

PURCHASING PHYSICAL EQUIPMENT

FOR

THE WOODWORKING SHOP SAFETY PROGRAM

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PURCHASING PHYSICAL EQUIPMENT  
FOR  
THE WOODWORKING SHOP SAFETY PROGRAM

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CHAPTER I

INTRODUCTION OF PROBLEM

It is the duty of every one to protect himself and those associated with him from accidents which may result in injury or death. Abraham Lincoln

A survey of records on accidental deaths and injuries in the United States is sufficient within itself to necessitate a complete study of the safety measures which can be practiced in the high school shop.

According to a survey by Samuel F. Hall on the accident records of public schools, it was found that there was a total absence of 2,160,000 pupil days during one year because of accidents.<sup>1</sup>

All accidents do not occur in the shop. The gymnasium with 35 per cent presents the highest percentage of accidents which occur to school children; accidents on stairs rank second with 20 per cent while the shop shows 14 per cent of all accidents. The following statement is quoted from a recent copy of Accident Facts, the annual statistical

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<sup>1</sup> Samuel F. Hall, "Safety in the School Shop," Industrial Arts and Vocational Education, 33:3, March, 1944.



bulletin from National Safety Council: "The influence of the vocational shop and the gymnasium on the accident rate is indicated by the sudden jump in the rate from the sixth to the seventh grade, which rose from 1.5 to 3.5. Further advance to 4.7 in the tenth grade and 5.4 in the eleventh indicates an increase in exposure to accidents."

Increasing demands for the use of safety equipment and safe operating practices became greater during the war years than ever before. The increased demand for rapid production brought about this change in attitude toward safety in the industrial plants. Any accident which constituted a loss of manpower was a loss to industry. Industrial leaders found that accidents could be partially prevented through a widespread safety program.

Manufacturers of power machinery are beginning to respond to the urge for greater safety. They are employing safety engineers who are constantly seeking new and better ways of safeguarding machinery. All these developments cast an interesting light on safety activities.

Origin of the Problem: All machine shops, vocational shops and high school shops do not have the same safety rules. The type of industry or shop will indicate the strictness or rigidity of the safety program.

Statistics compiled by officials in the National Safety Council<sup>2</sup> show that woodworking accidents ranked twenty-third

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<sup>2</sup> National Safety Council, Accident Facts, 1943 Edition. Chicago, Illinois.

on the list of accidents reported in 1942. These statistics were gathered from 99 reporting industries. The small home shop, hobby or craft centers and small woodworking business firms were not included. It is here that safety men encounter their greatest problem.

It is hard to impress on the owners and employees of small organizations the need for safety. To them, production and profits are considered before safety. Shults<sup>3</sup> attributes the high percentage of accidents in small shops to the following reasons:

1. Few such shops can afford to buy the best machines, and will not purchase guards which are furnished only at extra cost.
2. It is difficult to reach and impress the owners of such shops with the need for safety programs.
3. Their paid operators in particular often are not trained on guarded machines and disdain the use of safety equipment.
4. Owners and workers alike believe the use of guards limits production.

The Problem: The subject, Purchasing Physical Equipment for the Woodworking Shop Safety Program, has been selected for this study. Many studies have been made on the safety problem, but none have discussed the problem of purchasing the physical equipment needed to promote a safety program for the woodworking shop. This study includes the gathering of information about shop accidents and suggesting physical

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<sup>3</sup> Shults, Chauncey Smithey, An Analysis of Safety Guards on Woodworking Machinery, Master's Thesis, Oklahoma Agricultural and Mechanical College, 1947, page 3.

equipment which may be purchased to help prevent these accidents. Physical equipment discussed includes machine guards, personal protective equipment and visual aids. Special emphasis has been placed on the needs of the high school woodworking shop.

Need for Study: The study of the safety problem covers the safety programs used in industrial plants, vocational shops and high school shops. Industrial leaders, employees, school instructors and pupils need to know the advantages of using the safety equipment made available by the manufacturers. If all available safety equipment is used for a specified operation, it can be stated with assurance that all accidents can be prevented.

Similar Studies: Many studies have been made on the subject of safe operations of shop machinery. However, none of these deal directly with an analysis of physical safety equipment.

A report by Ade<sup>4</sup> stresses safe shop practices and safe operations of machines. Shults<sup>5</sup> has made an extensive study of safeguards for woodworking machines used in the high school shop. His study deals with existing guards and recommendations for better guards. Heinrich<sup>6</sup> has made a study of

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<sup>4</sup> Lester K. Ade, Safety Education in Industrial School Shops, Bulletin 332, Pennsylvania Department of Public Instruction, 1938.

<sup>5</sup> Shults, Op. Cit., page 3.

<sup>6</sup> H. W. Heinrich, Industrial and Accident Prevention, page 145.



accident prevention which stresses industrial accidents and educating the management in further accident prevention. The National Safety Council<sup>7</sup> has issued a study dealing with accident prevention and safety equipment. Detailed information is given on how to use all safety materials and on means of educating the employer and employee in the need of accident prevention.

Portions of pamphlets published by the National Safety Council,<sup>8</sup> The American Standards Association,<sup>9</sup> and United States Department of Labor<sup>10</sup> contain detailed information which pertains to this study.

Other studies which are generally related to this study include a magazine article by Joseph Murri<sup>11</sup> on safety regulations for the school shop. A new machine guard is discussed in an article written by G. Harold Billingham.<sup>12</sup>

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<sup>7</sup> Accident Prevention Manual for Industrial Operations, Chicago, Illinois, 1946.

<sup>8</sup> Woodworking Machinery and Equipment, Safe Practices Pamphlet Number 20, National Safety Council, Chicago, Illinois.

<sup>9</sup> American Standard Safety Code for Woodworking Machinery, American Standards Association, Approved February, 1944.

<sup>10</sup> United States Department of Labor Statistics, Department of Labor, Bulletin 67, Safety Subjects, 1944.

<sup>11</sup> Joseph Murri, "Safety Provisions and Regulations For School Shops." Industrial Arts and Vocational Education, 34:131, March, 1945.

<sup>12</sup> G. Harold Billingham, "Band Saw Guard," Industrial Arts and Vocational Education, 37:207, May, 1948.

Available Literature: Literature used in making this study includes books, pamphlets, magazines and manufacturers' catalogues. Illustrated sales literature furnished the basis for comparing products now available to the willing purchaser. A wealth of information on the safety problem can be obtained from periodicals such as National Safety News, School Equipment News and Industrial Arts and Vocational Education Magazine.

Delimitations: This study is concerned primarily with physical safety equipment for the school woodworking shop. The machines discussed are those typical of the school shops. Large factory equipment is not discussed extensively.

This study concerns itself with personal protective equipment, visual aids and guards for the circular saw, band saw, surfacer, shaper, jointer, and tool grinder.

Conclusions: The demand for greater safety in all types of shops is increasing. Consumer demand is responsible for motivating further advancement in the field of safety.

Machine manufacturers are beginning to accept the safety codes and whenever possible are incorporating guards in their machinery. If not practical to have a built-in guard, separately installed guards should be furnished as standard equipment. The practice of furnishing guards as extra equipment at additional cost should be discouraged.

Industries and small shops alike are beginning to see the advantages of personal protective equipment and visual



aids in their safety programs. These, incorporated with the better guarded machinery, should greatly decrease the number of accidental injuries.

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## CHAPTER II

### ACCIDENTS IN WOODWORKING PLANTS AND NEED FOR SAFETY GUARDS

An accident is an unexpected occurrence. The term "accidental injury" is used when a human injury is involved. The severity and frequency of accidents vary with the type of work done and the machine used. Plant safety measures play an important part in controlling frequency with which accidents occur. Statistical data available are based on compensated accident injury reports. A report of woodworking machine injuries for the State of New York<sup>1</sup> shows 5,235 injuries reported. Of these injuries, 28 resulted in death or total disability.

#### A. Causes of Accidents

Accidental injury is not the result of a single factor, but is the result of a sequence of factors. Behind every injury there is either an unsafe act on the part of the operator or a mechanical defect. Accident causes may be divided into three groups:

1. Mechanical and Material Faults: This refers to unguarded machinery, a tool in disrepair, protruding nails, etc.

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<sup>1</sup> United States Bureau of Labor Statistics, Department of Labor, Bulletin No. 67, Safety Subjects, 1944.

2. Unsafe Acts of Persons: The wearing of loose clothing around machinery, improper use of the tool, disregard of safety rules and many other unsafe acts cause a great number of injuries. The use of machines prior to specific instruction is probably one of the commonest of unsafe acts.

3. Reasons for Those Faults or Unsafe Acts: Fatigue, improper installation of equipment, and inattention are a few reasons behind the unsafe acts and mechanical faults which result in injury.

Heinrich<sup>2</sup> gives the following classifications as basic causes of accidents:

#### Personal Faults

##### Faulty instruction:

1. None.
2. Incompleted.
3. Not enforced.
4. Erroneous.

##### Inability of employee:

1. Inexperience.
2. Unskilled.
3. Ignorant.
4. Poor judgment.

##### Poor discipline:

1. Disobedience of rules.
2. Interference by others.
3. Fooling.

##### Lack of concentration:

1. Attention distracted.
2. Inattention.

##### Unsafe Practice:

1. Chance taking.
2. Short cuts.
3. Haste.

##### Mentally unfit:

1. Sluggish or fatigued.
2. Violent temper.
3. Excitability.

##### Physically unfit:

1. Defective.
2. Fatigued.
3. Weak.

#### Mechanical and Material Faults

##### Physical hazards:

1. Include mechanical, electrical, steam, chemical conditions, etc.:

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<sup>2</sup> Heinrich, H. W., Industrial Accident Prevention  
McGraw-Hill, pages 104-110.



- a. Ineffectively guarded.
- b. Unguarded.
- c. Unsafe design.

Poor housekeeping:

- 1. Improperly piled or stored materials
- 2. Congestion.

Improper working conditions:

- 1. Ventilation.
- 2. Sanitation.
- 3. Light.

Defective equipment:

- 1. Miscellaneous materials and equipment.
- 2. Tools.
- 3. Machines.

Improper planning:

- 1. Layout of operation.
- 2. Layout of machinery.
- 3. Unsafe processes.

Unsafe building conditions:

- 1. Fire protection.
- 2. Exits.
- 3. Floors.
- 4. Openings.
- 5. Miscellaneous.

Improper dress or apparel

- 1. No goggles, gloves, masks, etc.
- 2. Unsuitable, long sleeves, high heels, defective, etc.

Behind nearly every case of accidental injury can be found both a physical fault and a personal cause. After carefully studying the causes as listed above, it is obvious that many accidents could be prevented with a little forethought. If the physical hazards such as improper working conditions were removed, perhaps that would eliminate such personal faults as fatigue and inattention. Therefore, the sensible thing to do is to reduce physical hazards by every possible means and then make every effort to eliminate personal faults.

## B. Necessity of Guards

Studies of accidents have been made to a ratio between accidents chargeable to physical hazards and those chargeable to unsafe acts. The ratio developed is usually quoted as 15 to 85 per cent. The human element is considered 85 per cent

of the accident problem while physical hazards constitutes the remaining 15 per cent.

This generally accepted ratio is harmful in many respects. The attitude of taking care of the 85 per cent first and letting the 15 per cent take care of itself has received widespread acceptance especially by the "not-yet" safety-minded employer. He does not realize that the concentration required to dodge the hazards of an unguarded machine will lessen the worker's efficiency.

Much progress has been made in safeguarding machinery. To guard a machine adequately we must consider two things: (1) guarding the transmission machinery and (2) guarding the point-of-operation.

1. Guarding the Transmission Machinery: To guard the transmission machinery means to enclose all moving parts which carry the power from its source to the machine. This includes cables, motors, belts, gears, and other apparatus which cause the machine to function. These guards, usually made of metal, should be substantially constructed and firmly installed. Mesh or perforated metal is sometimes used. These guards should have no sharp edges and should not cause tripping. Transmission machinery guards should be arranged so as not to interfere with oiling, adjusting or controlling the machine.

2. Point-of-Operation Guarding: The point or area in which the cut is made, is called the point-of-operation.



Positive guarding at the point-of-operation should be relied upon to prevent accidents rather than the operator's consistent obedience to safety rules. Every effort should be made to make the guard so effective that the operator can not cause an accident. Whenever possible, the guard should be built into the machine. The point-of-operation is much more difficult to guard than the power transmission apparatus.

Many unsafe conditions can be and are being eliminated in the layout of new plants and shops. The newer and modern machines are being equipped with guards by the manufacturer. The older machines can be guarded by purchasing commercial guards or designing one for reasonable safety.

Point-of-operation guards are installed on those parts of machines where cutting, shaping or forming is performed, or at points where there is danger to the operators inserting or manipulating the stock in the machines. In order to be most efficient, these guards should protect the operator from the moving machinery and moving materials.

Not all positive guarding of points-of-operation provide 100 per cent protection. The type of guard needed varies with the machine in use and the type of operation performed.

The following types of safe positive guards may be used to a great advantage: (1) mechanical feeding and ejecting devices, enclosed guards, sweep guards, stroke limitations, and others are used to control the hazards of power machine operations, (2) two-hand control devices and (3) interlocking devices are sometimes used. (See Table I)

TABLE I GUARDS--POINTS OF OPERATION<sup>3</sup>

Type of guarding method	Action of guard	Advantages	Limitation	Typical machines on which used
Automatic or semi-automatic feed (with enclosure of danger points)	Stock fed by chutes, hoppers conveyors, movable dies, deal feed rolls, etc. Enclosure will not admit any part of body.	(a) Generally increases production. (b) Operator can not place hands in danger zone.	(a) Excessive installation cost for short run. (b) Requires skilled maintenance. (c) Not adaptable to variations in stock.	Baking and candy machines Circular saws Punch pressed Textile pickers Wood planers Wood shapers
Enclosures or barriers Warning enclosures (usually adjustable to stock being fed)	Barrier or enclosure admits the operator's hand, but warns him before danger zone is reached.	(a) Makes "hard to guard" machines safer. (b) Generally does not interfere with production. (c) Easy to install. (d) Admits varying sizes of stock.	(a) Hands may enter danger point-- enclosure not complete at all times. (b) Danger of operator not using guard. (c) Often requires frequent adjustment and careful maintenance.	Band saws Circular saws Cloth cutters Dough brakes Ice crushers Jointers Leather strippers Rock crushers Wood shapers

TABLE I (continued)

Type of guarding method	Action of guard	Advantages	Limitation	Typical machines on which used
Special Jigs and feeding devices	Hand operated feeding devices of metal or wood which keep the operator's hands at a safe distance from the danger point.	(a) May speed production as well as safeguard machines. (b) Generally economical for long jobs.	(a) Machine itself not guarded; safe operation depends upon correct use of device (b) Requires good employee training and close supervision. (c) Suitable for limited types of work.	Circular saws Dough brakes Jointers Meat grinders Paper cutters Punch presses

<sup>3</sup> This is a portion of the table on "Guards--points of operation" Accident Prevention Manual for Industrial Operations, National Safety Council, Chicago, Ill. Pages 122-124.



### C. Materials and Construction

After the need for a guard has been established, it is necessary to secure the best design, the finest materials and the safest construction available. Since all states do not use a uniform safety code, it is advisable to follow the American Standard Codes in making up guards. Generally speaking, a guard should have many of the following characteristics:<sup>4</sup>

1. Provide positive protection.
2. Prevent all access to the danger zone during operations.
3. Cause the operator no discomfort nor inconvenience.
4. Not interfere with production.
5. Operate automatically or with minimum effort.
6. Be designed for the job and the machine.
7. Preferably be a built-in feature.
8. Provide for machine oiling, inspection, adjustment and repair.
9. Withstand long use with minimum maintenance.
10. Resist normal wear and shock.
11. Be durable, fire and corrosion resistant, and easily repaired.
12. Not constitute a hazard itself (without splinters, sharp corners, rough edges, or other sources of injury).
13. Protect against any contingency, not merely against normal operation.

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<sup>4</sup> Accident Prevention Manual for Industrial Operations, National Safety Council, Chicago, Ill., page 117.

14. Conform with the provisions of the American Standards Association Codes. —

Materials used in constructing guards are sheet metal, perforated metal, expanded metal, metal guards of bar stock and heavy wire mesh. Some wooden guards are also used. Plastic guards are coming into use where inspection of the moving parts of the machine is necessary. Aluminum and soft metals are used when resistance to rust is an important factor. (See Table II for materials and dimensions of guards.)

#### D. General Rules for the Worker and Student

A well designed, well constructed and maintained guard will not prevent accidents if the worker does not understand the operation of such guard. Every worker or student should be carefully instructed in the function and value of the guards on his machine. Basic instructions with which every machine operator should be familiar are listed here:<sup>5</sup>

1. Remove the guards only as necessary and as authorized for adjustment, oiling, repairs or setting up new jobs. Replace the guards promptly.
2. Do not operate the machine unless the guard is in place, in good condition and in perfect working order.
3. Gloves, necklaces, neckties and loose clothing should not be worn around moving machinery or moving guards.
4. Stop the machine before oiling, adjusting, repairing moving parts. Never attempt to oil a machine through the guard unless the guard has been designed for that purpose.
5. Lock and tag machines under repair or adjustment so they can not be started accidentally.
6. If it is necessary for more than one person to work on a

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<sup>5</sup> Accident Prevention Manual for Industrial Operations, National Safety Council, Chicago, Ill., page 121.



TABLE II STANDARD MATERIALS AND DIMENSIONS FOR GUARDS<sup>6</sup>

Material	Clearance from parts at all points	Largest mesh or opening allowed	Minimum gage (U.S. Standard or thickness	Minimum height of guard from floor or platform level
Woven wire	Under 4"	$\frac{1}{2}$ "	No. 16	6'
	4 to 15"	2"	No. 12	5'
Expanded Metal	Under 4"	$\frac{1}{2}$ "	No. 18	6'
	4 to 15"	2"	No. 13	5'
Perforated metal	Under 4"	$\frac{1}{2}$ "	No. 20	6'
	4 to 15"	2"	No. 14	5'
Sheet metal	Under 4"	...	No. 22	6'
	4 to 15"	...	No. 22	5'
Wood or metal strip crossed	Under 4"	$\frac{1}{2}$ "	Wood $\frac{3}{4}$ inch	6'
	4 to 15"	2"	Metal No. 16 Wood $\frac{3}{4}$ inch Metal No. 16	5'
Wood or metal strip not crossed	Under 4"	$\frac{1}{2}$ "	Wood $\frac{3}{4}$ inch	6'
	4 to 15"	1"	Metal No. 16 Wood $\frac{3}{4}$ inch Metal No. 16	5'
Standard Rail	Minimum, 15"	$1\frac{1}{4}$ "	$1\frac{1}{4}$ " Pipe	42"
	Maximum, 20"	$1\frac{1}{2}$ " 2"x4"	$1\frac{1}{2}$ " Angleiron 2"x4" Wood	

<sup>6</sup> "Safeguarding Machinery," National Safety News, March, 1945, page 131.

machine, don't start it or "inch it" under power unless everyone is in the clear.

