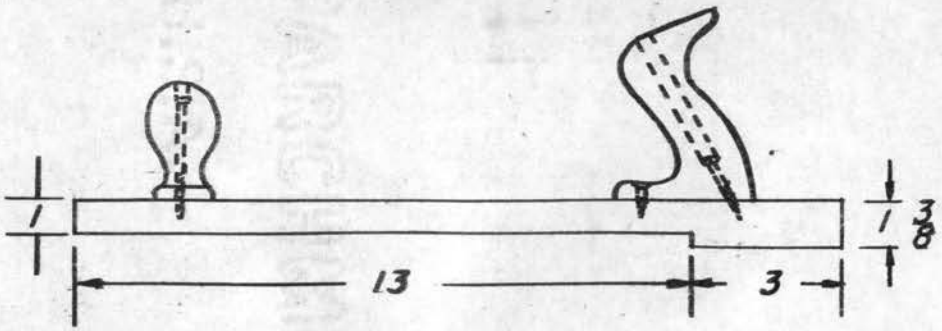
PUSH BLOCK FOR JOINTER
(LONG STOCK)





PUSH BLOCK MADE OF PINE

HANDLE AND KNOB FROM #5 JACK PLANE



Push Block for Jointer (short stock)

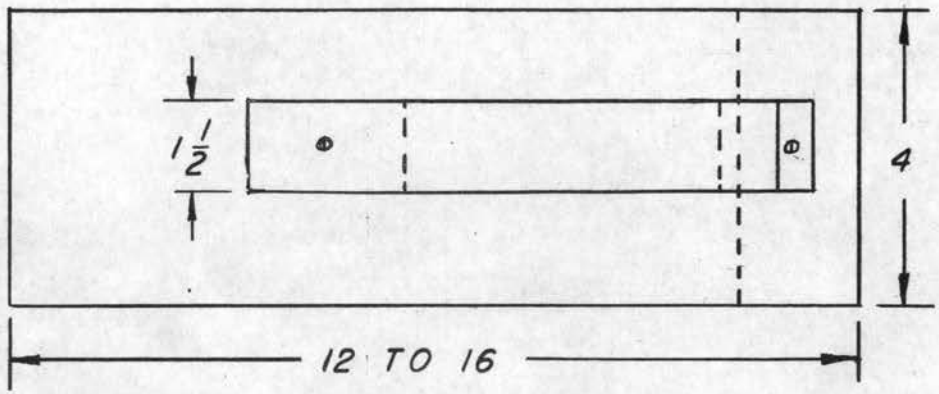
The push block (page 78) that is used when facing short stock differs somewhat from the push block that is used for long stock. The push block serves as a safety device when using the jointer and it should be a part of the standard equipment of the jointer in the school shop.

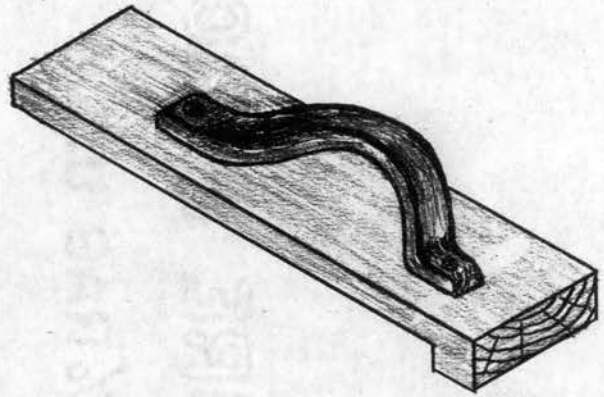
Design and Use. The overall design of the push block for short stock is the same as for long stock. The only difference is that the push block for short stock has one handle. The push block is used to prevent the hands from coming in contact with the knives of the jointer when jointing material.

Construction Materials. The push block should be made of a piece of maple 1" x 4" x 12" to 16". The handle is made of a piece of maple 1 1/2" x 4" x 10" and it is secured to the block with glue and screws.

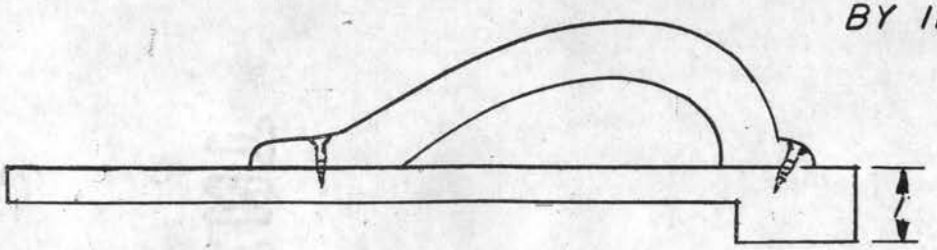
Special Recommendations. It is suggested that the use of the push block be emphasized, by the industrial arts instructor, as a safety factor when using the jointer.

PUSH BLOCK FOR JOINTER
(SHORT STOCK)





HANDLE DESIGN CAN BE ALTERED
BY INSTRUCTOR



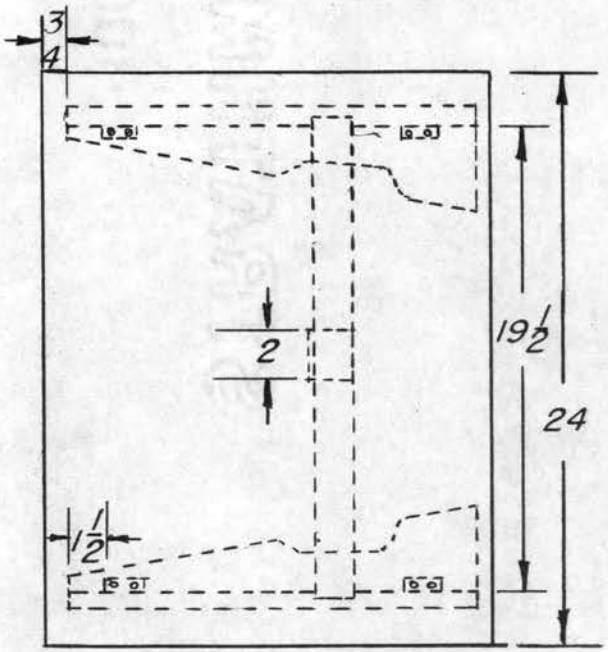
Portable Drawing Board

In many industrial arts installations, separate rooms are not provided for mechanical drawing. In this case, a provision must be made to supply a suitable work station for the student. The portable drawing board (page 80) can be used on a flat top table.

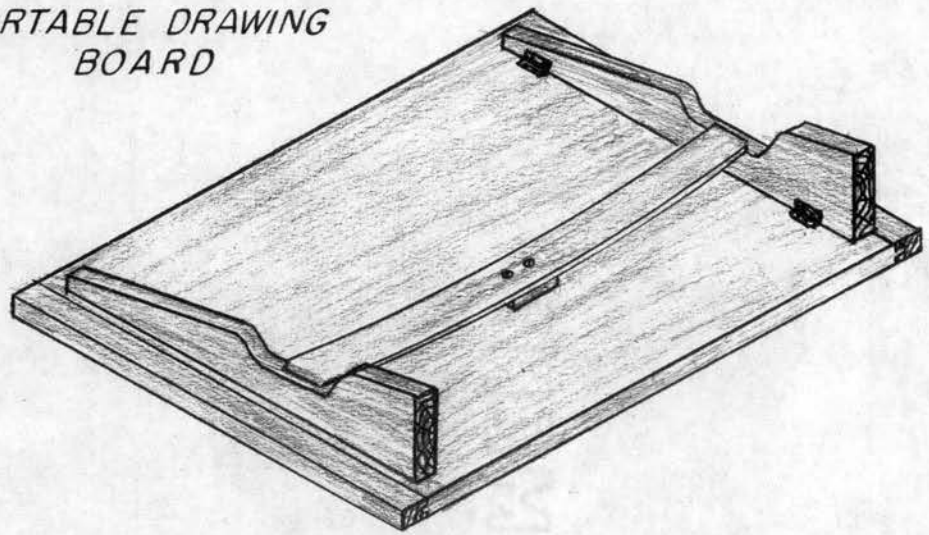
Design and Use. For the school shops that do not have separate drawing rooms, this drawing board is most useful for the students. To the back of the drawing board is attached the two supports to form a base. Aside from forming the base, the supports provide a slanting top much like the standard drawing table. The supports are held in position by a spring formed by a piece of hardwood.

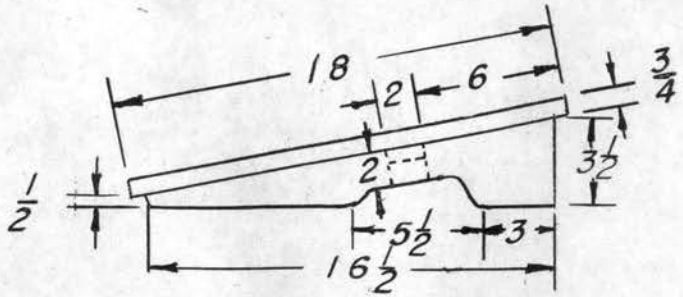
Construction Materials. The material used in the construction of the portable drawing board is usually available in the school shop. The drawing board is made of soft white pine. The supports may be made of any 3/4" material and the spring is made of 1/2" x 1 1/2" hardwood and is secured in place by screws.

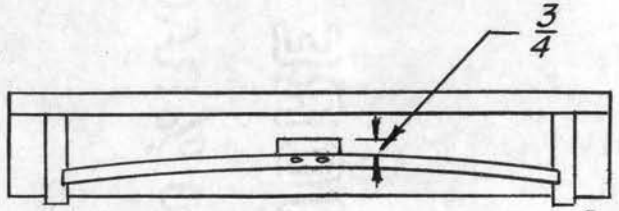
Special Recommendations. It is suggested that the portable drawing board be made by junior high and senior high school students.



PORTABLE DRAWING BOARD







Drawing Table

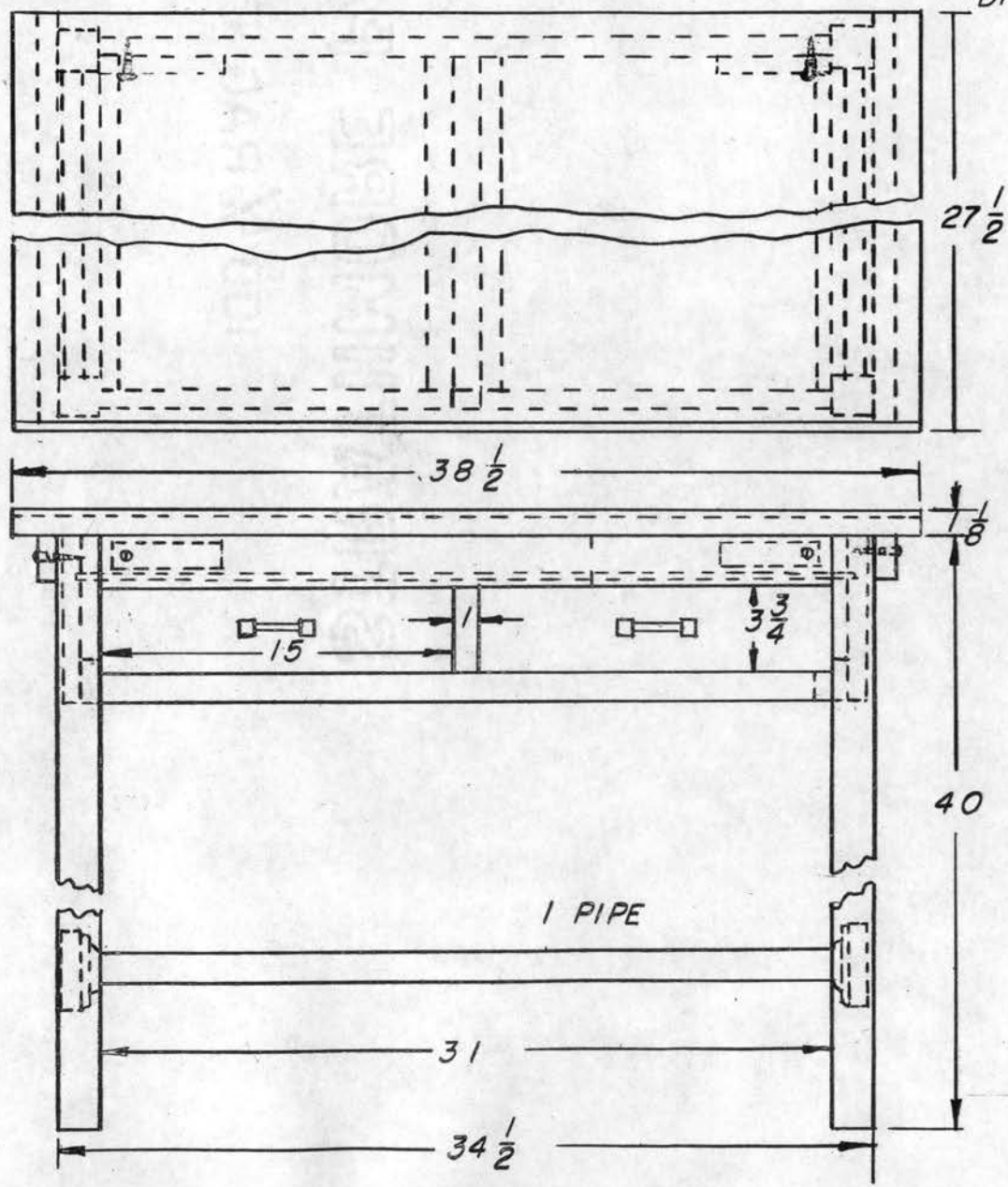
The drafting table (page 82) is the work station of the student learning mechanical drawing. This is the place or area where he will spend the greater part of the period and where he will perform the greater part of his work. With a suitable table upon which to execute the many operations required in mechanical drawing, the student will do much better work.