7. Report any guard that is not adjusted properly or working perfectly.
8. Don't "cheat" the guard by tying it down, blocking it or otherwise making it inoperative.
9. If it is necessary to reach between moving parts, use a hook, stick, tongs, jig or other accessory.

#### E. Conclusions

In the fight to cut down accidental injuries, there are two lines of defense. The first line should consist of designing and operating the machinery so carefully that they become potential hazards. Personal protective equipment should be considered as the second line of defense. It is far better to eliminate the hazards than to depend upon personal protective equipment.

With even the best available designs and operations all accidents would not be prevented. The human element is a very decisive factor in preventing accidental injury. The usually quoted 15 to 85 per cent places the brunt of the accident causes on the human element. This ratio is based on studies which attempt to fix the cause of an accident to one particular thing and ignore the fact that most injuries are a combination of unsafe acts and physical hazards. It is usually possible to improve on the factors behind these faults. To select a capable, alert, physically fit worker and give him complete instructions on how to safely operate the machine would without a doubt decrease the number of

accidents attributed to unsafe acts. Correcting such physical hazards as improper equipment, unsafe building conditions, and improper working conditions would result in a decline in the number of accidents caused by physical hazards.

The number of accidental injuries chargeable to machinery makes it imperative that all possible steps be taken to improve the guarding devices. The point-of-operation and the power transmission apparatus must be considered when attempting to provide well guarded machinery. The guards should be simple in design and sturdy in construction. They should comply with the uniform code of the American Standards Associations. Table II lists the standard materials and dimensions for guards.

Every machine operator should become familiar with a set of safety rules and practice them. In so doing, he is not only eliminating some of the personal causes of accidents, but is helping to eliminate some of the mechanical faults by using the safety equipment provided.



## CHAPTER III

### CIRCULAR SAWS

The circular saw is probably the most useful and the most used of all woodworking machines. Besides numerous sawing operations, for which this machine is especially suitable, many other operations, such as edge planing, shaping of molding, cutting of grooves, rabbets and tenons, and in some cases, boring and mortising, may be done on the circular saw.

Because of its large variety of uses, the circular saw is one of the first power machines to be selected when a woodworking shop is being equipped. It is in constant use in school woodwork shops, home craft shops and in many maintenance and repair shops.

The general and extensive use of the circular saw often causes the worker to become careless in the operation of this machine. A circular table saw, however, is one of the most dangerous machines made, and should never be operated by nervous, careless or untrained persons.

The circular saw should be properly maintained and in good condition at all times. The saw blade should always be properly set and sharp in order to prevent "kickbacks" and over heating the saw. In all cases, every available precaution should be used in operating the circular saw.

#### A. Preliminary Considerations

The general purpose table saw is involved in more

accidents than any other woodworking machine. Although many guards have been designed to lessen these hazards, a real foolproof guard, that can be used under all conditions has not yet been invented. The guard furnished is often in the way and must be moved for measuring and for certain types of cutting. Some operators, therefore, unless compelled to use the guard, fall into the habit of using the saw without the guard.

Accident Causes: Safety in circular table saw operation requires:<sup>1</sup>

1. Proper guards.
2. Maintenance of saw in proper condition.
3. Safe working habits.

According to a statement in a publication of The National Safety Council,<sup>2</sup> the principle means of preventing injuries on the circular saw may be summed up in the following order:

1. Correctly conditioned saws. A saw which is correctly conditioned should be free of cracks and broken teeth. The teeth should be sharp and properly set. A blade which is out of round or out of plane creates an accident hazard. If a saw is out of round, some teeth longer than others, an unequal strain is imposed on the saw which may cause it to run out of line, to heat up and to warp.
2. Suitable and properly maintained saw machinery. The machine in use should be suited for the type

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<sup>1</sup> United States Bureau of Labor Statistics, Department of Labor, Bulletin 67, Safety Subjects, 1944, page 101.

<sup>2</sup> Woodworking Machinery and Equipment, Safe Practice Pamphlet Number 20, National Safety Council.

of work being done. For example, rip and cut-off saw teeth differ in design for different kinds of wood and for different purposes. If properly maintained, the saw will be well oiled and the blade free from all defects. A saw in good condition and running at correct speed will cut easily, smoothly and straight.

3. Adequate saw guards. Saw guards are considered adequate when they conform with a standard safety code. Since all states do not have the same safety requirements, it is difficult to discuss adequate saw guards. According to the American Standards Association,<sup>3</sup> woodworkers have agreed that the following guards are the most useful in safeguarding a circular saw: (a) guards beneath the table, (b) hoods, (c) spreaders, and (d) anti-kickback dogs.
4. Familiarity with saws and their operation. Every operator should be familiar with the type of work which may be performed by the circular saw. Every operator should be carefully instructed on how to operate the saw. The operator should understand the purpose of the guards and not regard them as unnecessary nuisances.
5. Proper flooring. In order for the operator to obtain the best results from a circular saw, he must have sufficient space in which to handle the material. Minimum clearance on each working side of a rip or cross-cut bench or table saw should be equal to three feet more than the longest material handled. It is also important that no other person is regularly working in line with the saw where he might be hit by material in case of kickbacks. Heavy duty machinery should be located on the ground floor to eliminate most of the vibrations due to high speed operating. A cushion of felt, rubber, cork, or other elastic material between the machine base and the floor eliminates some vibrations and noise. These must be fastened to the floor by bolts that are independent of the machine base. Slipping and tripping hazards should be eliminated about the woodworking machines by use of non-slip mats or other non-slip materials. Provisions should be made for collecting chips and sawdust before they get on the floor or the floor should be thoroughly cleaned at frequent intervals.

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<sup>3</sup> American Standard Safety Code for Woodworking Machinery,  
American Standards Association, Approved February 25, 1944.



6. Proper lighting. Proper lighting is of vital importance. Over lighting is often as bad as insufficient illumination. It is a widespread belief among men experienced in accident-prevention work that improper lighting is a factor in perhaps 25 per cent of all avoidable accidents in the country.<sup>4</sup> All lighting equipment should be given proper attention as to cleaning and adjusting. Color of ceilings, walls, floors and equipment has a definite bearing on proper lighting. It is suggested that colors which absorb less light be used and dangerous and important parts of equipment be of contrasting colors.
7. Properly conditioned stock. Stock that is free from undue warping and knots may be considered proper stock. Warped stock will pinch or bind the saw causing kickbacks and over-heating. Trying to saw improper stock requires more effort on the part of the operator to control the wood, thus increasing the danger of his slipping, losing his balance or running his hand into the rotating blade.
8. Suitable clothing. The operation of some machines requires special protective clothing such as gloves, shoes, goggles and helmets. Although special clothes are not required to operate the circular saw, gloves, necklaces, and loose clothing should not be worn around moving machinery.

Failure to use guards supplied and operating faulty machines cause many accidents. One of the greatest causes of accidents on the circular saw is the careless attitude of the operator. Because of its wide general use, the owners and operators often become indifferent and careless in operating the circular saw. Workmen who have "learned" on unguarded machines usually resist guards. Since all operations of the circular saw can not be guarded, the operators have a tendency to remove all guards. Some workers believe

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<sup>4</sup> American Standard Safety Code for Woodworking Machinery, American Standards Association, Approved February 25, 1944.



guards slow up operations and efficiency of themselves and the machine.

Types of Accidents on the Circular Saw: As has been previously stated, the circular saw is one of the most dangerous of all woodworking machines. According to statistics compiled by officials of the United States Department of Labor,<sup>5</sup> 53.4 per cent of all woodworking machine injuries were caused by circular saws. These figures were based on a survey of woodworking machine injuries in the state of New York for the year of 1944. Of 5,235 accidents reported from woodworking machines, 28 were fatalities or total permanent disabilities and 19 of these were caused by circular table saws.

Common accidents suffered by operators of the circular table saw may be divided into three groups, namely (1) injuries to hands and arms, (2) kickback injuries, and (3) eye injuries.

1. Injuries to Hand and Arms: Contact with the saw either above or below the table causes the injuries received on the hands and arms. Above the table contact results when the operator is feeding or removing stock. Under table contacts occur when the operator is cleaning sawdust or making adjustments under the table. Accidents caused by contact vary from a minor cut to the complete loss of a finger or fingers. The 1943 edition of Accident Facts<sup>6</sup> shows that hands and

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<sup>5</sup> United States Bureau of Labor Statistics, Department of Labor, Bulletin 67, Safety Subjects, 1944, page 93.

<sup>6</sup> Accident Facts, 1943 Edition, National Safety Council, page 20.

fingers are the most frequently injured portions of the body. One out of every nine injuries was attributed to using hand tools while 26 per cent were caused by machinery.

2. Kickback Injuries: When pieces of stock which are being sawed are thrown back with great force and speed, it is called a kickback. These kickbacks are caused as follows:<sup>7</sup>

(1) when saw has too little set; (2) when the splitter guard is not used; (3) when the clearance block (Figure 8) is not used when crosscutting; (4) when a small piece of wood falls on an unguarded revolving saw or is picked up by its back teeth; (5) when badly warped stock is being sawed. These sometimes strike the operator with enough force to cause serious injury.

3. Eye Injuries: Workers suffer eye injuries from flying chips, knots, splinters and sawdust. Injuries to the eye are very serious and frequently result in the loss of sight from either one or both eyes.

Table III gives a complete listing of common accidents occurring on the circular saw and methods of preventing same.

Types of Guards Required: The versatility of the bench, variety or circular table saws makes the problem of safeguarding much greater than guarding a single operation machine. All operations of the circular table saw can not be guarded,

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<sup>7</sup> Hjorth, Herman, Operation of Common Woodworking Machines, Milwaukee: The Bruce Publishing Company, 1942, page 5.

TABLE III CIRCULAR SAW ACCIDENTS AND PREVENTIONS

Type of work done	Accident Hazards	Prevention
Ripping	Kickbacks	Use rip fence for ripping.
Cross-cutting	Binding of saw blade	Use cross-cut fence for cross-cutting.
Beveling	Personal contact with blade	Use hood guard when possible.
Chamfering	Broken blades	Use guard with splitter and anti-kickback dogs.
Tapering	Burning saws	Use a helper when sawing long pieces.
Rabetting	Inadequate floor space	Use feather boards and push sticks.
Mitering	Slippery floors	When ripping short stock, rip from both ends.
Grooving	Improper lighting	Know what you are doing.
Dadoing	Improper clothing	Observe all safety rules.
Squaring with Board		Keep hands clear of and in front of the moving blade.
Quantity sawing after patterns		
Cutting tenons		
Making different Joints:		
Dado joints		
Slip joints		
End lap joints		
Cross lap joints		
Spline miter joints		
Cutting straight moldings		



but whenever possible, guards should be used. Some circular saws are manufactured with one arbor and some with two. Some saws have tilting tables and some tilting arbors. All types are adaptable to cross-cutting, ripping, grooving, dadoing, rabbeting, tenoning and mitering. No one guard has been designed to furnish adequate protection for this large variety of work.

For safety in operation, the circular saw should be equipped with two guards. One, the hood, which covers the part of the saw blade which projects above the table, and the other, the splitter, which keeps the saw kerf open so the wood being sawed does not pinch and cause dangerous kickbacks. The splitter guard also keeps stock from being pulled or pushed around the back of the saw, thus resulting in a kick-back.

The hood and splitter guards are not the only guards used on the circular saw. The portion of the blade beneath the table should be well guarded to prevent contact with the moving blade. Anti-kickback dogs and guards designed for special types of work are also used to lessen accident hazards.

1. Hoods: Each circular saw should be guarded by a hood which covers the portion of the saw above the table when not in use; and the portion of the saw above the material being cut. The hood mounting shall be arranged so the hood will automatically adjust itself to the thickness of and remain in contact with stock. It shall be made of adequate



strength and designed so that the operator may see the cut but be protected from splinters and broken saw teeth. It shall be mounted so as to insure positive, reliable operation. It should be of strong, shatter-proof, non-explosive materials.

The hoods may be made of aluminum or magnesium alloy. If made of plywood, they should be of substantial construction. Hoods should have thin liner pieces of wood at the bottom of cast-metal sides to protect the saw teeth. Hoods are made of soft material so that if the running saw comes in contact with the hood, the saw will not be materially damaged. Latest designs show hoods made of plastic and plexi-glass being used where visibility of cut is necessary.

2. Splitter Guards: Every table saw shall be provided with a spreader or splitter to prevent materials from squeezing or binding the saw. This guard, shaped like a curved sword, is usually made of saw steel or tool steel. It shall be thinner than the saw kerf but thicker than the saw blade. The splitter may be mounted on the saw arbor or on the guard hood. If mounted on the saw arbor, it should be mounted one-half inch back of the saw and should be two inches wide at table level. (See Figures 1 and 2)

3. Anti-kickback Fingers: A circular saw used for ripping should be guarded with anti-kickback fingers. Kickbacks on rip saws are usually caused by one of the following:<sup>8</sup>

1. Failure to provide spreader or splitter.

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<sup>8</sup> American Standard Safety Code for Woodworking Machinery, American Standards Association, Approved February 25, 1944.

2. Improperly conditioned saw allowing material to pinch on saw and rise from the table.
3. Improper alignment of gauge or fence.
4. Improperly conditioned or twisted grain lumber.
5. Improper design or mounting of kickback dogs.

The anti-kickback fingers or dogs prevent the saw from pushing the stock up and back at the operator. They shall be mounted on the hood and designed to provide adequate holding power for all thicknesses of materials being cut. They should dig into and hold the stock securely in case of any backward motion. They must work instantly and equally well on all thicknesses of material.

4. Special Guards: Some operations of the circular saw can not be guarded. The dadoing, grooving and rabbeting operations are not easily guarded by standard equipment. Special jigs or push sticks, (See Figure 9) which keep the hand of the operator at least twelve inches from the point of operation, may be easily designed for these jobs or special machines set aside for this type of work only.

Feather boards (See Figure 10) are used in the resawing process. To resaw means to saw a board or plank into two or more thinner boards. The feather board is clamped so that the fingers bear firmly against the stock being sawed, holding it against the ripping fence. The feather board will permit stock to be pushed forward but will prevent it from going backward.

A fillister piece should be used to make the hood effective when cutting narrow strips with a rip saw. This should be made of wood about two inches wide, about

three-fourths inch thick or slightly thinner than the thickness of the material being cut. It should be provided with cleats or brackets at the ends so that it will either fit down over the front and back ends of the table, or can be quickly attached to the fence or gauge. This piece is attached between rip fence and saw so that the guard may be dropped to normal cutting position. This provides normal guard effectiveness even while cutting narrow pieces.

Limitations: All guards have their limitations. The manufacture of guards has become a considerable business. Manufacturers are constantly on the lookout for new designs which will provide greater safety. Homemade guards, which are well made and properly designed are sometimes as effective as the manufactured guards. Many of the guards used are makeshifts and are so cumbersome to use that they invite operation without the guard.

#### B. Analyses of Selected Table Saw Guards

After a careful study of illustrated literature furnished by the manufacturers of guards for circular saws, the following guards were selected as examples for study. A great many of the guards are of the same principle and therefore, will not be specifically described. Minimum requirements have been adopted by safety engineers. The guards discussed here are the ones which come the nearest to fulfilling those requirements. The Delta and the Boice-Crane are so nearly



identical with the Wallace product that they will be omitted.

Manufacturer: J. D. Wallace and Company.

Machine: No. 11 Universal Saw.

Manufacturer's Guard, Type and Installation: An aluminum, cage type guard with splitter and anti-kickback dogs attached. The unit is attached directly to the arbor bracket at the rear of the saw. (See Figure 1) Below the table the blade is protected by a fixed cage guard which also serves as a sawdust chute.

The Wallace machines are the only circular saws on the market which are supplied with an electric light assembly. The light unit is portable and may be attached to the fence and it is adjustable to any position. This is not considered standard equipment and must be purchased separately.

Function: The guard unit consisting of hood, splitters, and anti-kickback dogs tilts when the saw blade is tilted, thus alignment is automatic. The cage type hood is pivoted in such a manner that the blade is guarded during the process of either ripping or cross-cut sawing. The splitter prevents the binding of the wood against the saw blades.

In case of binding, the anti-kickback dogs prevent the materials from being thrown backward. The metal housing enclosing the portion of the blade below the table serves as a guard against flying sawdust and contact with moving blade.

Analysis: The cage guard on the hood is made of aluminum, with vertically slotted sides so the operator may see the cut.



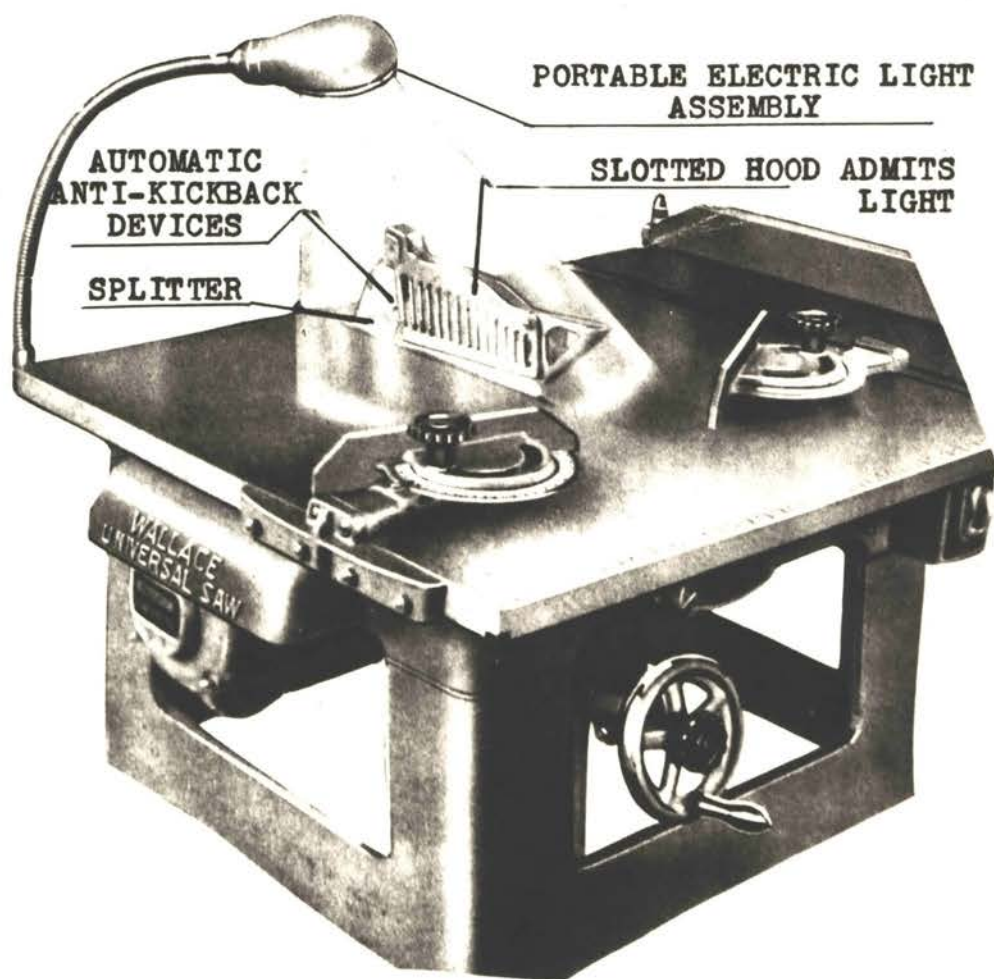


FIGURE 1

AUTOMATIC GUARD UNIT FOR THE WALLACE  
UNIVERSAL SAW NO. 11

Automatic alignment of the guard unit is possible since the cage is mounted on the splitter and the splitter is mounted on the arbor frame. The splitter is straight edged rather than curved to conform with the saw curvature. Two anti-kickback dogs (the Delta has four) are mounted in an eccentric pattern on the splitter. These are made of flat steel with serrated ends which make it possible for them to grip and hold fast any thickness of material being sawed.

Limitations: Hoods mounted on the splitter may be used even if material being cut extends beyond the sides of the saw table. This type of mounting is not practical for grooving, dadoing or rabbeting. To perform these operations, the entire guard unit must be removed from the saw table. This causes a loss of time.

Manufacturer: Oliver Machinery Company.

Machine: Model No. G-80 Saw Guard.

Manufacturer's Guard, Type and Installation: A guard unit consisting of hood, anti-kickback, counterweights and bracket for bolting on column now is furnished as regular equipment with the Oliver saws. The hood is made of cast aluminum, is vibrationless and has a long nose angle for easy acceptance of wood. A standard mounted to one side of the table supports the counter-balanced hood. The splitter guard is attached to the saw arbor and elevates with the blade. The anti-kickback dogs are attached on both sides of the hood at the rear. When hood is lowered for cutting protection, the anti-kickback

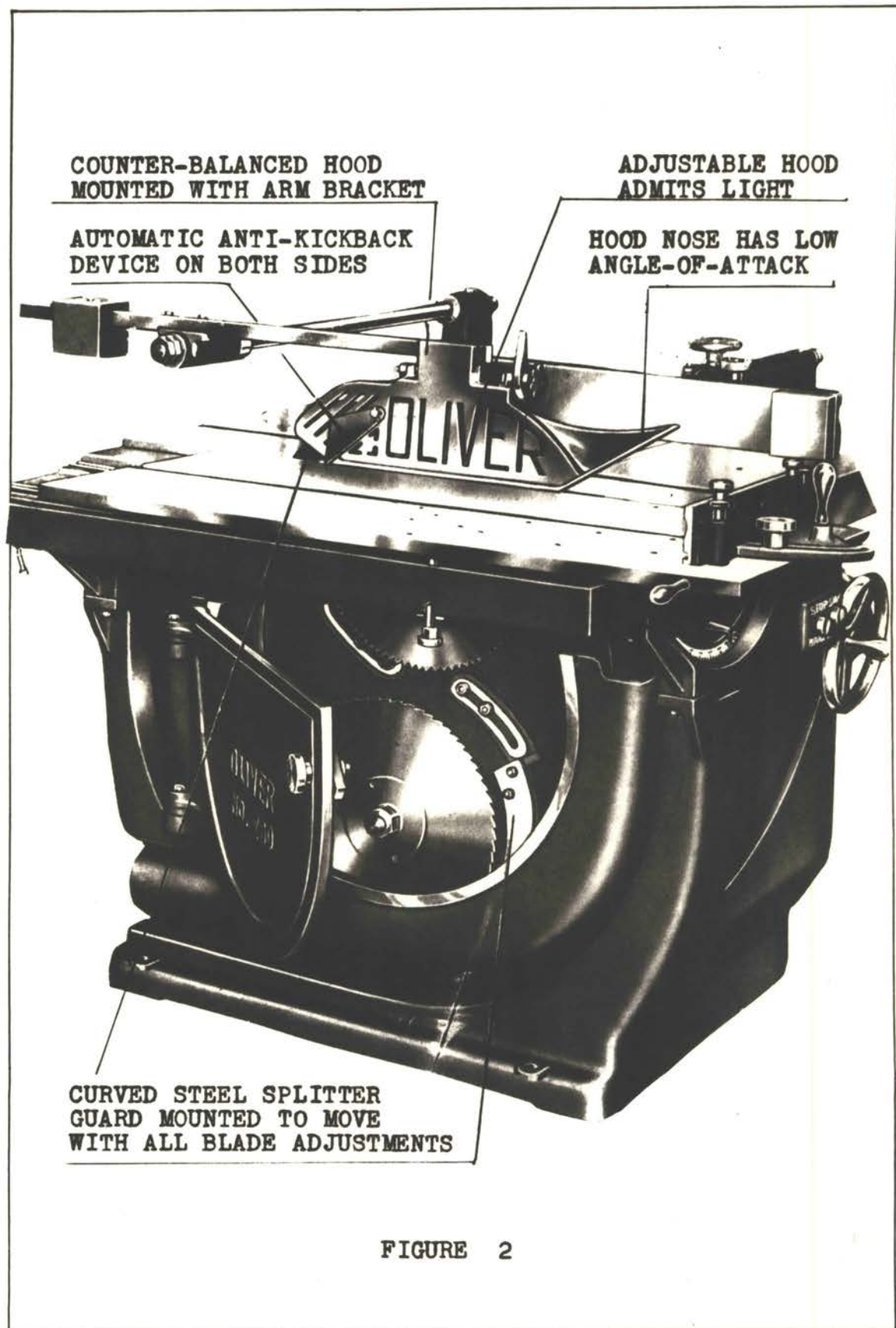


FIGURE 2



dogs press against materials being cut to prevent kickbacks.

In providing added protection, all revolving parts of the Oliver machines are housed within the frame of machine and either entirely enclosed or protected with suitable guards. All the larger size machines with motors 2HP or over are furnished with built-in push button magnetic control which supplies both overload and low-voltage protection. Most Oliver machines are furnished with quick-stop mechanical brakes, some of which are interlocked with the cutoff switch so that when the brake is applied the current is automatically cut off and the cutter is brought to a quick stop.

Function: The vertical raising hood must be manually adjusted to cover the saw when it is tilted as for bevel cuts. The hood being pivoted in the center of the top, raises afore when the board is inserted and rides flat as the board is advanced. When the pivot point is passed, the front of the hood drops down to cover the saw. The anti-kickback dogs prevent backward movement of stock being cut.

Analysis: The hood of the Oliver guard is partially open. (See Figure 2) The old type guards had solid metal sides and were divided in the middle. The hood is made of cast aluminum, which will not materially damage the saw teeth in case of contact. The arbor attached splitter is of flat, straight design and is moved up and down with the saw blade adjustment. The anti-kickback dogs conform to regulations. The lower portion of the machine is encased in a



solid metal casing.

Limitations: The use of the counterweight requires extra supervision. Extreme care is required to see that the counterweight is not altered or adjusted to keep the hood in a raised position at all times. The guard unit is attached to the side of the table with a bracket. This arrangement makes it easy to leave the guard unit up during all operations. A hood mounted on an arm attached to the side of the table can be used on most grooving, dadoing or rabbeting operations, but it limits the size of work that can be cut on the saw. Anti-kickback fingers should be attached to the splitter guard instead of to the hood.

Manufacturer: Flohr Manufacturing Company.

Machine: Automatic Saw Guard.

Manufacturer's Guard, Type and Installation: The Flohr Automatic Saw Guard is of the hood design and is equipped with anti-kickback fingers. These guards are made in sizes to fit the smallest saw, and up to the 36 inch diameters. The unit is secured to the table with bracket mountings.

Function: The Flohr Automatic Tilting Guards work on all tilting tables, double or single arbor, without adjustment. The tilting of the table tilts the guard unit, making alignment automatic. These guards are suited to any type of work, from the finest cabinet work to the heaviest roughing. The counter-balanced hood, mounted with arm bracket, is attached to the side of the table. (See Figure 3) The hood is designed to

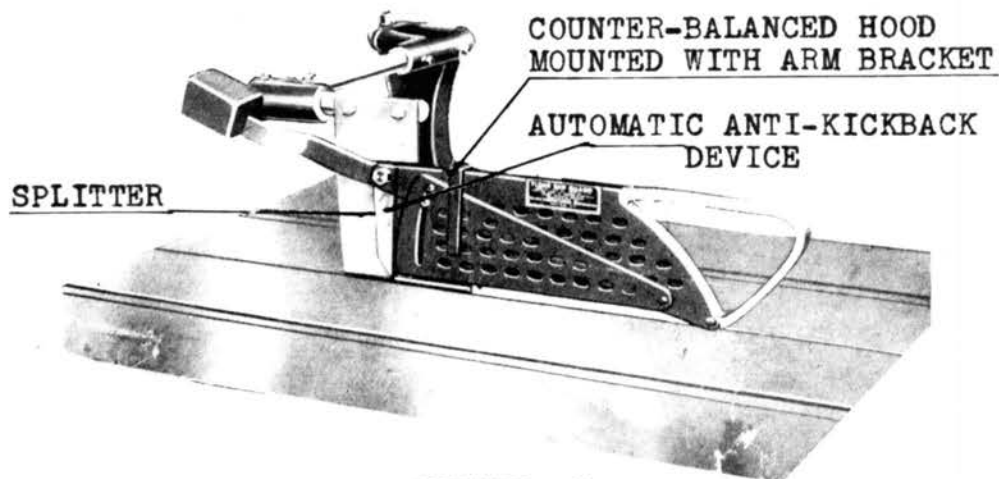


FIGURE 3

FLOHR AUTOMATIC GUARD NO. 5 FOR TILTING TABLE TOP

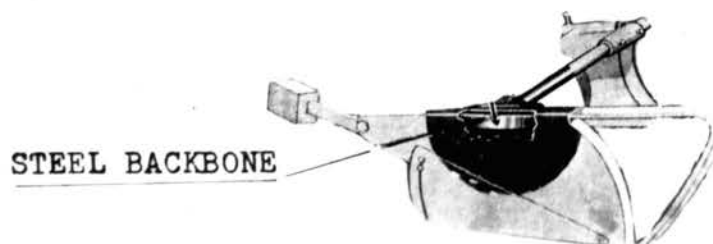


FIGURE 4

CONSTRUCTION FEATURE OF FLOHR AUTOMATIC GUARD

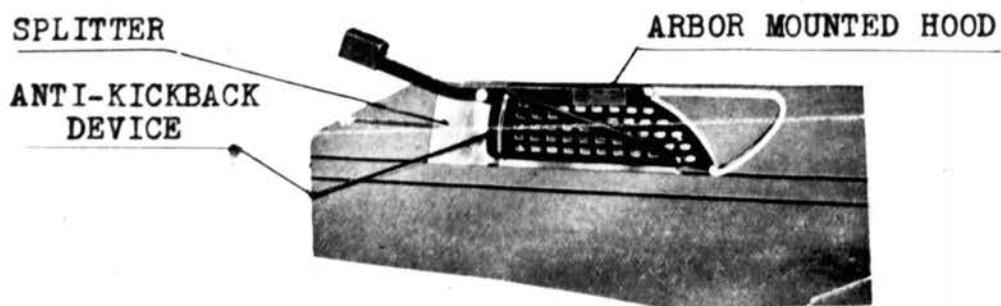


FIGURE 5

FLOHR AUTOMATIC GUARD FOR TILTING ARBOR SAW

automatically adjust itself to the varying thickness of lumber with no attention from the operator. This automatic adjustment, with the added protection of the anti-kickback dogs and splitter, leaves the operator free to devote his entire attention to the work at hand.

The Flohr guard for the non-tilting table saw is a steel spreader mounted guard which is attached to the saw arbor. It has the same sturdy construction and protective features as the guard for tilting table saws. The guard unit tilts with the tilting of the saw arbor, thus it is properly aligned at all times.

Analysis: Built of steel and malleable iron, the Flohr guards will withstand any strain that may be put upon them. The steel backbone (See Figure 4) is unquestionably one of the greatest features of construction ever included in a saw guard. It affords unusual protection against the most serious accidents. The steel bar is placed directly over the saw so that it is impossible for the broken saw to injure the operator.

The lower portion of the hood is attached in a manner which permits it to rise and fall with the varying thickness of the stock. The splitter is attached at the back of the hood and prevents the stock from binding the saw blade. The anti-kickback dogs conform with standard regulations. They are attached to the hood arm just back of the hood and firmly grasp the stock and prevent kickbacks.



Limitations: All guards are limited in the amount of protection they provide. These guards furnish adequate protection for ripping and cross-cut sawing but can not be used to any advantage for grooving, dadoing and rabbeting. The design of the sides does not permit a clear view of the work being cut. Two anti-kickback dogs, one on either side of the splitter, are single pointed. More dogs of varying lengths would serve to a greater advantage. Single pointed dogs will not grasp all thicknesses of stock.

Manufacturer: The Surty Manufacturing Company, Inc.

Machine: The Surty Saw Guard.

Manufacturer's Guard, Type and Installation: The Surty guard for circular saws meets all specifications of the American Standards Association. It is of open front hood design with spreader and kickback protection. This guard is installed on the throat plate, which makes it one of the most convenient guards for variety saw tables. The Surty Company manufactures guards designed to fit all types of saws. All guards are of the same construction, featuring anti-kickback dogs and splitter guards. They differ in mounting only. The guards for the tilting top and tilting arbor saws are mounted directly on the throat plate. The guard unit for the home craft saw is attached to a long arm which is attached to the throat plate. (See Figure 7)

Function: The functions of these guards are the same as have been previously described. The hood rides on the board

and protects the operator from the moving blade. The spreader prevents the wood from binding and causing kickbacks. The anti-kickback dogs are provided to comply with state codes and are attached to the splitter guard at the rear of the hood.

Analysis: The open front of the cast aluminum hood permits view of the work. Hardwood insert strips prevent splinters from raising off material being cut. The spreader is made of saw steel, tempered and ground. The hood mounted on two rollers and traveling at an angle to the rear prevents kickbacks. Anti-kickback dogs are provided to comply with state safety codes.

Limitations: When dado work is done this guard must be removed from the machine. The throat plate must be lifted out and another plate inserted. This causes loss of time and the operator is tempted to leave it off for all operations. It sometimes occurs that the largest saws that can be used on a table can not be used with this guard because there is not enough space at the rear of the saw to accommodate the splitter. This guard has only two anti-kickback dogs. They are located one on either side of the guard. They are used only to conform with the standard codes, while the chief anti-kickback prevention is the angle at which the splitter is set.

### C. Conclusions

Since the invention of the first crude circular saw in

OPEN FRONT PERMITTING  
VIEW OF WORK

SPLITTER



AUTOMATIC  
ANTI-KICKBACK  
DEVICE

FIGURE 6

SURTY AUTOMATIC GUARD

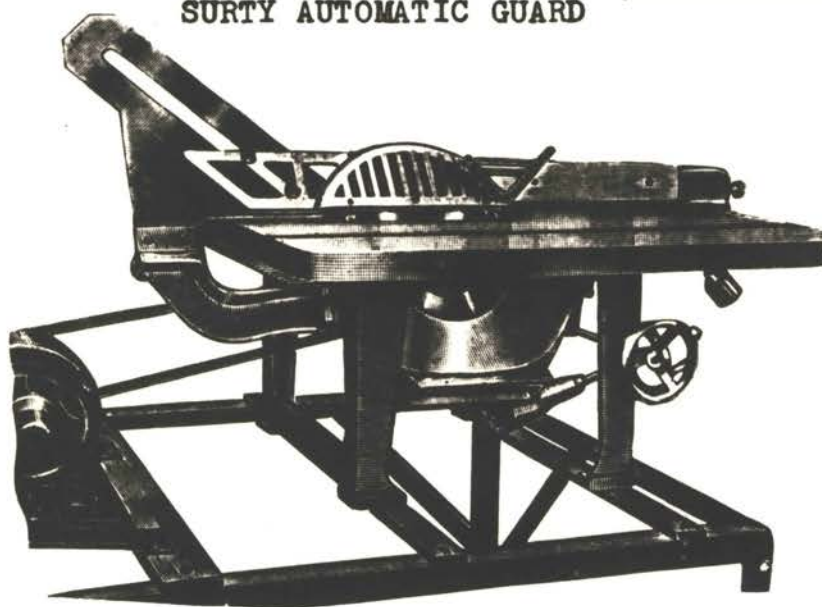


FIGURE 7

HEMOCRAFT TILTING ARBOR SAW GUARD, SURTY MFG. CO.

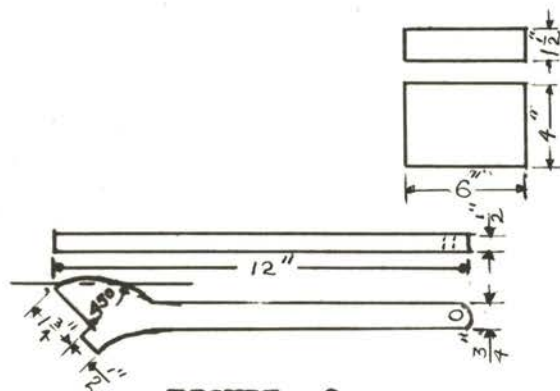


FIGURE 9  
PUSH STICK

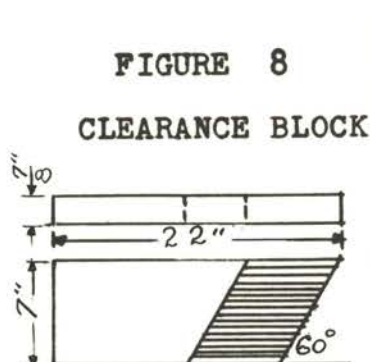


FIGURE 10  
FEATHER BOARD

FIGURE 8  
CLEARANCE BLOCK



Holland in 1777,<sup>9</sup> many changes have been made. The first circular saw was introduced in America in 1814.<sup>10</sup> In 1917, the J. D. Wallace Company introduced the first gear driven table saw. From these early beginnings, we have seen the circular saw grow into a modern, single arbor or double arbor machine with many uses. The first tilting arbor saw was introduced in 1917. The modern machines have either tilting arbors or tilting table tops.

Necessity of Guards: Each new development in the circular saw increased the number and types of operations possible. These in turn increased the problem of adequate guarding. No single guard can be expected to protect the operator of a circular saw on all cuts required of any given saw.

The fact that the circular saw is so common has increased the necessity of guards. The operators become careless in operating the machines and are subjected to severe injuries. These injuries, in some cases, result in permanent disabilities and in a few cases death.

What the Guard Must Do: The guard of the circular saw must protect the hands of the operator from contact with the saw blade on all ripping, cross-cutting and mitering operations,

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<sup>9</sup> Hjorth, Herman, Operation of Common Woodworking Machines. Milwaukee. The Bruce Publishing Company, 1942, page 2.