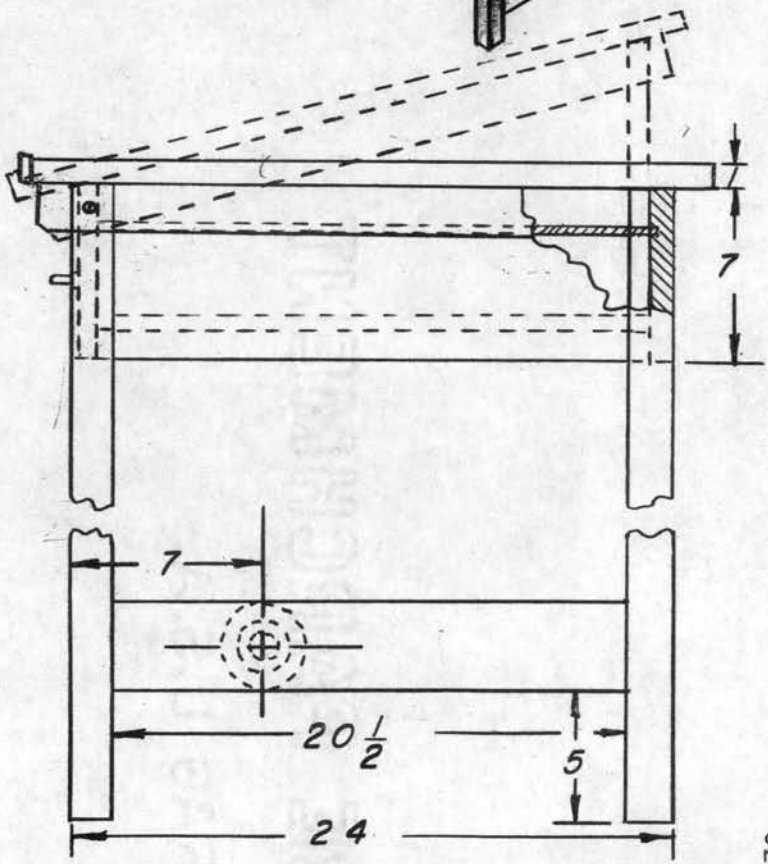
Design and Use. The drafting table is one of the conventional types of table found in the drawing room. It is simple in design and can be used in any industrial arts installation. The slope of the top is regulated by two stops that fold out of sight when not in use and there are two drawers which provides storage of drawing supplies.

Construction Materials. The materials required for the drawing table are usually stocked in the school shop. The legs and rails are made of oak or other hardwood. The 1" pipe brace serves as a foot rest when the student is sitting at the table. Soft white pine is recommended for the construction of the top and care should be taken to insure good joints in the top so as to provide a smooth drawing surface.

Special Recommendations. If a quanity of these tables are needed in the school, it is suggested that they be built in the cabinet shop on a production basis. The table may be constructed in advanced junior high and senior high school shopwork classes.

DRAWING TABLE





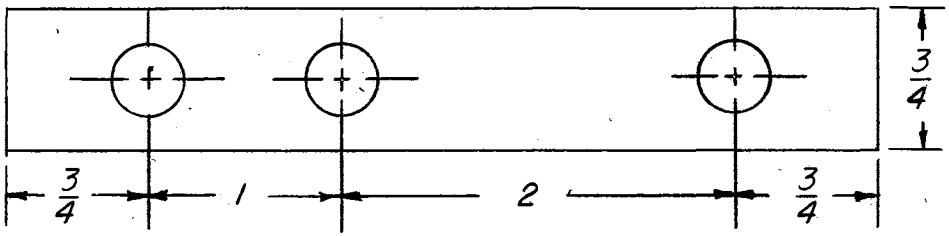
Chalk Holder for Lettering Guidelines

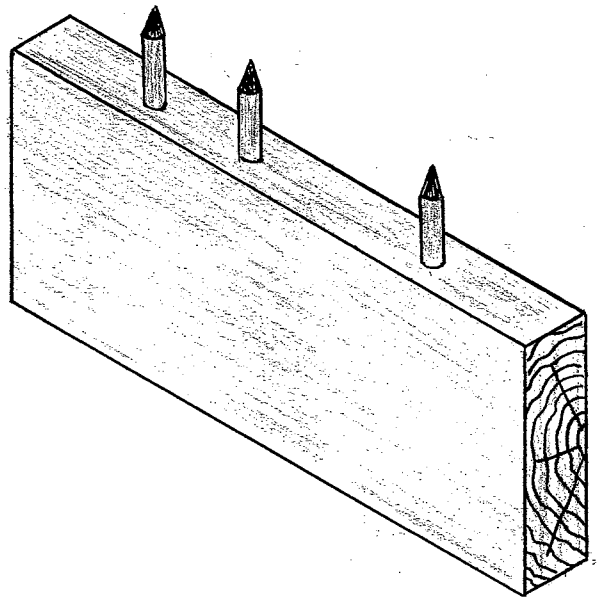
The chalk holder (page 84) serves as a teaching aid in mechanical drawing and is used by the instructor when demonstrating lettering on the blackboard.

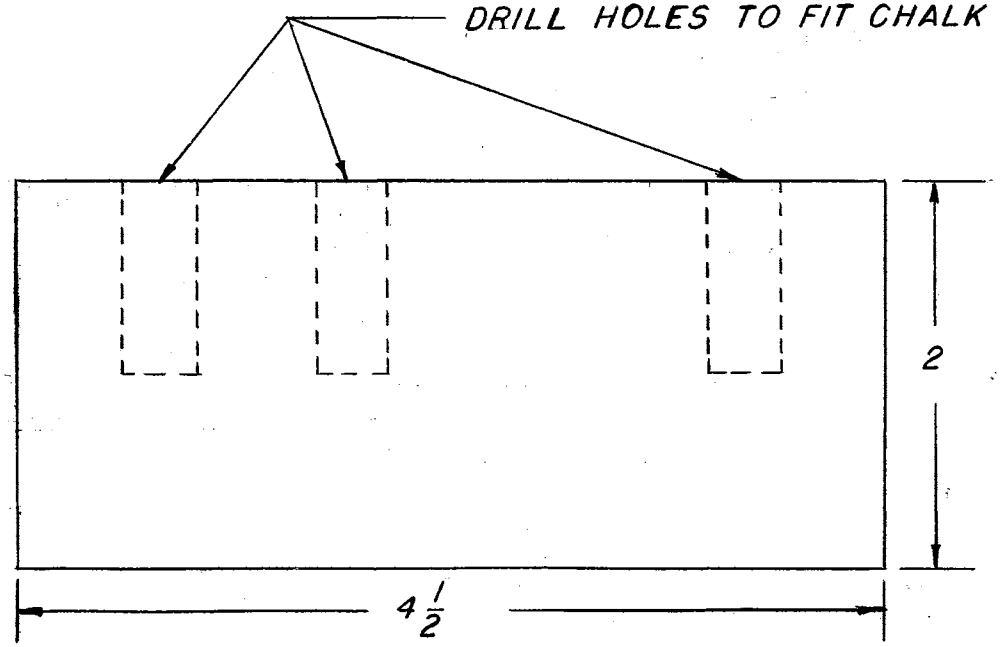
Design and Use. The chalk holder for lettering guidelines was designed for drawing three lines for lettering. Lettering on a blackboard can be performed much easier if guidelines can be followed. This simple device can be used by the instructor to draw the guidelines needed in the demonstration.

Construction Materials. The material required for this device can be found in the scrapbox in most shops. A piece of white pine 3/4" x 2" x 4 1/2" is required for the chalk holder. The holes are drilled to fit the chalk.

CHALK HOLDER FOR LETTERING GUIDELINES







Portable Circular Saw Rack

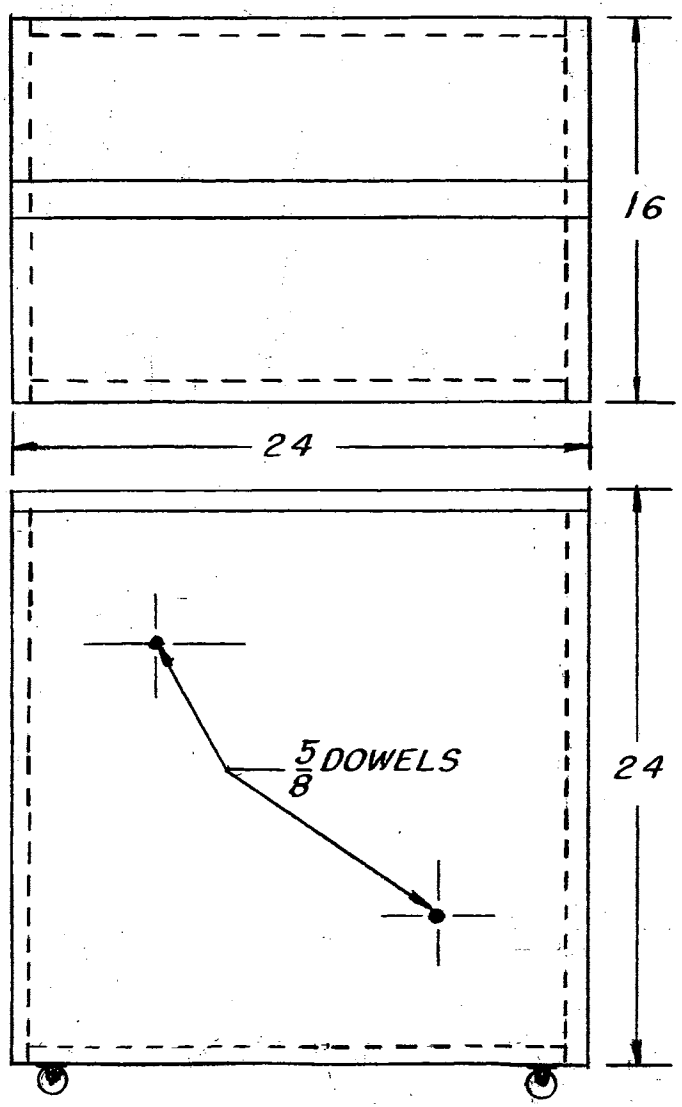
A portable saw rack (page 86) is a suggested method of holding tools and blades that are used on the circular saw. The rack is a convenience that should be included in every industrial arts shop.

Design and Use. The portable saw rack was designed to serve as a tool and saw holder. Tools that are mounted on the tool panel should include a framing square, try square, and a wrench for changing the saw blades. The saw blades are mounted on the panel by using two dowel rods. The size of the dowels are determined by the diameter of the arbor of the saw. Casters are mounted on the bottom of the saw rack to permit moving for cleaning of the floor around the saw.

Construction Materials. The saw rack should be constructed of plywood. The sides are made of two pieces of plywood 3/4" x 24" x 23". The ends are made from two pieces of plywood 3/4" x 14 1/2" x 23" and the bottom is made of a piece of plywood 3/4" x 14 1/2" x 22 1/2". The top rail is made of a piece of maple 3/4" x 1 3/4" x 24". The saw rack is mounted on four 2" casters.

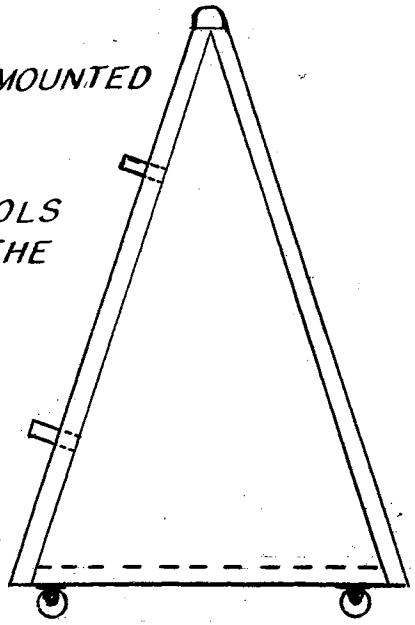
Special Recommendations. The portable saw rack may be made by the students in either the junior high or the senior high school. The tool outlines should be painted on the panel to indicate location of tool.

PORTABLE CIRCULAR SAW RACK



SAW BLADES ARE MOUNTED ON ONE SIDE

WRENCHES AND TOOLS ARE MOUNTED ON THE OTHER SIDE



Dado Head Holder

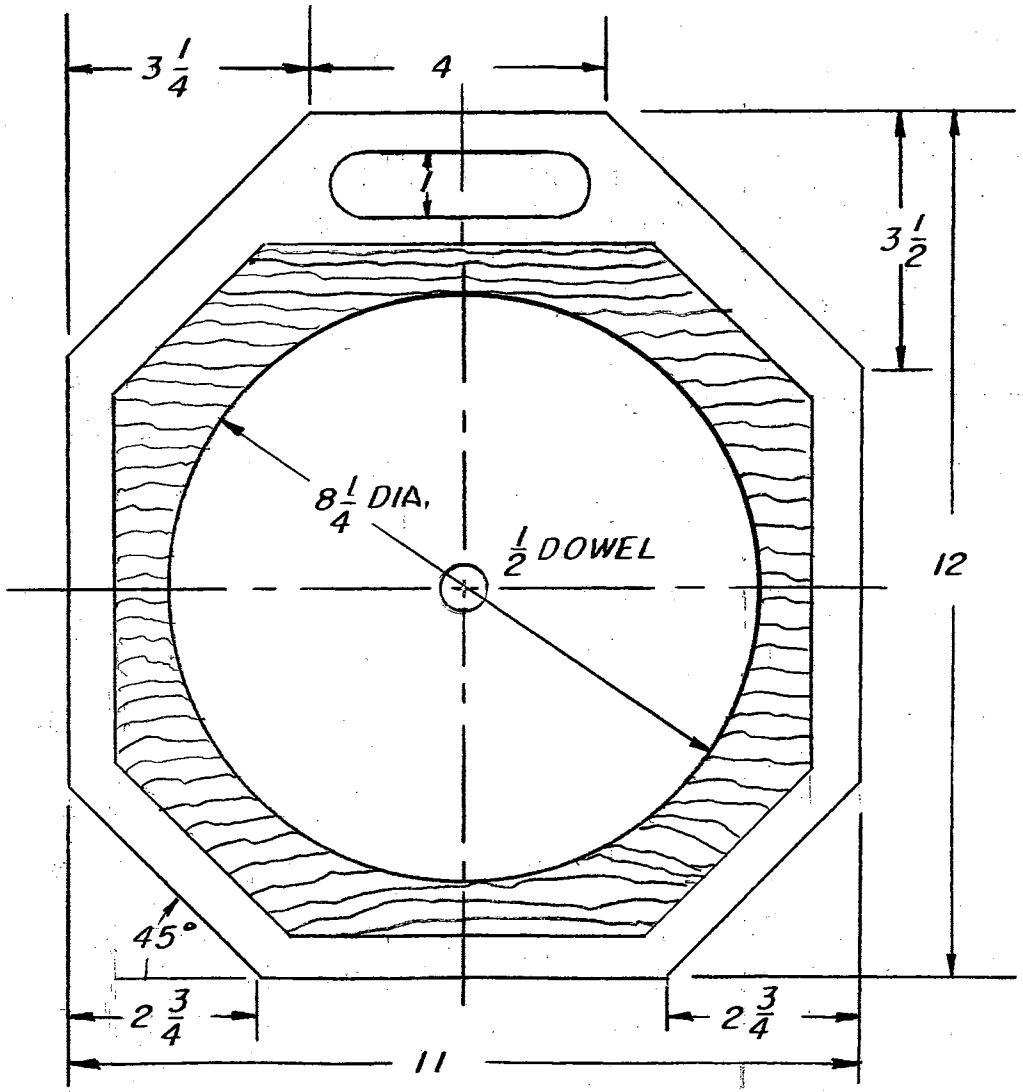
The dado head holder (page 88) is a unique device used for storing dado blades, and it can be built quite readily in the school shop.