<sup>10</sup> H. E. Tautz and C. J. Fruits, The Modern Motor-Driven Woodworking Shop, Volume 1, page 47.

even with the table or arbor at any degree of tilt; it should prevent binding, and it must eliminate kickbacks.

Some suggested requirements which help reduce the accident hazards of the circular saw are listed:

1. Provide for visibility of the saw blade during cutting process. This may be done with open front hoods or by using glass or plastic in front of guard.
2. Be supplied with anti-kickback dogs.
3. Furnish a splitter or spreader if the saw table is not equipped with same.
4. Use push stick, clearance boards and feather boards (See Figures 8, 9, and 10) when using the regular guard is impossible.
5. Supply proper lighting.
6. Provide proper floor space and a non-skid floor.
7. Guard the portion of the saw beneath the table.
8. Provide a means of sawdust exhausting to prevent it from blowing into the eyes.

Anti-Kickback Dogs: Kickbacks may be prevented by properly installed dogs or cams of adequate strength and length. These are usually made of flat steel with serrated ends. The purpose of these is to prevent the saw blade from picking up the stock and shoving it backward with great force. The kickbacks of the circular saw are one of the major causes of injuries received in operating the circular saw.

Binding Prevention: Splitter guards have proved effective in alleviating the dangers caused by the stock binding and clamping on the saw blade. If the saw table is not equipped with a splitter, the guard unit must supply this. The

splitter should be made of tempered material strong enough to prevent its being bent out of alignment with the saw blade. It is placed in such position as to keep the cut in the lumber open enough to prevent binding on the saw blade.



## CHAPTER IV

### GUARDS FOR JOINTERS

The jointer or hand planer (See Figure 11) is, next to the circular saw, the most necessary and useful of all woodworking machines. This machine, invented in England by Samuel Bentham in 1793,<sup>1</sup> has become indispensable to the modern shop because of the ease, speed and accuracy with which wood can be planed on it.

Again, except for the circular saw, the jointer or hand planer is the most dangerous of all woodworking machines. The high speed cutting head equipped with very sharp knives is enough to classify this machine among the most dangerous.

#### A. Preliminary Considerations

Only a few guards are available for the jointer. It is generally accepted that the existing guarding devices for the jointer furnish adequate protection to the operator. Despite this accepted opinion, it is a mistake to think any jointer is safe if it is possible for the fingers to get against the head. A study of statistics proves that existing guards are not sufficient to eliminate this hazard. A report made by the officials of the United States Department of

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<sup>1</sup> Hjorth, Herman, Operations of Common Woodworking Machines, Milwaukee: The Bruce Publishing Company, 1942.

Labor shows that of the 1,086 reported surfacing and edging machine injuries, 80 per cent were charged to the jointer.<sup>2</sup> These statistics were based on compensated woodworking machine injuries reported in the state of New York.

The jointer is fitted with revolving knives suitable for tapering, rabbeting, edge planing and other miscellaneous work, but its chief utility is to take the place of the hand plane for all sorts of work both big and little. Every piece dressed must be run over the knives revolving under a slot in the table, and it is difficult to have guards of any kind that would be foolproof. These knives, continuing to revolve at high speed for some time after the power is off, create the possibility of a careless operator or by-stander getting his fingers in the knives.

All cutting operations, unless skillfully handled, may result in a kickback which may cause the operator to lose his balance and accidentally come in contact with the knives. Dull knives, slippery floors, or too deep a cut may also result in the wood being thrown back and permitting the hand to drop on the knives.

Types of Accidents: Although the jointer is considered adequately guarded, accidents do occur when the machine is operated in a careless manner. Mostly of the minor nature, these injuries come almost entirely from getting the hands and

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<sup>2</sup> United States Bureau of Labor Statistics, Department of Labor, Bulletin 67, Safety Subjects, 1944, page 93.

fingers against the knives. Most of these occur when short pieces are being planed.

The use of the cylindrical cutter head has greatly reduced the severity of the jointer accidents. The square cutter head is so dangerous that state laws in almost all states prohibit its use. Although accidents are frequent, very few cause permanent disablement. Most accidents result in partial loss of one or more fingers. A complete listing of jointer work accidents and accident preventions is given in Table IV.

Kickbacks, the prevention of which a guard has not been designed, may occur when knots or changes of grain in stock are encountered, by taking too deep a cut, by dull knives, or by insufficient pressure on the stock. Any kickback may cause the fingers to slip or be thrown into the blades. The hazard of jointing very short pieces is excessive. Pieces less than 12 inches in length should not be planed on a jointer.

Types of Guards Required: Of all guards available for the jointer, the most common swings on a pivot and is held against the fence or guide with a spring. (See Figure 11) The guard is pushed aside by the stock being planed, but the spring holds it against the side of the stock so that the portion of the cutter head between the operator and stock is always covered. This guard, shaped like a leg of mutton or segment of a circle, is often termed the "leg-of-mutton" guard. It may be made of wood or metal. For edge jointing, this guard gives good protection, but for surface jointing, it leaves much of



TABLE IV JOINTER--ACCIDENTS AND PREVENTIONS

Type of work done	Accident Hazards	Preventions
Edge planing	Kick-backs	Give complete attention to work.
End wood planing	Flying chips	Use all available guards.
Face planing	Personal contact	Observe all safety rules.
Squaring stock to dimensions	Improper light	Do not attempt to plane board less than 12 inches.
Tapering	Improper flooring	Use pusher for face planing.
Rabbeting	Improper clothing	See that knives are sharp.
Beveling		Do not take too deep a cut.
Chamfering		Don't hold hands too near end of board.
Planing an octagon using a V block		Do not adjust fence while machine is in motion.
		Do not wear loose clothing.
		Keep floor clean.
		Examine stock carefully for knots, splits and nails before running over the jointer.

the knife exposed as the stock approaches and leaves the knife.

Another guard, which is considered better because it affords more protection to the operator's hands in surfacing, is described by the officials of the United States Department of Labor as follows:<sup>3</sup>

A metal cover over the jointer head somewhat wider than the opening in the table, self-adjusting vertically to ride the work, front edge shaped to allow easy insertion of the work, self-adjusting horizontally to the position of the guide to cover at all times all of the head on the working side of the guide. (See Figure 13)

Other minimum requirements for guarding the jointer include the use of the cylindrical cutter head and of a sheet metal guard to cover the jointer head back of the guide or fence. This guard is fixed to the guide and covers the unused portion of the blade regardless of the position of the guide. (See Figure 12)

Available jointer guards furnish adequate protection to the operators for all bevel-cutting, chamfering, tapering, edge-planing and some surface planing. For jointing thin stock and short pieces, a pusher is indispensable. (See Figure 16)

#### B. Analyses of Selected Guards

All jointer guards are the same in principle although they vary in design. There are three basic designs: (1) the leg-of-mutton, (2) the back of the fence guard, (3) the riding guard.

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<sup>3</sup> United States Bureau of Labor Statistics, Department of Labor, Bulletin 67, Safety Subjects, 1944, page 103.

The guards discussed here were selected because they are among the most efficient and most carefully designed of the three general types of guarding devices. Each of the guards fulfill the minimum requirements, and should give adequate protection if operated with skill.

Manufacturer: Yates-American Machine Company.

Machine: M-31 Hand Jointer Guard.

Manufacturer's Guard, Type and Installation: A spring pivoted leg-of-mutton guard attached to the front edge of the feed table covers the cutter blade on the side next to the operator. (See Figure 11) A crescent shaped, sheet metal guard is attached to the fence and protects the unused portion of the knives behind the fence. (See Figure 12)

Function: The front guard is self-adjusting. Swinging laterally on a spring, it is pushed aside by the stock as it enters the knives and returns to position against the fence when stock has cleared the knives. Adjusting the fence moves the back guard into position so as to keep the unused portion of the knives guarded at all times.

Analysis: The aluminum safety guard, which covers the cylinder in front of the fence, is sturdy and substantially built. The spring holds it in position so that the cutter is guarded until the stock is inserted. The cutter knives are partially exposed just before and just after the passage of the stock. During the cutting process, the hands are protected only by the thickness of the material being cut.



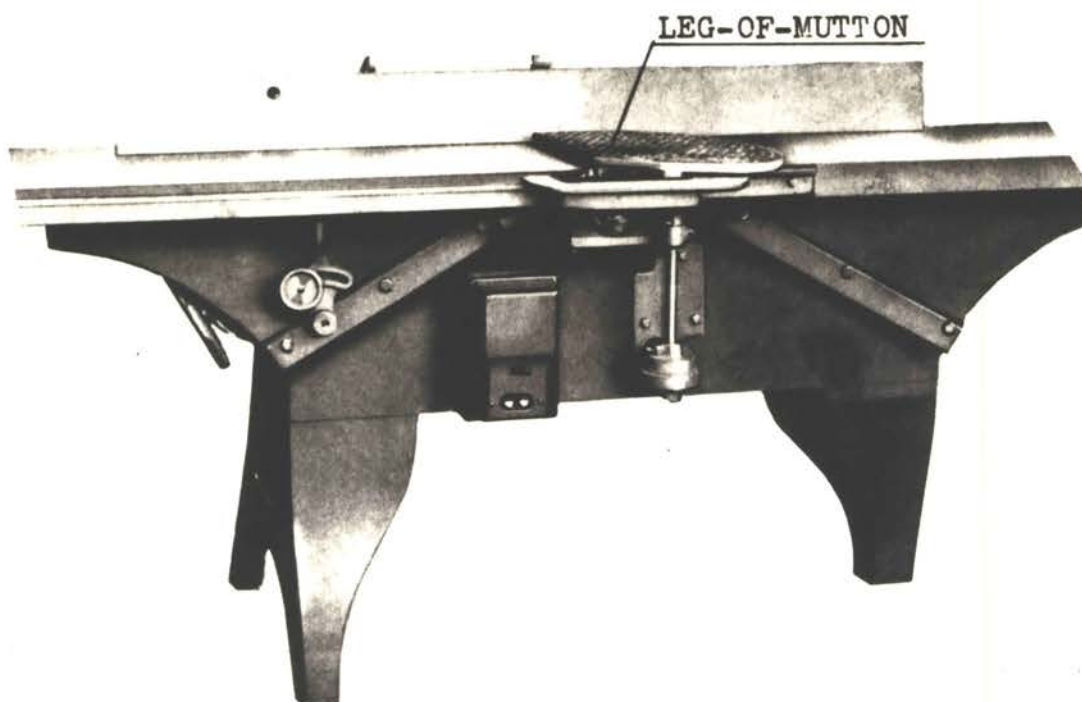


FIGURE 11

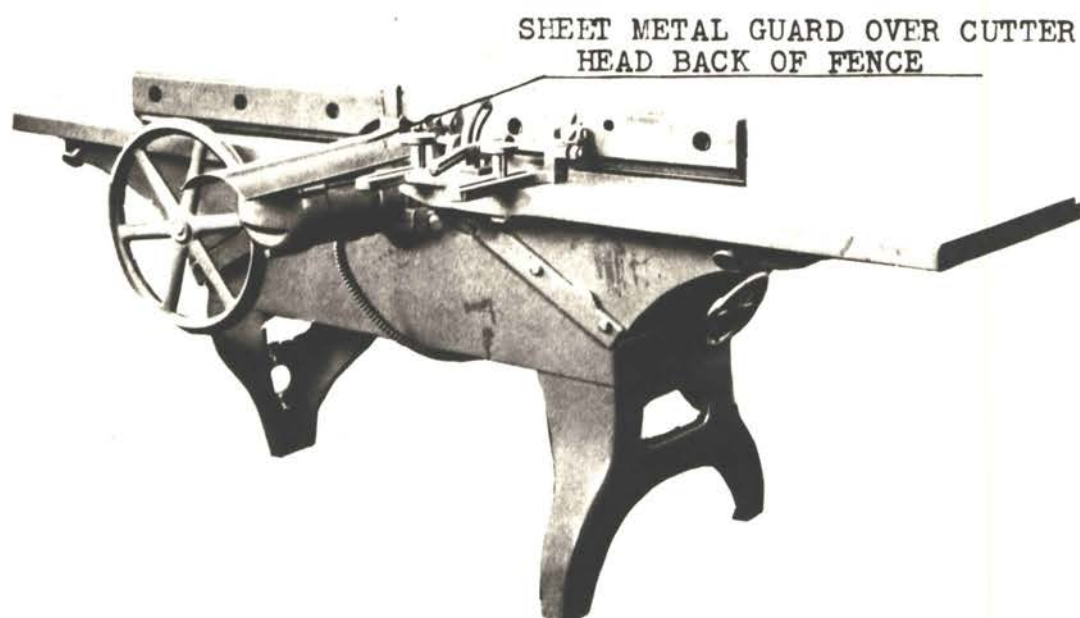


FIGURE 12

Limitations: The leg-of-mutton guard gives adequate protection for edge work. On surfacing operations, it leaves much of the knives exposed as the stock is moved to meet the knives. This guard offers no protection against kickbacks. The leg-of-mutton guard must be removed to permit rabbeting to be done. Constant use sometimes weakens the spring. A weak spring will not allow the guard to return to position against the fence quickly enough or closely enough to keep the operator from getting his fingers in the revolving head.

Manufacturer: Surty Manufacturing Company.

Machine: Surty Jointer Guard.

Manufacturer's Guard, Type and Installation: An aluminum, extension arm front guard is pivoted under the rear or out feed table. It is spring loaded and can be turned over the end of the table for rabbeting. (See Figure 13)

The unused portion of the cylinder back of the fence is protected with an aluminum guard. This guard is fixed to the fence and moves backward or forward when fence adjustment is made. It keeps the knives covered at all times.

Function: The Surty Jointer Guard moves vertically for surfacing and horizontally for edge work. The guard is held in place with springs. The shield is supplied with a guide which raises automatically as the stock being surfaced reaches it.

Analysis: The guard is made of aluminum and rides on the stock being planed. The shield moves automatically and keeps

constant pressure on the work. The guard is not moved from the fence and the knives are never exposed. The shield adjusts automatically for edging. A spring returns it against the fence immediately after removal of the material. The portion of the knives behind the fence is covered at all times with a shield fixed to the fence.

Limitations: This guard, like the leg-of-mutton, offers no kickback or rabbeting protection. It furnishes adequate protection for all other operations.

Manufacturer: Boice-Crane Company.

Machine: Number 1400 Jointer Guard.

Manufacturer's Guard, Type and Installation: The Boice-Crane jointer head is guarded on both sides of the fence with aluminum leg-of-mutton guards. The fence has provisions for spring hold-downs.

Function: Both knife guards have double-pivot action. The vertical pivot allows the guard to open and shut over the knives. A torsion spring keeps the guard closed against the fence or work. The horizontal pivot lets the guard be swung entirely below the table to permit rabbeting. The guards remain bolted to the machine at all times. Spring hold-downs are provided for safe feeding of short or thin stock. This keeps the hands away from the cutterhead and holds the lumber down while being fed from a short distance.

Analysis: The use of the leg-of-mutton guard both in



front and back of the fence allows the fence to be moved forward or backward and never expose the cutting blades. The spring hold downs are not standard equipment and must be purchased separately.

Limitations: No device prevents the fingers from getting into the knives. No device for kickback protection is provided. Like all leg-of-mutton guards, the knives are exposed just before and just after the stock is passed over them in surfacing. The hands are protected only by the thickness of the material during the cutting operations.

### C. Conclusions

Few notable changes have been made in jointer guards in the last decade. The most commendable change has been the acceptance of the round head cutter to replace the square head. The round cutter is equipped with knives which take smaller bites. This tends to reduce the kickback hazard. The round head also eliminates the danger of throwing broken knives.

Another noteworthy change is the fact the manufacturers are realizing the need for guards and are furnishing them as standard equipment rather than as extras.

What the Guards Must Do: Effective jointer guarding should do three things:<sup>4</sup> (1) It should shield the unused

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<sup>4</sup> Shults, Chauncey Smithey, An Analysis of Safety Guards on Woodworking Machinery, Master's Thesis, Oklahoma Agricultural and Mechanical College, 1947, page 61.

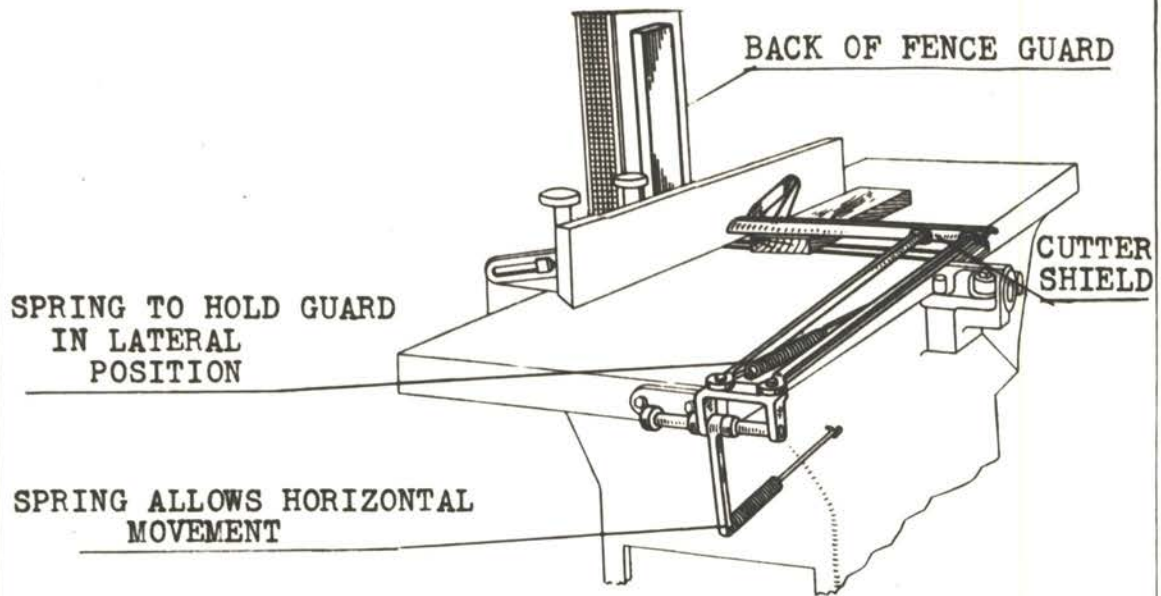


FIGURE 13



FIGURE 14

LEG-OF-MUTTON GUARD IN FRONT OF FENCE



FIGURE 15

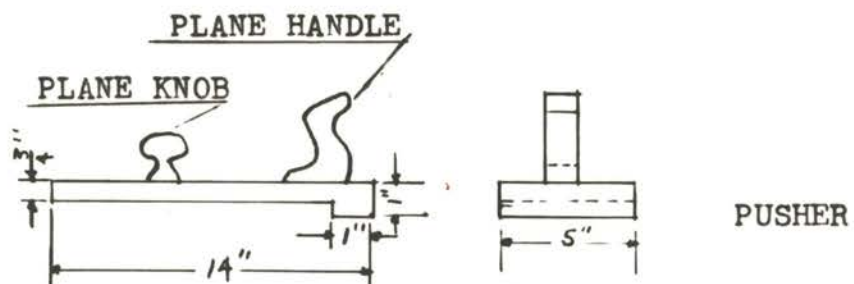


FIGURE 16

portion of the cutter head behind the fence; (2) it should cover that portion of the cutter head which is to be used in the operation required and (3) it should eliminate kickbacks.