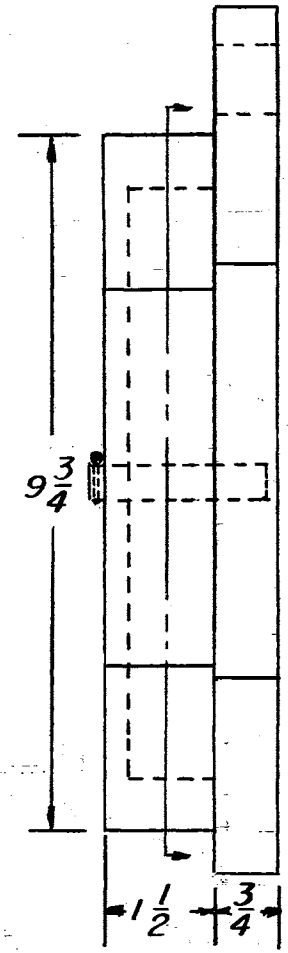
Design and Use. The dado head holder was designed as a carrying case and a storage case for a complete set of 8" dado blades. This holder protects the blades when not in use and prevents any undue damage caused by dropping or careless handling.

Construction Materials. A piece of plywood 3/4" x 11" x 12" is needed for the body of the holder. The cover that protects the dado set is made of a piece of maple 1 1/2" x 9 3/4" x 9 3/4". A wood lathe is needed in making the cover; the block is chucked into the lathe and the space required for the dado set is removed with a lathe chisel. Allowance of 1/4" larger in diameter should be made to provide for easy fitting of the cover over the dado set.

Special Recommendations. It is suggested that the dado head holder be made by students in either junior high or senior high school. The various techniques required in its construction would prove beneficial to all students.

DADO HEAD HOLDER





Jointer Blade Holder

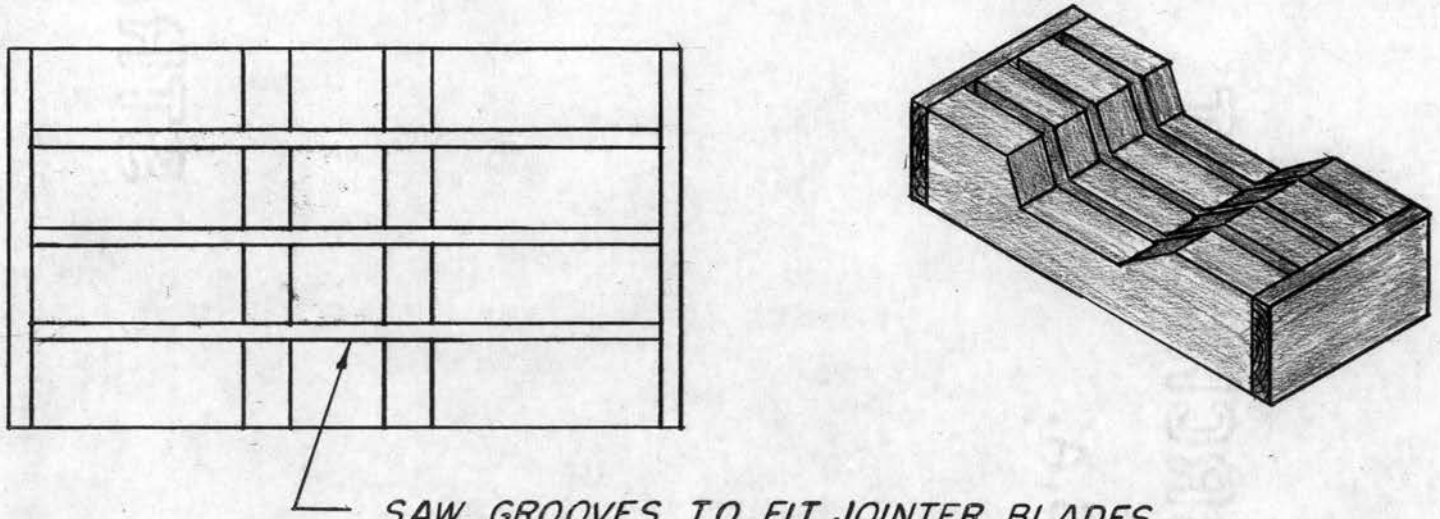
A place in the tool room should be provided for the storage of jointer blades. After the space is provided for, some type of holder should be designed. With this thought in mind, the jointer blade holder (page 90) is suggested.

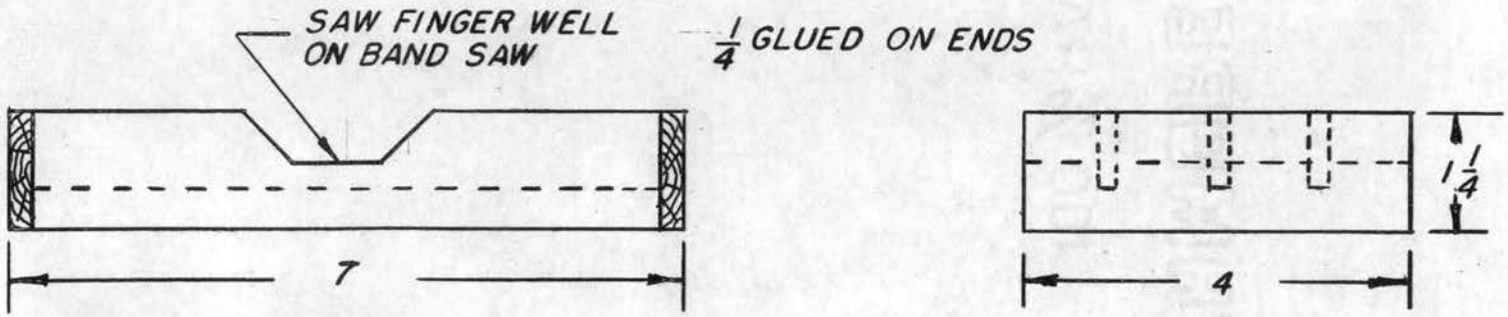
Design and Use. The holder is designed to hold three jointer blades after they have been removed from the jointer head. The holder is used as a storage place for extra sharpened blades, thus, preventing the blades from being chipped while in storage.

Construction Materials. The jointer blade holder can be made from material normally found in the scrap box in the school shop. The body of the holder is made of a piece of pine 1 1/4" x 4" x 6 1/2". The ends are made of two pieces of pine or plywood 1/4" x 1 1/4" x 4" and they are held in place by glue, however, screws may be used.

Special Recommendations. The jointer blade holder may be made by students in either junior high or senior high school shopwork classes. It is suggested that in placing sharpened blades in the holder, the ground edges are placed down.

JOINTER BLADE HOLDER





Band Saw Cutoff Fence

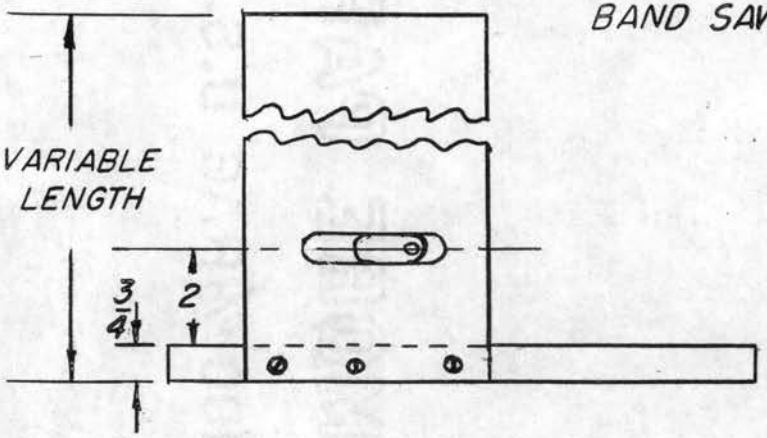
The band saw cutoff fence (page 92) is an inexpensive device for the band saw. The cost of constructing such a device is much less than purchasing a miter gage for the saw.

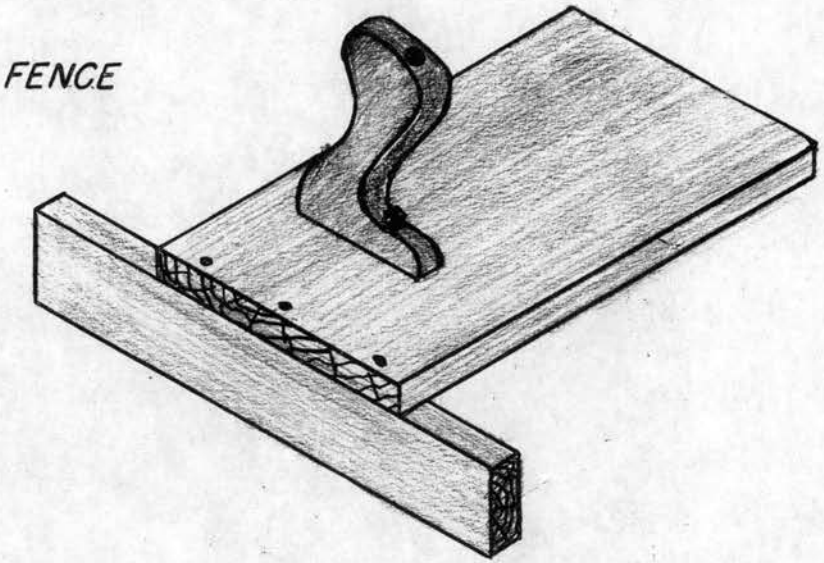
Design and Use. The band saw cutoff fence is designed to be used on the band saw to square the ends of boards, and it can be used as a substitute for a miter gage.

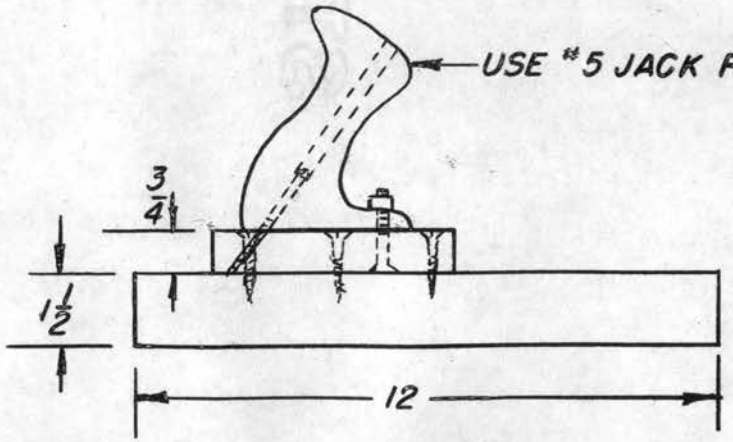
Construction Materials. The guide is made of a piece of hardwood 3/4" x 1 1/2" x 12" and the crossmember is made of a piece of hardwood 3/4" x 6" and the length is determined by the distance of the blade from the edge of the table. A #5 jack plane handle is used on the cutoff fence.

Special Recommendations. It is suggested that the band saw cutoff fence be made by the advanced junior high student.