Guards Available: Standard guarding equipment which is either provided with the machine or may be bought separately include three types of guards: (1) the leg-of-mutton, (2) the behind the fence guard, and (3) the guard which rides on top of the stock being cut. A good home-made guard is the pusher. This is indispensable when planing short or thin pieces of stock.

1. Leg-of-Mutton: This guard is shaped like a leg-of-mutton and is attached at a point to the side and in front of the jointer head. It is arranged to swing back when material is pushed through, yet the spring pivot keeps it in contact with the stock at all times and covers the portion of the head not covered with the stock being planed.

2. Back of Fence Guard: Each hand-fed jointer should have a guard which will cover the section of the cutter head behind the guide fence. A sheet metal guard attached to the guide fence is usually used for this purpose.

3. Stock Riding Guard: This metal cover guard is somewhat wider than the opening in the table over the cutter. It is self-adjusting vertically to ride the work. The front edge is shaped to allow easy insertion of the stock and rides in such position as to keep all the head on the working side well guarded.

Although well guarded, there are many things which the



operator can do to help eliminate accidents. It is well to remember that a narrow jointer is safer than a wide one. There is very little work which requires a wide jointer. Learning and carefully following the safety rules which are provided with each machine will eliminate a great many accidents.

## CHAPTER V

### SAW GUARDS FOR USE ON THE BAND SAW

With the patenting of the first band saw in 1808,<sup>1</sup> the woodworking shop found another indispensable machine. There are various types of band saws, the most common being the band scroll saw, which is used mainly for sawing curved work.

The band saw is one of the easiest woodworking machines to guard. There is no danger from kickbacks, and all moving parts except the point of operation may easily be enclosed.

#### A. Preliminary Considerations

Although injuries from band saws are less frequent and less severe than from other woodworking machines, they are not uncommon.

Band saws accounted for 3.1 per cent of all injuries from woodworking machines in Massachusetts in 1946, according to a table from a report from the United States Department of Labor.<sup>2</sup> The same table shows that, while no deaths were caused by the band saws, 115.4 of every 1,000 accidents on it resulted in permanent partial disablement. Data such as these show the possibility of still more progress in safeguarding the band

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<sup>1</sup> Hjorth, Herman, Operations of Common Woodworking Machines, Milwaukee: The Bruce Publishing Company. 1942.

<sup>2</sup> Safety Education in the School Shop, National Safety Council, 1946, page 37.

saw.<sup>3</sup>

Types of Accidents: Band saw accidents are of two principle types: (1) those resulting from contact with the moving blade, and (2) those caused by the breaking blades.

1. Personal Contact Accidents: The point-of-operation on the band saw can not be fully guarded, thus injuries usually result from hands coming in contact with the moving blades. Almost all band sawing is done freehand and the operator's hands must come close to the moving blades. A careless operator or a sudden jarring of even the most careful operator may result in the fingers being caught in the blades.

2. Breaking Blades: Although modern machines are equipped with devices to prevent breaking blades, they have not entirely eliminated this hazard. The pieces of a broken blade are thrown with great force and may cause serious injury.

Table V gives a complete listing of band saw work, accident hazards and preventive measures.

Types of Guards Required: The guards on a band saw consist of metal doors for the upper and lower wheels, as well as channel shaped steel guards for the vertical portion of the blade. The entire run of the saw, except the section needed to make the cut, should be completely enclosed. The outside periphery of the enclosure shall be of solid metal. The front

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<sup>3</sup> Shultz, Chauncey Smitley, An Analysis of Safety Guards on Woodworking Machinery, Master's Thesis, Oklahoma Agricultural and Mechanical College, 1947, page 42.



TABLE V BAND SAW ACCIDENTS AND PREVENTIONS

Type of work done	Accident Hazards	Prevention
Ripping	Personal contact	Give undivided attention to work.
Beveling	Broken blades	
Tapering	Improper clothes	Good lighting.
Cross-cutting	Improper lighting	Let machine reach maximum speed before starting the cut.
Sawing after pattern	Improper floor space	
Sawing circular disks and segments		Set blade and guide post before turning on the power.
Multiple sawing		Do not wear loose or ragged clothing.
Compound sawing		
Making joints:		
Miter joints		
Tenons		
Slip joints		
End lap joints		
Cross lap joints		
Middle lap joints		

and back of the enclosure may be solid metal or of mesh material. The wheel enclosures should be strong enough to contain with safety a breaking saw, and arranged to permit replacement of saw easily. The return section of the saw from the enclosure of the upper wheel down to the table may be protected by two fixed strips of stiff metal at least one-half inch wider than the widest blade used. One of these guards should be fixed, but the other should be fastened to the guide post and move up or down with this. The use of these guards leaves only the part of the saw which does the cutting exposed.

Each band saw shall be provided with an automatic tension control device to help prevent breakage of blades due to improper tension. This automatic control takes care of the contraction that takes place in the cooling of the blade after a job is finished.

Miscellaneous Guards: Although not required by law, many band saw manufacturers are equipping their machines with brakes. These brakes, whether foot operated or electrically operated, stop the wheels in a very few seconds, thus eliminating the hazard of touching the rapidly moving blade. Some of these brakes are automatic to a point that they shut off the power and stop the wheels when a saw blade is broken. The Tannewitz Band Saw may be used as an example. (See Figure 17)

The newest guard designed for the band saw is described in the May, 1948 issue of Industrial Arts and Vocational Education magazine.<sup>4</sup> The guard, made of wood, is glued

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<sup>4</sup> Band Saw Guard, G. Harold Billingham, Weehawken, N. J., Industrial Arts Vocational Education, 37:207, May, 1948.

together and has no nails or screws. It fits the throat area, and covers the blade and part of the movable guard. It is approximately eight inches long, six inches high, and nine inches wide, and was designed for a 30 inch wheel model. The rear of the case is equipped with a handle. All corners are rounded. This guards the actual cutting area of the blade and eliminates the hazard of having students run pieces of wood against the teeth after the power has been turned off. (See Figure 18)

This guard is lettered and painted to remind the operator that working at a band saw is a dangerous operation and makes it unnecessary for the instructor to continually remind his students of safe practices.

The freehand feeding of the band saw requires strong glare-proof lighting. To prevent glare and provide proper illumination, some band saws are equipped with small, vibration-proof electric lights.

#### B. Analyses of Selected Guards

The guards analyzed here were chosen for analysis because they furnish the most complete protection of all band saw guards. They were selected after careful evaluation of catalogs, data, and descriptive literature supplied by the manufacturer.

Manufacturer: The Tannewitz Works.

Machine: Model P-M (See Figure 17)

Manufacturer's Guard, Type and Installation: All moving parts



are enclosed either by the frame casting or by heavy circular sheet metal guards. Complete and speedy access to all parts covered by the guards is accomplished by swinging the doors open.

A patented pneumatic siphon system removes all dust from under the table. A foot treadle brake is located on the lower wheel hub. This brake, unlike the brakes on other saws, stop both bottom and top wheels. This saw provides a geared hand wheel for raising and lowering the guide post. Guards on the guide posts are of narrow steel which casts no shadows on the work.

Function: The operator is protected from all moving parts except at the point-of-operation. The heavy steel wrought guards are rigid, vibration proof and unbreakable. They offer the best protection against blade breakage. The counter balanced guide post is easily adjusted to care for varying thicknesses of stock. A spring tension lever with indicator showing proper saw tension is provided as a precaution against blade breakage.

Analysis: This band saw probably includes more recommended safety features than any other machine studied. In addition to enclosing all moving parts, this saw is equipped with a patented syphon dust discharge system which utilizes the air current generated by the saw to remove all dust.

The Tannewitz band saw is the only saw manufactured with synchronized wheel brakes interlocked with the power cut-off.

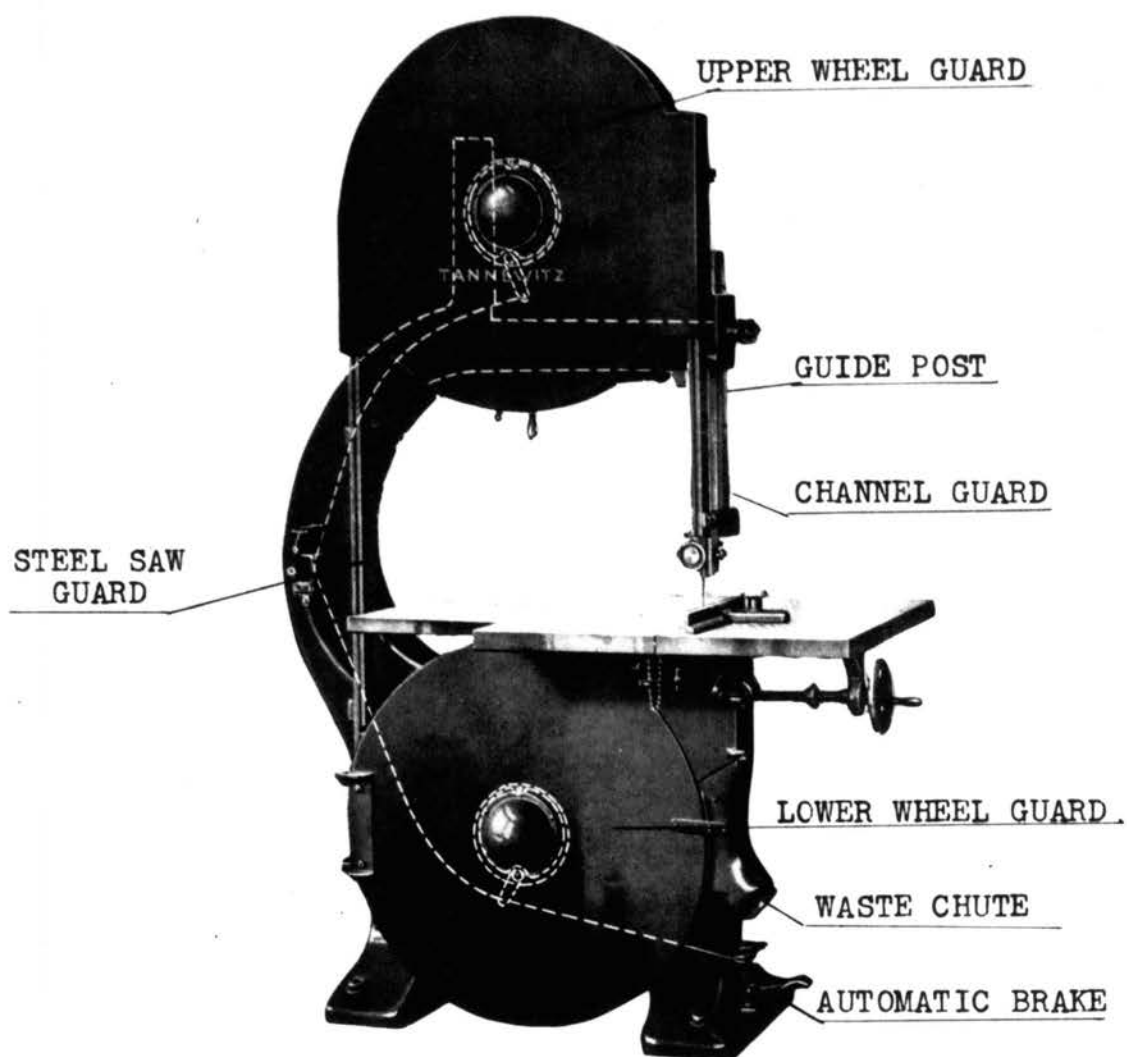


FIGURE 17

DOTTED LINES SHOW ACTION OF AUTOMATIC POWER SHUT-OFF BRAKE

TANNEWITZ BAND SAW

In event of the saw blade breaking, the saw tension lever automatically snaps back into its original position. This presses a switch button which shuts off the power and automatically stops the wheels. A conveniently located foot treadle brake interlocked with the power control is used for stopping the wheels under ordinary circumstances.

Limitations: This band saw has many safety features, but leaves the point-of-operation unguarded. If properly located in a well illuminated shop, the built in light is not needed, but it is well to include this feature.

Manufacturer: The Surty Company.

Machine: Surty Band Saw Guard No. 100 and Surty Automatic Point of Operation Band Saw Guard. (See Figure 20)

Manufacturer's Guard, Type and Installation: The Surty Company designs and manufactures guards which will fit nearly all makes of band saws. The Band Saw Guard No. 100 is considered 100 per cent safe because of the automatic aluminum shield which encloses the wheels. The all steel point-of-operation guard gives positive finger protection yet provides a clear view of the work at all times.

Function: The mesh guards which enclose the wheels prevent personal contact. An aluminum roller guide prevents the saw from running off the wheels. The point-of-operation guard provides finger protection.

Analysis: The No. 100 Band Saw Guard has an aluminum



shield covering the front and side of the saw. A steel band covers the top of the wheel, thus preventing flying pieces of the broken blades. The automatic point-of-operation guard rides on the material. It is fitted with four roller bearing and is counterweighted so that the slightest pressure of material raises the guard. The long nose angle permits easy insertion of the material. The rear part is rounded so that there is no drag on the material in any direction.

Limitations: The band saw guard No. 100 provides protection for only one side of the lower wheel. There is no automatic tension device or electric light furnished with this equipment. The line of work is shadowed by the base of the point-of-operation guard.

Manufacturer: Flohr Manufacturing Company.

Machine: Automatic Band Saw Guard. (See Figure 19)

Manufacturer's Guard, Type and Installation: This automatic point-of-operation guard will fit any size band saw. Built of steel and fully adjustable, it is fastened to the channel guards of the guide post.

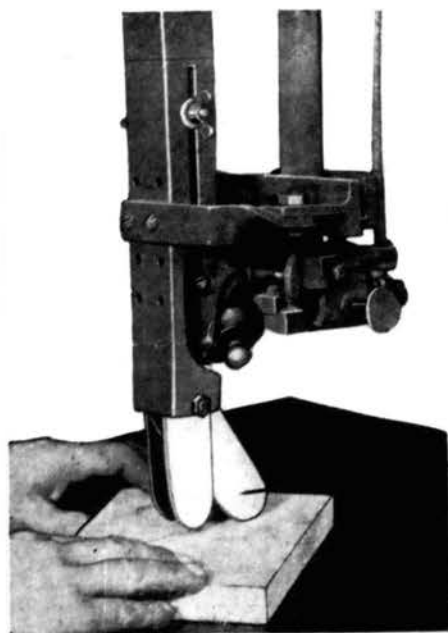
Function: This guard furnishes adequate finger protection from the moving blade. It is impossible for the operator to be injured in case of a breakage. It provides automatic protection for the back and sides of the saw.

Analysis: This steel constructed guard is fully adjustable and is easily attached or removed. The wooden fingers of varying

POINT-OF-OPERATION GUARD  
DESIGNED BY  
HAROLD BILLINGHAM

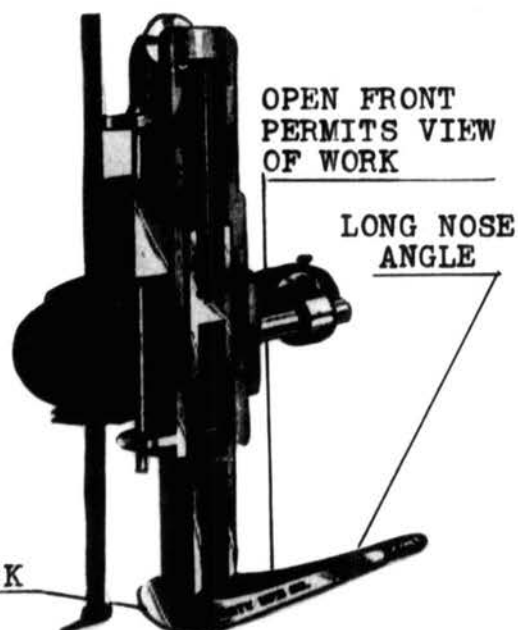


FIGURE 18



AUTOMATIC PROTECTION ON  
BACK AND SIDES OF SAW

FIGURE 19  
FLOHR POINT-OF-OPERATION GUARD



ROUND BACK PREVENTS DRAG ON STOCK

FIGURE 20  
SURTY #100 POINT-OF-OPERATION GUARD

lengths will actually provide point-of-operation protection. It affords ample clearance from the stock and the automatic feature gives protection from back of the saw as well as the sides. The open front construction permits a view of the saw.

Limitations: This guard appears to be cumbersome and to shade the line of work. Unless the machine is equipped with a built in electric light, this shadowing may cause an improper cut to be made.

### C. Conclusions

Great progress has been made in safeguarding the band saw. Instead of having crude built on guards, the band saw guards are designed and built into the machine itself. Lack of kickback dangers and the complete guarding of all movable parts except the point-of-operation makes the band saw one of the safest of all woodworking machines.

To be considered adequately guarded, both the upper and lower wheels of the band saw and the entire saw run must be encased in metal guards. A guide post with channel guards should provide protection for the downward travel of the blade between the upper wheel guard and the table. Providing a breaking device and a means of proper waste elimination would greatly reduce the accidental injuries chargeable to the band saw.

Although considered one of the safest of all woodworking machines, the band saw can not be considered completely safe until a guard is devised which encloses the point-of-operation



without limiting visibility and yet eliminating the possibility of careless contact with the blade. Furthermore, accidents will continue to occur until a method is devised to protect the operator in all cases of blade breakage.

## CHAPTER VI

### THE SURFACER

The planer or surfacer differs from the jointer in that stock is fed into it by mechanical means and is planed to uniform thickness. The jointer is hand fed. This machine differs from other woodworking machinery in that only one operation is performed on it. This operation is planing to thickness.

#### A. Preliminary Considerations

The single surfacer or planer is considered one of the safest woodworking machines to operate. Because of this, very little statistical information is available. A table compiled by the officials of the United States Department of Labor shows that 20.8 per cent of all woodworking machine compensated injuries in the State of New York were caused by surfacing and edging machines. Of the 1,086 injuries, 80 per cent were produced by the jointer. The remaining 20 per cent were divided between tenoners, planers, moulders, stickers and edgers. Although the machine is considered safe, it is well to remember that accidents can and will happen if carelessly operated. If an accident occurs on this machine it may be of a serious

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<sup>1</sup> United States Bureau of Labor Statistics, Department of Labor, Bulletin 67, Safety Subjects. 1944, page 93.

nature.

Types of Accidents: The chief hazards encountered while using the surfacer are getting the fingers caught in the rollers, knives flying out of the machine and the danger of kickbacks. It is not often that the operator becomes careless enough to get his fingers in the knives. This usually occurs when the operator is trying to clean the sawdust from the feed table or trying to plane too short a piece of stock. The shortest piece of stock to be planed should be at least 14 inches or two inches longer than the distance between the rolls in the bed.