BAND SAW CUTOFF FENCE







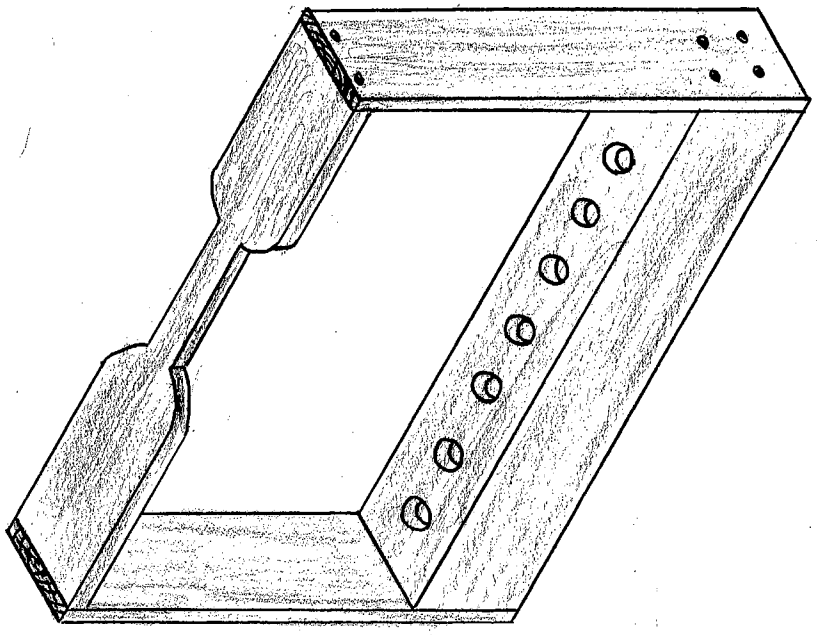
Portable Lathe Tool Rack

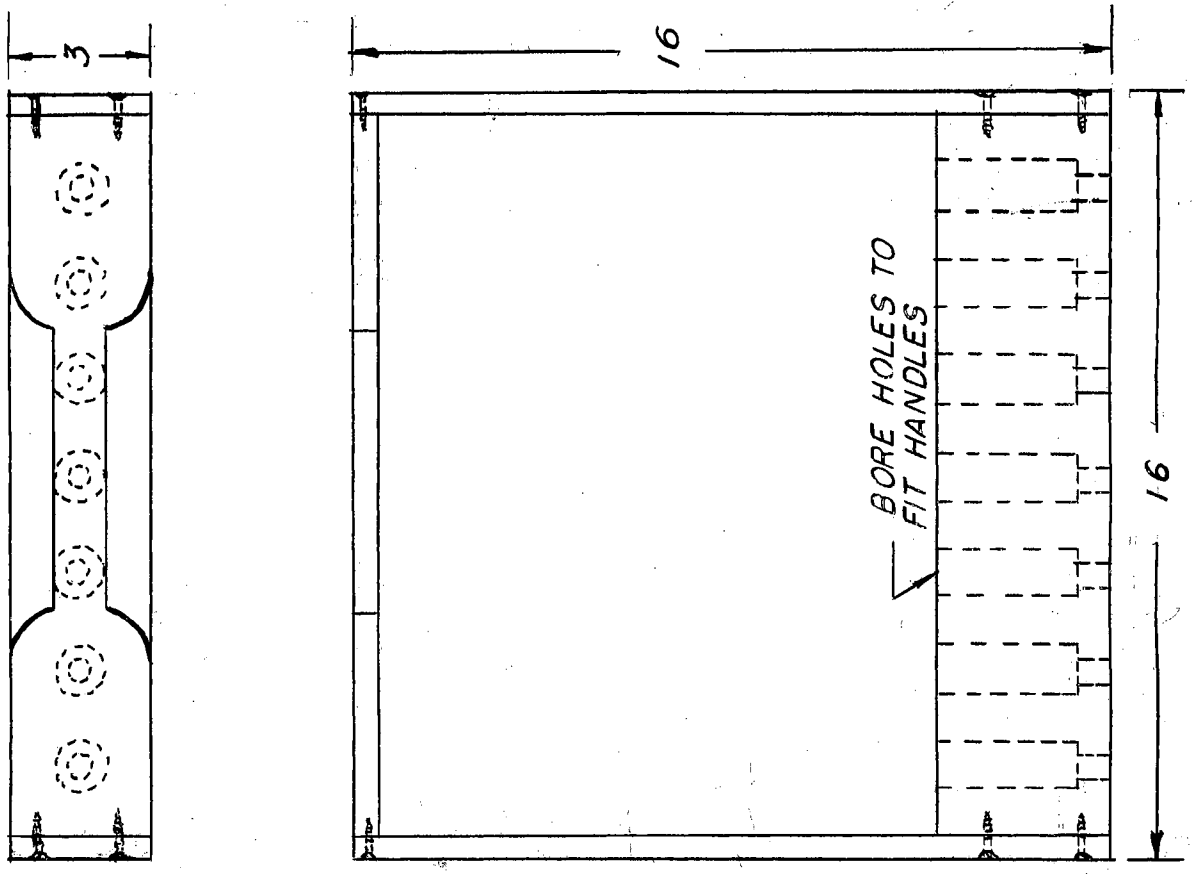
The portable lathe tool rack (page 94) provides for the rapid selection of the lathe tool. The lathe tools are mounted with the cutting edge in view.

Design and Use. The portable lathe tool rack is simple in design and serves as a carrying case for the lathe tools. The sets of tools are kept in this rack and the rack may be stored in the tool room. With this type of rack, a student is assured of receiving a complete set of tools. An advantage of this rack is that holes are bored through the base permitting dust and shavings to fall from the holes bored to fit the handles.

Construction Materials. The base is made of a piece of fir 3" x 4" x 15"; the sides are made of two pieces of pine 1/2" x 3" x 16"; and the handle is made of a piece of pine 1/2" x 3" x 15". Screws are used to secure the sides to the handle and base.

PORTABLE LATHE TOOL RACK





Band Saw Clamp

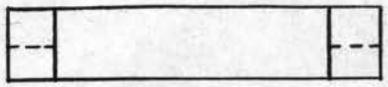
The band saw clamp (page 96) is one of the simplest devices in the school shop and also one of the most essential if band saw brazing or welding is being done. This device warrants construction in the industrial arts shop.

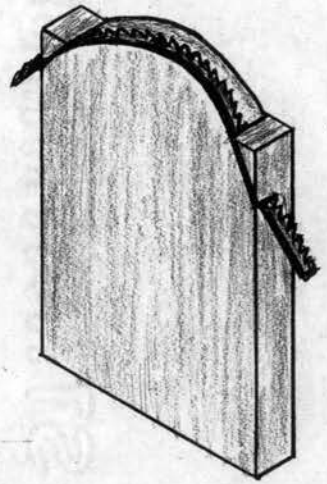
Design and Use. After a band saw blade has been welded, the weld must be filed and in searching for a method of holding the blade, G. I. Kennedy of the Industrial Arts Department, Oklahoma Agricultural and Mechanical College, designed and constructed this band saw blade clamp. When using, the clamp is place in a wood vise and the band saw blade is inserted into the grooves, teeth first. The teeth prevent the blade from moving when the filing begins. The filing should be done parallel with the blade insuring a flat surface when completed.

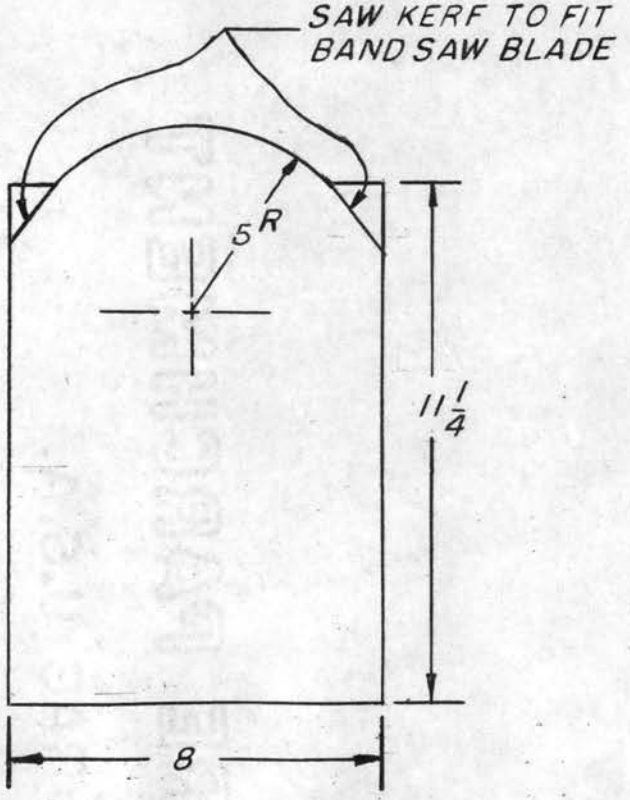
Construction Material. The material required for this device is a piece of maple 1 1/2" x 8" x 12".

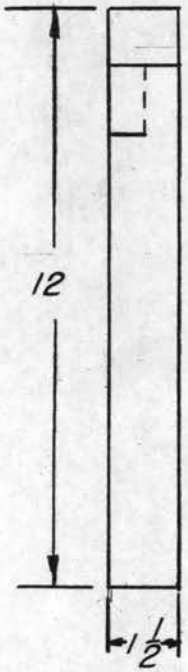
Special Recommendations. It is suggested that the band saw clamp be made and used by students in the shopwork classes. Its simplicity and practicability makes it an ideal improvement for the industrial arts installation.

BAND SAW CLAMP









The drawings of equipment and devices presented in this chapter are only a few of the simple, economical, and usable items that may be constructed by either the students in, or by the instructor of the junior high or senior high school shopwork classes for the improvement of the physical facilities of the school shop. Each item was designed with the purpose of being of use to the student in performing the various manipulative activities in the industrial arts shopwork classes.

The drawings included in this chapter will be used as material for the Seventh Oklahoma State Industrial Arts Clinic.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

From the reading of the title of this thesis, it will be noted that the problem deals with shopbuilt equipment for use in industrial arts installations. This work has been done in an effort to compile material which will assist the industrial arts instructor in improving the physical facilities of the shop and in improving the teaching situation. Assumptions were eliminated and earnest effort was made to provide accurate data. References and quotations used in this study were taken from the most recent books available on the subject. Recommendations are suggested concerning implementation of the findings of this study. In any detailed study, factors are found that cannot be included in the work, but may in turn, make research topics for further study. Recommendations concerning problems for further study will be presented in this chapter.

Summary of Findings of the Study

Industrial arts shopwork, as it is known today, has been developed through the countless influences on manual instruction. Industrial arts as a secondary school subject is recognized by school administrators and it is being offered in more and more public schools every year. Because industrial arts is so widely presented, it is quite logical and necessary that attention be given to conditions or situations improving the field. Factual evidence is needed in order to recommend improvements in its methods and materials. It is observed by the writer that methods practiced in presenting the material in industrial arts subjects are as varied as the number of instructors. Very few attempts have been made

to establish the superiority of any given method or procedure. Since industrial arts teachers are attempting to prepare their shopwork students to take their place or to function adequately in society, they will fail in their duty if they do not investigate all of the possible questions relating to worthwhile subject matter and organization.

The shopwork classes should be so arranged and organized as to provide the student with activities in which he is interested, and if this is not accomplished, the program will suffer considerably. The shop instructor should soon discover the techniques required to have a successful program. Exploitation of the students in the industrial arts shops is to be avoided and too many teachers fail to realize this important fact.

Equipment required in the industrial arts installation is expensive and through proper supervision the instructor or students may construct effective devices which are simple and inexpensive. The advantage of student-built equipment is that the student may participate actively in the shop improvement plan. Drawings of items of equipment have been presented in this study to serve as an aid in shop improvement, and most of all, as an aid to the teaching situation.

Recommendations Concerning Implementation of the Findings of the Study

After making the study of shopbuilt equipment for use in industrial arts installations, the following recommendations are presented.

The curriculum offered in industrial arts should meet the needs and interests of the students in shopwork classes. In the school system where one industrial arts teacher is employed to teach shopwork, the general shop should be adapted to the curriculum. It offers a wide

variety of experiences with methods, processes, and materials which are particularly valuable to the students. In the larger schools in which two or more teachers are employed, comprehensive shops should be provided.

Adequate working space should be provided for the student in the industrial arts shop. Elroy W. Bollinger recommends that at least seventy-five feet of floor space should be provided for each student. There should be two workstations provided in the general shop for every student enrolled in the course.

Instructors of industrial arts shopwork should be constantly on the lookout for new techniques, teaching aids, and equipment which will increase their ability to teach, understandingly, the knowledge and skill to their students.

Equipment and devices which help in the improvement of the physical facilities in the school shop may be built by the students if it does not impose hardships on them. The students should not be denied the priviledge of working on their own projects.

Recommendations Concerning Problems for Further Study

A thesis of this type cannot be written without an awareness of the many problems that would suggest further study. The problems which the writer believes would be most helpful and beneficial to the field of industrial arts are as follows:

Visual Aids: Their Construction in the School Shop. This would be an interesting study and it would be beneficial to industrial arts teachers. Analyses and drawings should be made of the visual aids that may be constructed in junior high and senior high school shopwork classes.

Exploitation of Students in the School Shop. This study could present the complications that might arise if this situation occurs in the school shop, also reasons why such practices should not be used by the instructor. This would be beneficial to the industrial arts teacher as well as to the industrial arts department.

General Shop Offerings in Oklahoma Schools. The survey technique could be used in the solution of this problem. The results would indicate the different industrial arts subjects offered in the general shop. This would be of value to prospective teachers of industrial arts as to the major field of their college work as well as to college industrial arts departments.

A SELECTED BIBLIOGRAPHY

1. Anderson, L. F., History of Manual and Industrial School Education, D. Appleton and Company, New York, 1926, 251 pages.

2. Bawden and Others, Industrial Arts in Modern Education, The Manual Arts Press, Peoria, Illinois, 1934, 168 pages.

3. Bawden, William T., Leaders in Industrial Education, The Bruce Publishing Company, Milwaukee, Wisconsin, 1950, 196 pages.

4. Bennett, Charles A., History of Manual and Industrial Education 1870 to 1917, Charles A. Bennett Company, Inc., Peoria, Illinois, 1937, 566 pages.

5. Bonser, Frederick G., Industrial Arts for Public School Administrators, Bureau of Publication, Teachers College, Columbia University, New York, 1930, 95 pages.

6. Ericson, Emanuel E., Teaching the Industrial Arts, The Manual Arts Press, Peoria, Illinois, 1946, 384 pages.

7. Federal Security Agency, Office of Education, Digest of Annual Reports of State Boards for Vocational Education, Washington D. C., 1949, 74 pages.

8. Federal Security Agency, Office of Education, Offerings and Enrollment in High-School Subjects, Washington D. C., 1951, 118 pages.

9. Friese, John F., Course Making in Industrial Education, The Manual Arts Press, Peoria, Illinois, 1946, 297 pages.

10. Friese, John F., Exploring the Manual Arts, The Century Company, New York, 1926, 412 pages.

11. Good, Carter V., Dictionary of Education, McGraw-Hill Book Company, Inc., New York, 1945, 495 pages.

12. Karch, R. Randolph and Estabrook, Edward C., 250 Teaching Techniques, The Bruce Publishing Company, 1943, 131 pages.

13. Leavitt, Frank M., Examples of Industrial Education, Ginn and Company, Boston, 1912, 330 pages.

14. McCarthy, John A., Vocational Education: America's Greatest Resource, American Technical Society, Chicago, Illinois, 1950, 397 pages.

15. Newkirk, Louis V., Organizing and Teaching the General Shop, The Manual Arts Press, Peoria, Illinois, 1947, 200 pages.

16. Newkirk, Louis V., and Johnson, William H., The Industrial Arts Program, The Macmillan Company, New York, 1948, 357 pages.

17. Newkirk, Louis V., and Stoddard, George D., The General Shop, The Manual Arts Press, Peoria, Illinois, 1929, 190 pages.

18. Selvidge, R. W., and Fryklund, Verne C., Principles of Trade and Industrial Teaching, The Manual Arts Press, Peoria, Illinois, 1946, 395 pages.

19. Struck, F. Theodore, Creative Teaching, John Wiley and Sons, Inc., New York, 1938, 623 pages.

20. Struck, F. Theodore, Vocational Education for A Changing World, John Wiley and Sons, Inc., New York, 1945, 550 pages.

21. United States Department of Interior, Office of Education, Industrial Arts Its Interpretation in American Schools, Bulletin No. 34, 1937, 125 pages.

22. University of the State of New York, Shop Safety Education, State Education Department, Albany, New York, 1949, 319 pages. Order from Delmar Publishers, Inc., 650 Broadway, Albany 7, New York.

23. Varnum, William H., Industrial Arts Design, The Manual Arts Press, Peoria, Illinois, 1948, 248 pages.

24. Vaughn, Samuel J., and Mays, Arthur B., Contents and Methods of Teaching the Industrial Arts, The Century Company, New York, 1924, 397 pages.

25. Weaver, Gilbert G., and Bollinger, Elroy W., Visual Aids, D. Van Nostrand Company Inc., New York, 1949, 388 pages.

26. Wilber, Gordon O., Industrial Arts in General Education, International Textbook Company, Scranton, Pennsylvania, 1948, 362 pages.

THESIS TITLE: SHOPBUILT EQUIPMENT FOR USE IN INDUSTRIAL ARTS INSTALLATIONS

NAME OF AUTHOR: Kenneth Glen Ekstrom

THESIS ADVISER: DeWitt Hunt

The content and form have been checked and approved by the author and thesis adviser. "Instructions for Typing and Arranging the Thesis" are available in the Graduate School office. Changes or corrections in the thesis are not made by the Graduate School office or by any committee. The copies are sent to the bindery just as they are approved by the author and faculty adviser.

NAME OF TYPIST: Zola Mae Ekstrom