The danger of kickbacks can not be entirely eliminated by mechanical devices. Kickbacks occur when trying to plane stock of varying thicknesses at the same time or planing pieces shorter than 14 inches. This is especially dangerous if the operator is stooping down and looking into the machine. The high speed of the cutting knives occasionally cause chips to be thrown back with great violence.

Types of Operations: Table VI lists the types of work that can be done and the hazards encountered while using the surfacer.

Types of Guards Required: Existing guards and careful instructions in how to operate it make the surfacer a comparatively safe machine. A properly guarded machine should have the cutter head completely enclosed in solid metal guards which should be kept closed when the planer is running. There should be a good exhaust from the cutting heads.



TABLE VI SURFACER ANALYSIS

Types of work done	Hazards Encountered	Prevention
Surface planing	Kickbacks striking operator in legs or groin.	If planer is equipped with sectional feed rolls, feed narrow boards at lateral intervals of 3" to 5".
Narrow boards planed to exact width while held upright by two side guides	Kickbacks striking operator in face or eye as he looks into the machine.	Stand to one side out of line with the board travel.
	Fingers or hand caught between in-feed rolls.	If solid feed rolls are being used, never plane boards of varying thickness at same time.
		Never bend down to look into the surfacer while it is running.
		When the rolls grip the board, let it go.
		Do not push with the hands a short piece that is stuck in the machine.
		Do not attempt clean shavings from the table while the cutter is running.
		Install guard over in-feed rolls.

All moving parts such as belts, pulleys, chain drives, gears etc., should be guarded by sheet metal or heavy mesh guards. Feed rolls should be guarded by a wide metal strip or bar which will allow boards to pass through but which will keep the fingers out of the rollers. To avoid being struck by kickbacks, the operator should stand to one side out of line of the board travel.

#### B. Analyses of Selected Guards

Only a small amount of material is available on the surfacer. After carefully studying manufacturers' catalogs and illustrated materials, the following surfacing machines were selected for study. The machines selected show clearly the various safety features of the surfacer.

Manufacturer: Surty Manufacturing Company.

Machine: Sectional Safety Stop. (See Figure 22)

Manufacturer's Guard, Type and Installation: A steel sectional stop is installed in front of the feed rolls on the single surfacer planer. It is especially adapted and recommended for solid roll planers.

Function: The sectional safety stop is installed so as to clear the table by one-eighth of an inch. The automatic adjustment of the dogs permits the handling of any thickness of material. It provides kickback safety and makes it almost impossible for the operator to get his hand into the rollers. This is one of the very few guards available for installation

on a surfacer.

Analysis: The sectional safety stop is made up of swinging steel dogs. When the stock is pushed toward the rolls, the dogs swing back. The single sharp point of each section digs into the lumber and prevents it from being thrown backward. It is especially effective when short stock is being planed.

Limitations: This guard is adaptable to all styles and makes of planers. It appears to have the point-of-operation well guarded. One of the chief drawbacks is trying to straighten stock while the machine is running. If a piece of stock is caught at an angle it can not be straightened with a strong pull. The dogs gripping the board will force the operator to shut off the power and lower the bed in order to remove the stock and start the cut over.

Manufacturer: Parks Woodworking Machine Company.

Machine: Parks No. 20 Planer. (See Figure 21)

Manufacturer's Guard, Type and Installation: A strong sheet metal guard covers the cutter head. All power transmission apparatus is enclosed.

Function: The steel guard over the cutter head prevents contact with the knives. It also serves to deflect the shavings and throw them on the floor. The steel and semi-steel frame protects the operator from all of the moving parts except the in-feed rolls which constitute a serious hazard.



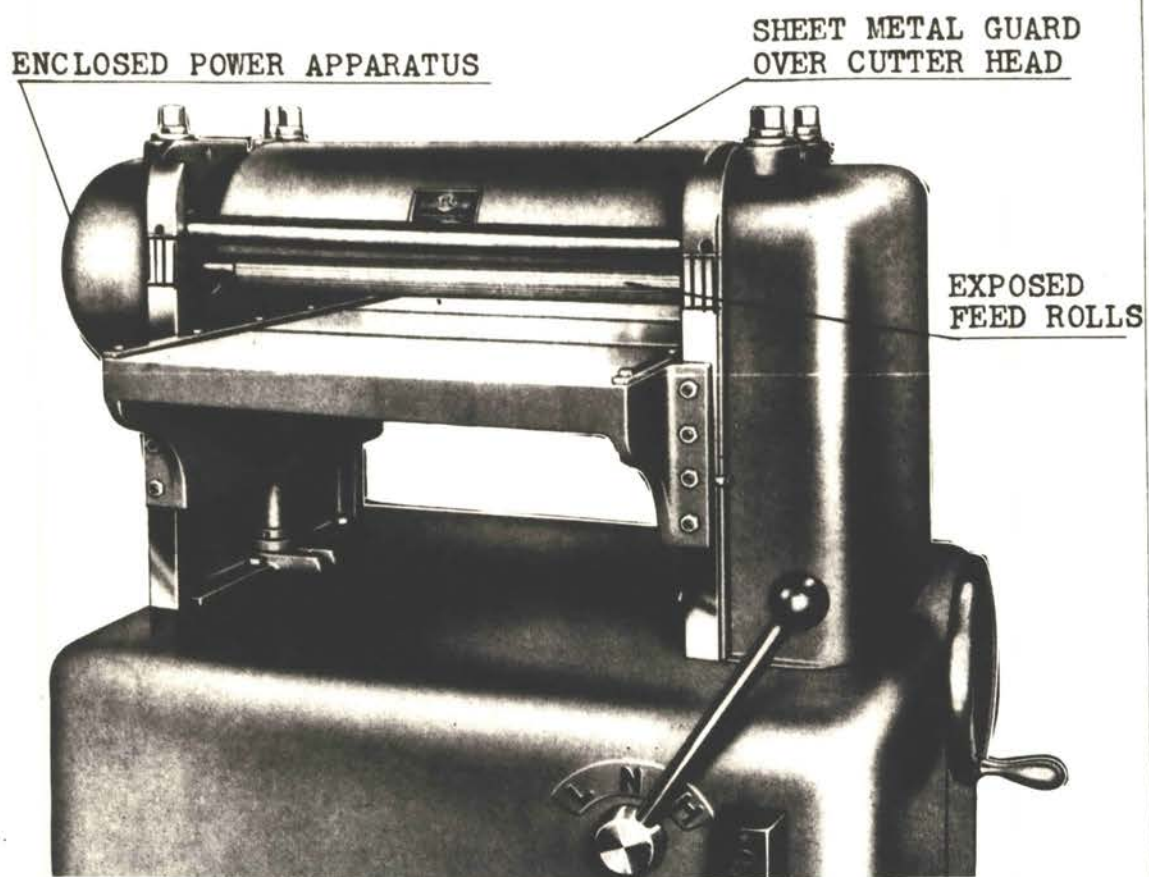


FIGURE 21  
PARKS NO. 20 PLANER

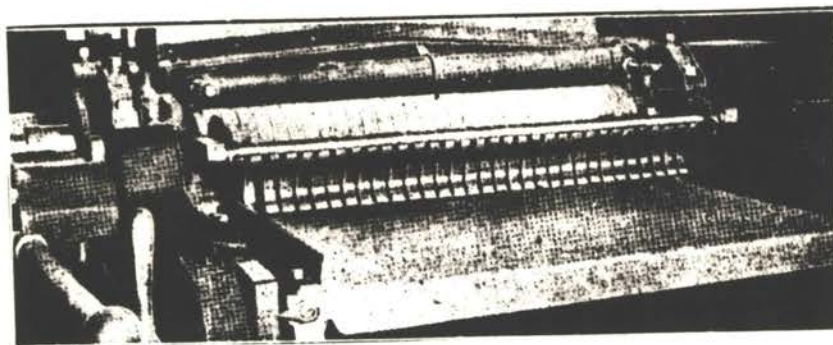


FIGURE 22  
SURT Y SECTIONAL SAFETY GUARD

Analysis: The steel guard and shavings deflector cover the head and can be easily removed for accessibility to the working parts. The frame is made of steel and semi-steel construction. All power transmission apparatus is protected inside the frame.

Limitations: This machine is typical of the surfacing machines found in the woodworking shops of today. The feed rolls are badly exposed. The feed roll and chip breaker are solid rather than sectional. Sectional feed rolls are considered to be safer. There is no provisions made to take care of the kickback hazards. A piece of angle iron  $3/16" \times 2\frac{1}{2}" \times 2\frac{1}{2}"$  and three inches longer than the capacity of the machine, fastened to the shaded surfaces (Figure 21) will guard the feed rolls; or the Surty Sectional Safety guard may be installed here.

Manufacturer: Oliver Machinery Company.

Machine: Oliver No. 299 Single Surface Planer. (See Figure 23)

Manufacturer's Guard, Type and Installation: Metal guards protects the feed rolls and knives. All revolving parts, except two universal joints, are fully enclosed in cast chambers.

Function: The machine guards comply with the safety standards. They protect the operator from the cutting knives and power transmission apparatus. The sectional chipbreaker provides greater safety than the solid chipbreaker.

Analysis: The Oliver No. 299 is provided with a sectional

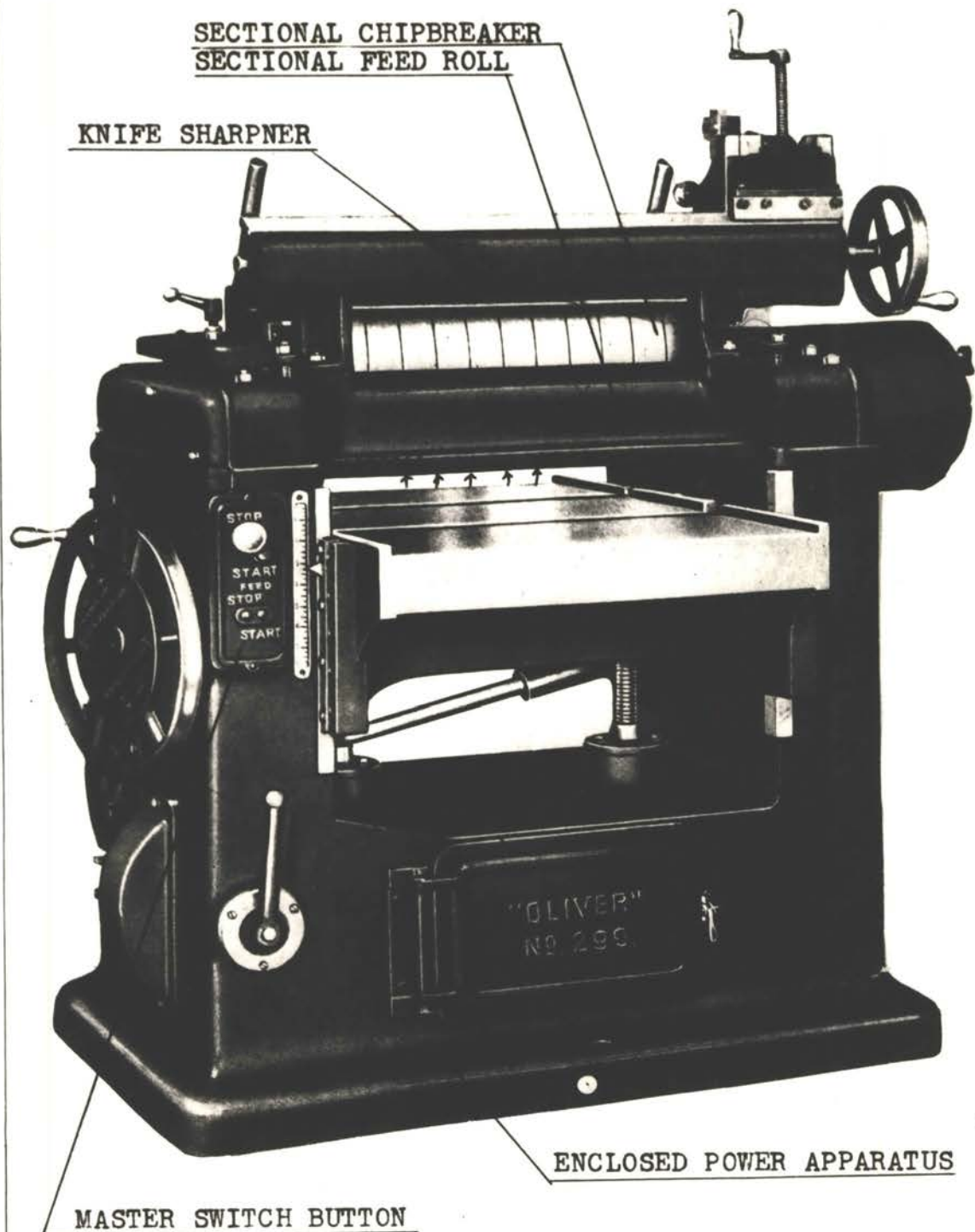


FIGURE 23

OLIVER NO. 299 SURFACER



feed roll and sectional chipbreaker. The feed roll consists of twelve two inch cast steel sections mounted on an alloy steel forged spider. This affords greater protection while surfacing narrow boards. The sectional toes of the chipbreaker are two inch cast steel forms.

The attached knife grinding and jointing device allows the knives to be sharpened without removal. This keeps the knives in a true position. All electrical and mechanical control is centralized at the front of the machine. Start and stop buttons control the cutter head and feed rolls. The master stop button disconnects both cutter head and feed motors and applies brakes to the cylinder for a quick stop.

Limitations: The sectional feed roll and chipbreaker serve to prevent kickbacks. No device prevents the operator from getting his fingers into the rollers if he attempts to clear the bed of shavings while the machine is running. Note the exposed in-feed rolls shown by the several arrows in Figure 23. This construction will allow hands to be caught and pulled into the machine. By installing a piece of angle iron  $\frac{1}{4}" \times 1\frac{1}{2}" \times 2\frac{1}{2}"$  on the surface crosshatched, with the  $2\frac{1}{2}"$  surface in the horizontal plane, these rolls may be completely guarded; or the Surty Safety Guard (See Figure 22) may be installed.

### C. Conclusions

The planer or surfacer is a machine which planes boards smooth and to an even thickness. The modern surfacer is a

powerful machine with a casting, between the sides of which a heavy table can be raised or lowered, a cutter head mounted over the table, and four feed rolls making up the main parts. The surfacer may be equipped with two cutter heads which plane two surfaces at the same time; or it may have a single cutter head which planes only one surface. The latter is the most popular for use in the high school woodworking shops and small cabinet shops.

Safety Measures: The surfacer is considered one of the safest of all woodworking machines, but no machine can prevent accidents without the cooperation of the operator. The surfacer may be operated safely if the operator will practice a little personal safety. Fewer accidents would occur if the operator would remember the following things:

1. The operator must always remember to stand out of the line of the board travel. This avoids kickback injuries.
2. Never try to plane a board that is less than 14 inches in length.
3. Boards of varying thickness should not be planed at the same time.
4. One surface of a warped board should be planed straight on a jointer before it is put through the surfacer.
5. Do not look into working portion of machine when it is in operation.

Frequently a board gets caught and jams the mechanism. If the board is long it may be straightened with a quick side-wise pull. If too short or too wide a piece of stock jams, the machine should be stopped, the cutterhead raised, the stock

removed and the table reset.

Kickbacks: Kickbacks create the greatest hazard.

Although not too frequent, or of a fatal nature, these kickbacks can cause severe injury. Mechanical devices will not entirely prevent these kickbacks. If the operator will stand to one side and have a helper, many kickback injuries will be eliminated.

Reaching Over Small Machines: With the availability and use of small surfacers, those with capacities of 12", 14", 18", 24" etc., the operator is inclined to reach over the machine to receive the stock as it comes out of the machine. This act defies all safety rules. There is a possibility of the operator slipping and falling into the machine or getting chips in the eyes. To require the use of a helper would eliminate this practice.

STRATHMORE PARCHMENT

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## CHAPTER VII

### GUARDS FOR USE ON THE SHAPER

The shaper is a machine used for rabbeting, grooving, fluting, beading, and shaping all kinds of moldings. It is one of the most useful of all woodworking machines, but also one of the most dangerous. The high speed of the cutter head and the danger of flying knives puts this machine on the highly hazardous list.

Shapers are made in types and sizes varying from the large production type with two spindles to the small bench and portable types. Because of the wide variety of uses, this machine is indispensable to industries which specialize in woodworking.

#### A. Preliminary Considerations

Safeguarding the shaper presents a very difficult problem. Because of the varied types of work performed on the shaper, a variety of guards must be devised and used. No single guard can be adjusted to fit all the protection needs of the operator. The guards available are not incorporated in the machine. They must be installed separately and are usually furnished on special order and at additional cost.

Types of Accidents: Of the 5,235 compensated woodworking



injuries reported in New York State in 1944,<sup>1</sup> 7.3 per cent were shaper injuries. The principle danger comes from hands striking the knives. Severe accidents are caused by broken knives being thrown. Although there were no fatalities in the reported 7.3 per cent previously mentioned, broken knives may be thrown with sufficient speed and force to kill a person standing a considerable distance from the shaper.

Table VII shows the type of work, accidents, and accident prevention activities relative to the shaper.

Types of Guards Required: Guarding the wood shaper is a very difficult problem. Because of the varied works for which this machine is adaptable, more than one guard is necessary. To protect the fingers, a number of guards are available. All of these should cover the spindle and knives and clear the table just high enough for the stock to pass between the table and the guard. The American Standard Safety Code for Woodworking<sup>2</sup> contains a recommendation for guarding the cutting head with a cage or adjustable guard. This shall be so designed as to keep the operator's hands away from the cutting edge. The diameter of the circular shaper guards shall be not less than the greatest diameter of the cutter.

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<sup>1</sup> United States Bureau of Labor Statistics, Department of Labor, Bulletin 67, Safety Subjects. 1944.

<sup>2</sup> American Standard Safety Code for Woodworking Machinery. American Standards Association, Approved February 25, 1944.

TABLE VII ACCIDENT ANALYSIS OF THE SHAPER

Type of work	Accident Hazards	Prevention
Cutting grooves and rabbets on straight stock.	Flying knives caused by improper installation and broken knives.	Use a fence or jig whenever possible.
Shaping or molding a straight edge.	Careless contact with the knives.	See that knives are well balanced as to height, and width before starting the machine.
Making a rule joint.	Inadequate training of the operator.	Do not wear loose or ragged clothing.
Fluting and reeding.	Backing-up material pulling the hands into knives.	Tuck in necktie and roll up sleeves.
Shaping curved edges.	Improper setting of machine as to floor and working space.	Do not attempt to shape small pieces.
Planing edges by use of a template.	Improper clothing.	Have ample floor space to care for the largest materials to be used. Use helper when helper is needed.
	Kickbacks due to starting work at middle instead of at end.	Never "back up." Stop the machine and start again.
		Start machine in a series of short starts and stops until required speed is reached.
		Use braking device to stop revolving spindle instead of the hand.
		Use solid cutters if possible.

TABLE VII (continued)

Type of work	Accident Hazards	Prevention
		Keep major portion of cutter below top of shaper table.
		Always use cover guard. Use manufactured one if available, otherwise devise one of wood.

The best prevention against thrown knives is to use the solid cutterheads. The cost may be greater but the safety value is greater also. When loose knives are used, the engineering staff of the Industrial Division of the National Safety Council offers the following suggestions.<sup>3</sup>

1. Knives must be of the best obtainable shaper steel, purchased according to rigid specifications.
2. Shaper knives must be set only by a fully qualified shaper man.
3. Knives and grooves in the collars must fit perfectly and be absolutely free of dust.
4. The two knives in the shaper must balance perfectly. They must be weighed against each other in a beam balance every time they are set.
5. Shaper knives must not be used after they have become so short that the butt end does not extend beyond the middle point of the collar.

<sup>3</sup> Accident Prevention Manual for Industrial Operations, National Safety Council, Chicago, Illinois. page 157-159.



6. Deep cuts should be avoided. It is more efficient and safer to take two light cuts than one heavy one.
7. When starting a shaper, the operator should apply the power in a series of short starts and stops so as to bring the spindle up to operating speed slowly. While doing this, he should watch and listen carefully for chatter or other evidence that knives are out of balance.

The use of jigs while shaping narrow or thin stock will keep the hands away from the knives. It is a good policy for a limit to be set on the minimum width of stock to be shaped. Some shops use a six inch minimum, other use a twelve inch limit.

#### B. Analyses of Selected Guards

After carefully considering available material, we find that all shaper guards serve the same purpose. The guards may vary in design. The following guards are examples of the most popular shaper guards.

Manufacturer: Greenlee Brothers and Company.

Machine: Shaper Guards. (See Figures 24, 25, 26)

Manufacturer's Guard, Type and Installation: This company makes various types of hold-downs, guards, and rubber rings to meet the requirements of a great variety of shaping operations. The guards are attached to a common standard which is bolted to the table. Vertical adjustment is made by means of a hand wheel. Horizontal adjustment is made by adjusting two sliding arms with thumb screws. These arms support the hold-down bar.

Function: These guards make shaping more accurate and



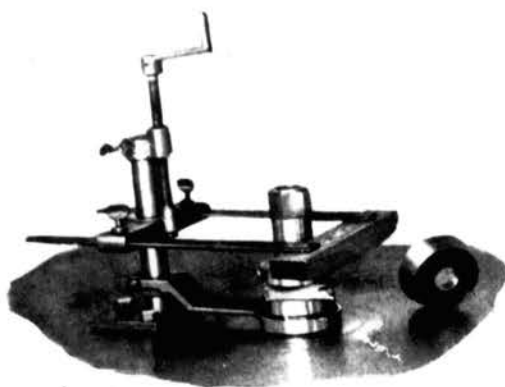


FIGURE 24

HALL SHAPER GUARD AND RUBBING COLLAR

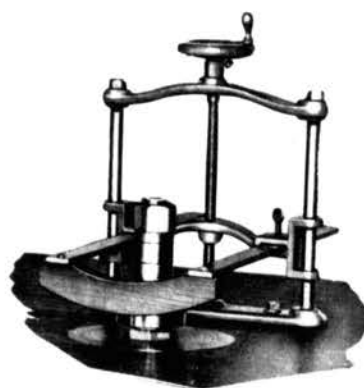


FIGURE 25

VARIETY SHAPER HOLD-DOWN GUARD

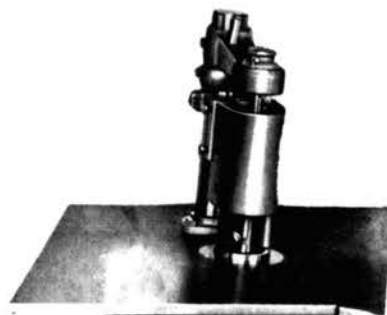


FIGURE 26

GREENLEE GUARD FOR SQUARE CUTTER HEAD

prevent accidents. They serve as a hold-down for the material being shaped. They prevent careless contact with the knives. All seem to be too flimsy and of inadequate guarding coverage.

Analysis: These guards are simple in design and construction. They give some protection for most shaping operations. They serve as a hold-down yet do not obstruct the view or trap waste products. The heavy sheet metal guards shown in Figure 27 are used on square-head cutters. They are quickly adjusted to take care of changes in work to be shaped.

Limitations: These guards do not furnish any protection against broken knives. The presence of these guards hinder the changing and adjustment of the knives.

Manufacturer: J. D. Wallace and Company.

Machine: No. 18 Shaper. (See Figure 27)

Manufacturer's Guard, Type and Installation: The spindle guard is a hat shaped guard. It is clamped to the edge of the table and projects over the spindle. It is cushioned with a spring for vertical adjustment. The adjustable iron fence fastened to table with screws serves as an additional guard.

Function: The guard encircles the upper portion of the spindle and knives. It serves to protect the fingers. The all over cup serves as a guard against flying knives.

Analysis: This aluminum guard is detachable and may be used when shaping with rubbing collars as well as with the

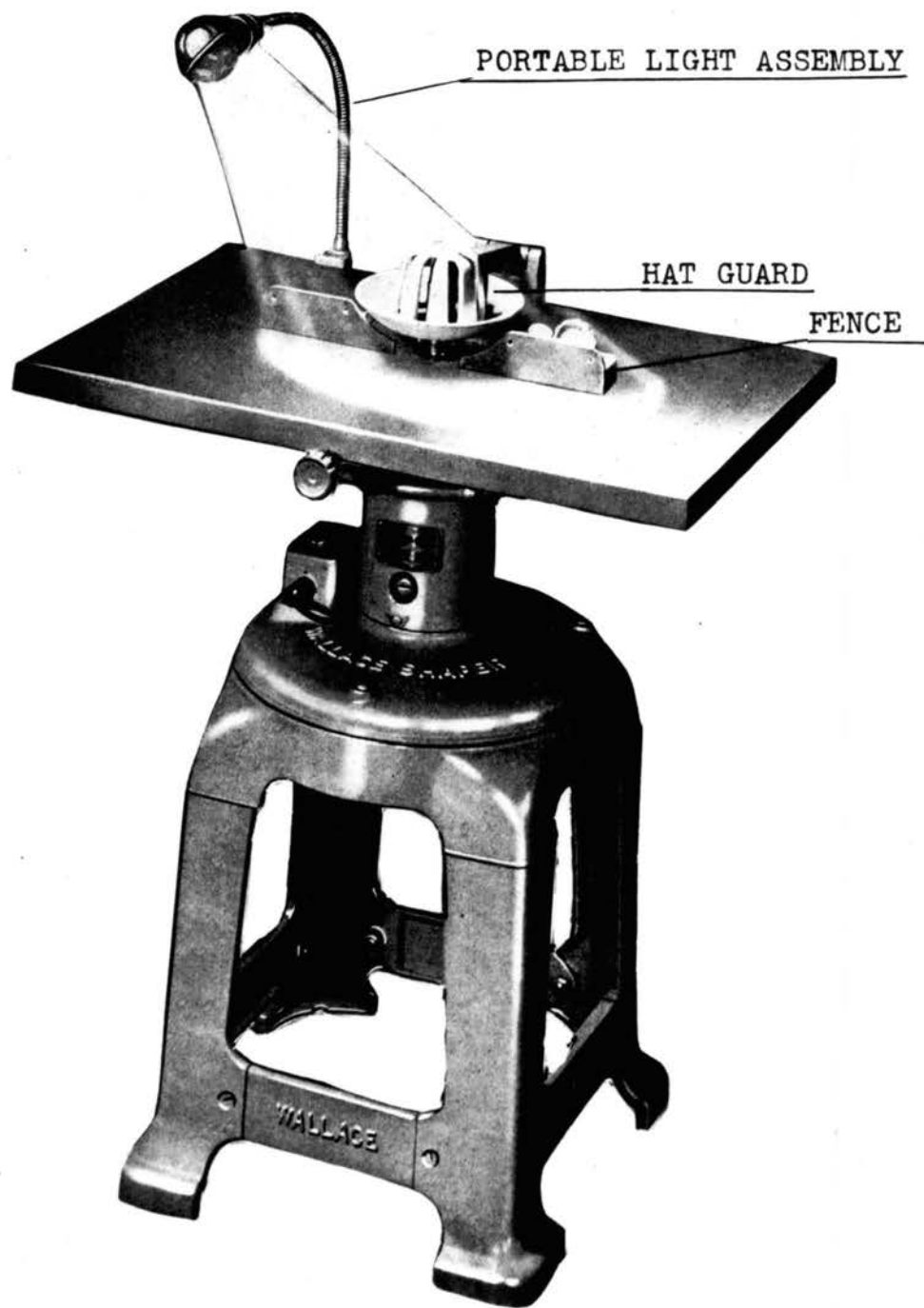


FIGURE 27

WALLACE SHAPER NO. 18

fence. The guard may be swung back over the table while the knives are being adjusted or changed.

Limitations: This machine has no brakes or automatic stopping device. The guard cuts down the visibility of the cut. No means of waste exhaust is provided. The guard furnishes some protection from broken knives but aluminum casting will not withstand too much pressure. The cup rests on the stock but the spring load prevents it from being classified as a hold-down. It can not be fastened rigidly in one position.

Manufacturer: Flohr Manufacturing Company.

Machine: Automatic Shaper Guard. (See Figure 28)

Manufacturer's Guard, Type and Installation: A box type guard is attached to the back of the table. Vertical and horizontal adjustments are easily made. The cutting aperture opens to take care of the largest shaper blade. A pressure foot with a reversible kickback finger is attached to the guard arm.

Function: This guard is the latest development in protection from shaper accidents. The box encloses the head and serves as a protection against flying knives. Personal contact with the knives is almost impossible.

Analysis: This guard is suitable for any style or shaper type of work. It is made in sizes to take from 4 inch to 12 inch heads. A sliding pressure-foot-tension equipped with springs holds the work firmly to the table. This spring allows for sliding variations in thickness of material. The kickback



finger attached to the pressure bar prevents a kickback of material by the knives. This feature has never before been incorporated in a shaper guard.

Limitations: This guard seems to furnish complete protection. It completely obstructs all view of the work. The parts seem light in construction.

### C. Conclusions

There have been only a few changes in the design of the shaper in several years. All major changes have been made to make the machine safer, rather than alter the fundamental principle of the construction and operation.

Of the two major problems which confronted the safety engineers, the problem of safeguarding the source of power transmission apparatus has been more nearly completed. The introduction of the individual motor drives to replace the belt and pulley drives make it possible to enclose all moving parts within the machine frame.

The problem of guarding the point-of-operation has not been so easy to solve. The development of a braking device to stop the spindle has eliminated the practice of stopping it with the hand. The introduction of the solid cutterhead is a major forward step. This cutter is recommended by the National Safety Council to replace the separate knives. This eliminates the possibility of accidents from broken and thrown knives. Many safety collars are being used to keep the fingers away from the knives.

What the Guard Must Do: To be considered adequate, the shaper guard must do three things. It must prevent flying knives; it should completely cover the knives to protect the operator's hands; and it should serve as a hold-down for the stock and should help to prevent kickbacks.

Existing guards for covering the point-of-operation include the box guard, (See Figure 28) the variety hold-down (See Figure 25), the bell guard, the ring guard, (See Figure 29) and the cup guard. (See Figure 27) All these keep the fingers from the knives when shaping ordinary stock. In shaping short pieces or thin stock, special jigs can be made and used successfully.

Most shaper guards are furnished as extra equipment and at additional cost. Because of this practice, operators rely more on their own knowledge of operation rather than on guards. It is possible that some operators may work for years without an accident. It is also possible, that if the attention is allowed to stray for one second, a serious accident may occur. Practical advice would be to use all safety guards as well as practice safety first.

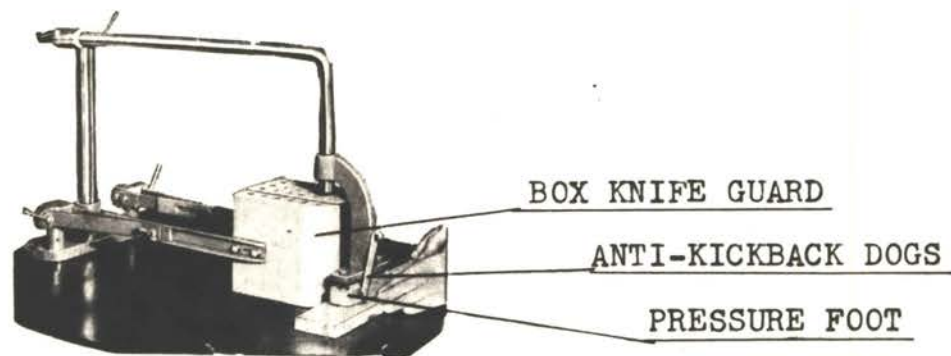


FIGURE 28  
FLOHR SHAPER GUARD



FIGURE 29  
SURTY RING GUARD

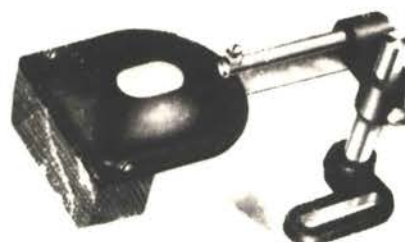


FIGURE 30  
BOICE-CRANE SHAPER GUARD



## CHAPTER VIII

### GUARDS FOR TOOL GRINDERS

Tool grinders are generally considered as metalworking machines. However, most woodworking shops, especially those that make use of a number of hand tools, are equipped with tool grinders. High school woodworking shops are usually equipped with tool grinders.

Accidents on the tool grinder are very infrequent if the wheel is properly used, cared for and protected. They are not to be considered too safe though. The speed with which the machine operates increases accident possibilities.

#### A. Preliminary Considerations

The most important parts of the tool grinder are a stand, one or more grinding wheels mounted on a spindle, and an electric motor. The grinding wheels are usually known as emery wheels. This name is incorrect, however, because very few are made of emery. The majority are of artificially made abrasives such as carborundum and some bonding material. These wheels can be very hazardous if subjected to abuse.

Types of Accidents: The statistical data available on abrasive wheel accidents include the metal-working industries. No data are available which pertains to woodworking shops alone.

The eyes receive the brunt of grinding wheel injuries.



Flying particles and sparks cause injury and infection to the eyes. Too much can not be said about the necessity of furnishing and insisting upon the use of protective devices for the eyes. Injuries from broken wheels are less frequent than eye injuries, but are usually very serious. Broken wheels may result from over speeding, improper mounting and improper use. Burns and abrasions occur when the operator comes in contact with the turning wheel. Where tool grinders are used constantly, the dust creates a respiratory hazard. This does not happen in small shops or high school woodworking shops where the tool grinder is used only occasionally.

Types of Guards Required: The manufacturers of tool grinders are realizing the importance of user safety and are giving it their fullest attention. They have accepted the safety codes as approved by the American Standards Associations and are making their machines in accordance with them.

Eye injuries are prevented by the use of goggles and shatter-proof glass shields over the grinding area. Goggles should be worn even for short grinding jobs. All grinding wheels used in ordinary shops should be equipped with non-shatter glass shields. These shields fit over the grinding area and are equipped with a light to illuminate the work.

The grinding wheel should be protected with a hood. This hood should have a cutting aperture of not more than 90 degrees. This hood should be of adequate strength to hold a bursting wheel. An adjustable lip is attached to compensate for the wear of the wheel and to act as a spark arrester.

Tool rests should be securely mounted and adjusted to a distance of not more than 1/8 inch from the wheel. These rests should be shaped to fit the contour of the wheel. They will help prevent wedging the work between the grinding wheel and the hood.

#### B. Analyses of Selected Guards

In selecting guards to be analyzed, attention was given to those which would be suitable for use in the woodworking shop. These guards were selected after carefully considering the safety features of each. Manufacturers' catalogs and illustrated literature furnished the source of information.

Manufacturer: Delta Manufacturing Company.

Machine: Delta Bench Type Motor Grinders. (See Figure 31)

Manufacturer's Guard, Type and Installation: The abrasive wheel guards are made of heavy cast iron with steel side plates. A steel spark guard is attached to the wheel guards and is adjustable to take care of the wear on the wheel. Tool rests are slotted and fit closely to the face and sides of the grinding wheel. The tool rests are also ample in size. They are adjustable and can be moved in as the wheel wears and becomes smaller in diameter. Safety eye shields of generous size are provided as standard equipment with all Delta tool grinders. These eye shields are lighted when the machine is turned on. The dust is exhausted through chutes at the rear of the wheel.

Function: The heavy wheel guards are designed to protect the operator from the dangers of broken wheels, flying particles, dust and grit. The tool rests extend along both sides and across the face of the wheel. They are fully adjustable vertically and horizontally. The eye shields are equipped with shatter-proof glass. Twin lights are included with the shield to illuminate the work.

Analysis: The grinding wheel is completely enclosed except for the actual working portion which is exposed by a 90 degree opening in the hood. Removal of the wheel guards permits changing of the wheel. The hood, adjustable spark guards, and the eye shields afford adequate protection from broken wheels and flying sparks. The eye shield is equipped with twin lights which illuminate both sides of the work. They are wired to the motor switch so as to go on and off with the motor operation.

The Delta Company furnishes several safety devices at additional cost. Among these we find attachments to be used in drill grinding, plane bit grinding and a holder for tool dressers. A dust collecting machine is a very important addition to any safety program. This box is attached to the dust chutes of the Delta grinders by means of long tubes.

Limitations: The Delta tool grinder is completely equipped for safe operations. It furnishes complete protection to the operator. The water cup could be more conveniently located. Placing it between the two wheels would make it accessible when working on either wheel. If the cup were

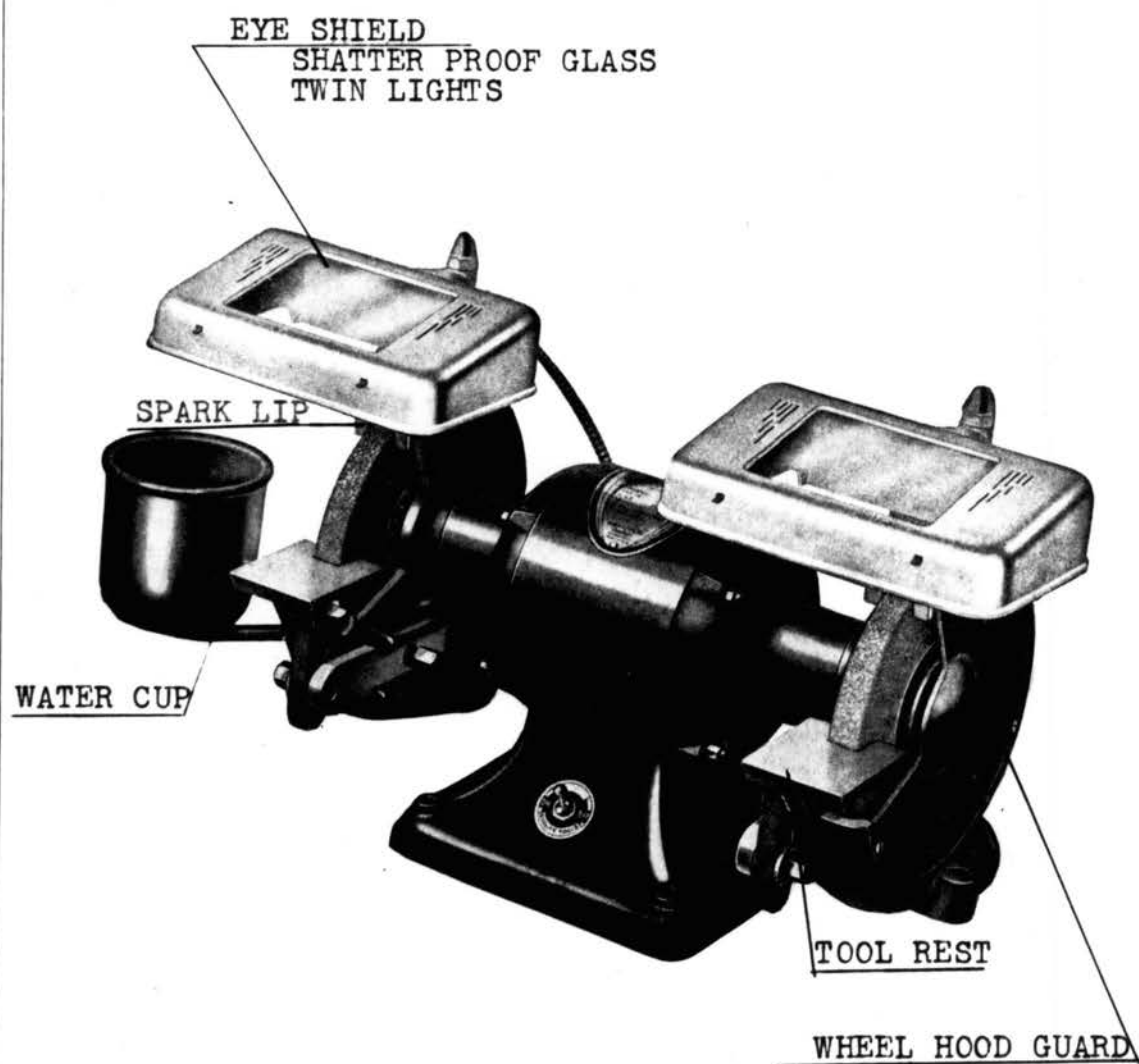


FIGURE 31  
DELTA BENCH GRINDER



located here, it should be mounted below the motor switch. This machine, generally used in the woodworking shop, is suitable for most tool grinding jobs. However, the speed is too great to obtain best grinding results on plane bits.

Manufacturer: Oliver Machinery Company.

Machine: Oliver Number 585 Grinder. (See Figure 32)

Manufacturer's Guard, Type and Installation: All gears and bearings are enclosed with cast iron covers. A steel hood with a 90 degree opening covers the emery wheel. The emery cone, used to grind inside curves of tools, is encased in a steel guard. When not in use, the guard completely covers the cone. A right angle tool rest on the emery wheel permits grinding on the side of the wheel. A tilting table equipped with a special tool holder is attached in front of the oil stones.

Function: The hood guard and tool rest of the emery wheel protects against broken stones and flying sparks. The tool holder for the oil stones hold chisels, plane bits and other small tools and prevent them from jamming the wheels.

Analysis: The operative units of this machine consists of two oilstone wheels, one emery wheel, one emery cone and one leather stropping wheel. The oilstone wheels, one of heavy and one of fine abrasives, are used to sharpen small tools. An automatic saturation system with special wipers are provided for each stone. The tool table for the oilstone

wheels may be adjusted horizontally and tilted to any angle. The emery wheel is used for general dry grinding.

Limitations: The emery wheel is not equipped with a spark lip. The tool holder does not conform with standard regulations. The right angle rest permits grinding on one side of the wheel only. The eye shield is furnished as extra equipment. It is not equipped with non-glare lights. This item should be included as standard equipment. No provisions are made to exhaust the dust. The water cup of the emery wheel is not detachable and would be hard to keep clean.

### C. Conclusions

The grinding wheel is one of the oldest of all machines. It has developed from the hand-operated grindstones with natural sandstone wheels to a powerful electrically driven machine with many uses. The modern abrasive wheels are delicate, and dynamically balanced. They are made of abrasive particles which are held together by an artificial or natural mineral or natural organic bond. They must be carefully fitted, and properly cared for or they may become very dangerous.

Guarding the Tool Grinder: The American Standards Association has set up a code on abrasive wheels. These standards have been accepted by manufacturers and most users. In states where safety codes exist, this code is generally accepted.

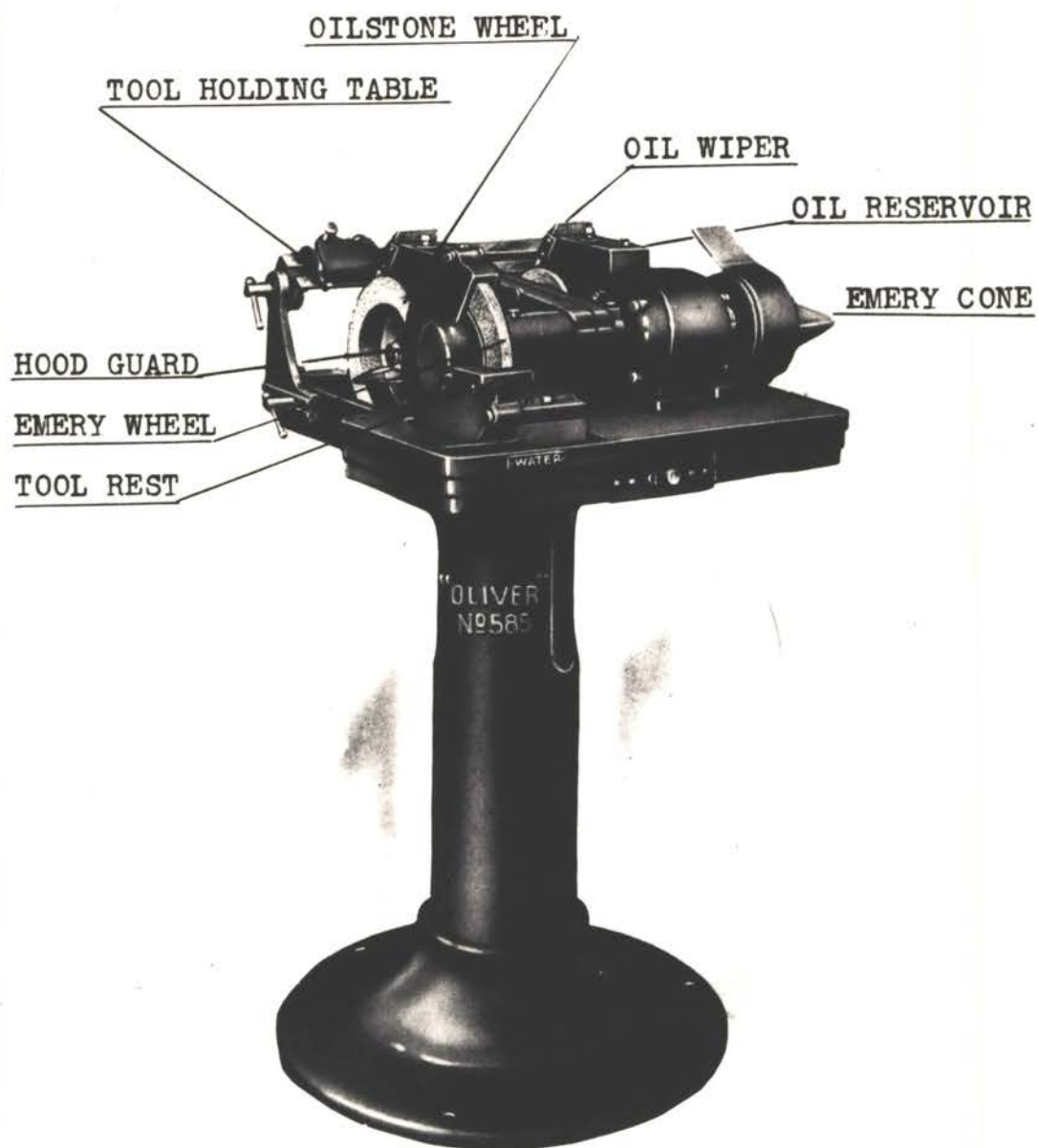


FIGURE 32  
OLIVER TOOL GRINDER NO. 585

Eye protection is fundamental in guarding the tool grinder. Even for the smallest jobs, the operator should wear goggles and use the protective shield which is attached to the machine. In larger shops, each person should have his own goggles, carefully fitted and provided with prescription lenses if necessary.

The wheel should be enclosed with a hood, preferably one which covers the end of the spindle. The opening in the hood should not be too large. Tool rests should be provided.

The abrasive wheel, like any other tool, needs a periodical cleaning. The pores sometimes clog with dust and particles of steel. These tend to dull the stone and cause improper cutting. They should be cleaned with a dressing stone or heated in an oven.

Many feel that small abrasive wheels are not as hazardous as large ones and do not require as much protection. This is a mistake. The pieces of a small stone are thrown with the same velocity as those of the large stone and can cause serious damage.

The tool grinder will be completely safe if we consider the following:

1. Careful selection and mounting of wheels.
2. Proper use of and care of the stone.
3. Wearing of goggles.
4. Using protective devices furnished with the machine.
5. Complete instruction to operator on speeds and types of work to be performed on the tool grinder.



## CHAPTER IX

### SAFETY EDUCATION THROUGH VISUAL AIDS AND PERSONAL PROTECTION

Accidents will continue to occur, even with all machinery carefully guarded, until all machine operators are completely safety conscious. Visual aids and personal protection equipment are used to educate the operators in effective safety measures.

#### A. Visual Aids

Visual aids command the attention of the students, increase interest and causes students to want to learn. A person who has been taught through visual aids will remember the facts much longer than one that has been taught by the question-answer method. The most effective mediums of visual education are the bulletin boards, motion pictures, safety literature and safety signs.

1. Bulletin Boards: This is the most widely used of all visual aids. These boards, properly located, lighted and maintained can serve as one of the most effective means of getting across safety messages. The boards should be attractive. They should be well lighted and the displays protected by glass. Green has been found a practical color for the boards. This color is easy on the eyes and does not show dirt or need repainting so often.



FIGURE 33  
BULLETIN BOARD

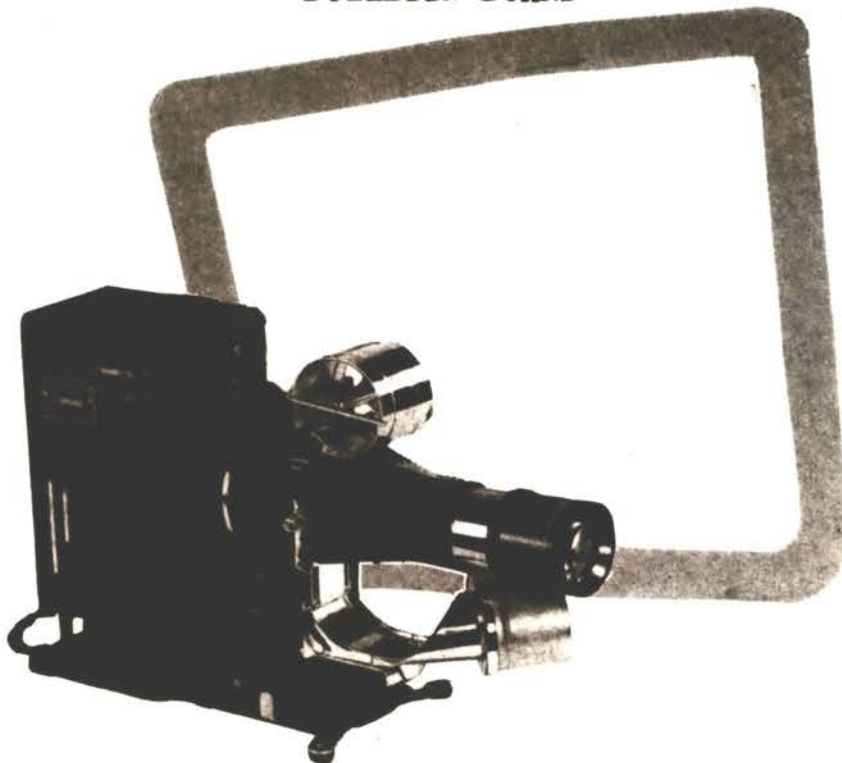


FIGURE 34  
MOVIE PROJECTOR AND SCREEN

To make a bulletin board effective, the posters should be changed as frequently as possible. The posters should be carefully selected as to the needs of the department where they are displayed. (See Figure 33)

2. Motion Pictures: Everyone knows that a picture is more effective than words, thus motion pictures and film strips play an important part in visual education. Through these mediums, safety practices are depicted so forcefully that they make a lasting impression on the mind of the observer. A number of safety films may be bought, borrowed or rented from many sources. Catalogs listing nationally distributed films may be obtained without charge from the National Safety Council and from film producers. (See Figure 34)

3. Safety Literature: New safety books, pamphlets, and other publications are constantly appearing in print. These are listed each year by the National Safety council in a book called Industrial Safety and Health Bibliography.

4. Safety signs: Safety signs are included in the posters used for bulletin board display. They are, however, not confined to this particular use. Safety signs may appear wherever an accident is likely to occur.

Safety signs should be easily seen. They are best seen when located at or below the eye-level. They should be in bold, simple lettering. The message should be short yet not as brusque as an order.

Color has a great deal to do with the make up of safety signs. The color red is associated with danger, yellow with

caution, green with safety instruction, and black with direction signs. The red danger signs should be restricted to such serious hazards as high voltage, explosives, chemicals, etc.

According to the American Standard Association specifications, signs should be made up as follows:<sup>1</sup>

1. Danger signs shall have a white background. Word "DANGER" shall appear in white letters on a red oval inside a black rectangular panel. Sign wording should be black letters on the white background. Danger signs should be used only where an immediate hazard exists. (See Figure 35)
2. Caution signs shall have a yellow background. Word "CAUTION" shall appear in yellow letters on black rectangular panel. Sign wording should be in black letters on the yellow background. Should be used only to warn against potential hazards or to caution against unsafe practices. (See Figure 36)
3. Directional signs shall have a white background. "ARROW" should be in white on black panel. Wording in arrow or below panel should be in black. Used to indicate way to locations; exits, fire escapes, stairways, first aid rooms, etc. (See Figure 37)
4. Informational signs may be of a variety of designs and colors, except that neither red nor yellow shall be used. They convey information not necessarily of safety nature, but tend to avoid confusion and misunderstandings. (See Figure 38)
5. Safety instruction signs should have a white background. If such words as "THINK" or "SAFETY FIRST" are used, they should be in white letters on green rectangular panel. Sign wording should be in black letters on white background. Should be used for general instructions and suggestions relative to safety measures. (See Figure 39)

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<sup>1</sup> American Standards Association Specifications for Industrial Accident Prevention Signs, Z 35:1, 1941.





FIGURE 35  
DANGER SIGN

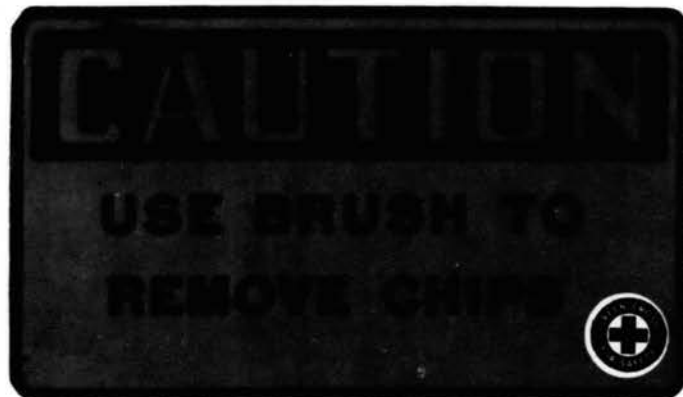


FIGURE 36  
CAUTION SIGN

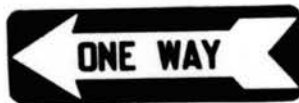


FIGURE 37  
DIRECTIONAL SIGN



FIGURE 38  
INFORMATIONAL SIGN



FIGURE 39  
SAFETY INSTRUCTION SIGN

## B. Personal Protection

Personal protective equipment should be considered as a defense against accidents. Personal protective equipment refers to that which may and should be worn to protect the body. This includes protection for the eye, ear, head, foot, respiratory system and safety clothing.

Since safety clothing has very little to do with the high school woodworking shop, such equipment will be discussed only briefly in this chapter.

1. Eye Protection: Several methods have been designed to protect the eyes from flying objects, corrosive substances and harmful rays. Of these methods, goggles hold first place. Goggles should be well fitted, afford clear vision and be easy to clean. Goggles find a place in the woodworking shop when tool grinders are used.

Face shields are made of plastic and protect the face from sparks as in spot welding. The plastic sheet should be non-flammable, free from scratches and flaws which will cause distorted vision. Acid hoods give the most complete protection if made of soft rubber or rubberized fabric with a glass or rigid plastic window. (See Figure 41)

2. Head and Hair Protection: Safety hats are used for head protection against falling objects. These hats are made of a hard shell supported upon a cradle to keep the shell away from the head and cushion the blow if the top is struck. Many industries furnish these as a part of their safety program. (See Figure 42)

Protection of the hair pertains chiefly to women workers. Accidents are likely to occur at points where the hair comes in contact with moving machinery or pulled up by static machinery. Nets and turbans are not sufficient protection. Specially designed caps which completely cover the hair should be worn.

3. Foot protection: The feet are protected by wearing shoes that are provided with steel toe caps. These caps protect the foot against falling objects. Non-slip soles provide added safety insurance. (See Figure 43)

4. Respiratory Protection: Protection in the form of masks should be used in irrespirable atmospheres. There are many designs of masks. (See Figure 40)

5. Hand and Arm Protection: The problem of hand protection is very complicated. The sense of touch is necessary in all occupations so the protective device can not be rigid. Gloves will not protect the hands from crushing blows, but will provide valuable protection against other hazards. Gloves of canvas or leather will prove satisfactory for most work, however, rubber gloves are used whenever chemicals are present. (See Figure 43)

6. Ear Protection: Ear stopples are sometimes used to protect the ear from loud, prolonged noise. Cotton is not as effective in shutting out the sound as the stopples.

7. Additional Protection: Aprons, asbestos suits, rubberized suits, safety harness and belts all play an important part in cutting down accidents in industries.





FIGURE 41  
EYE AND FACE PROTECTION



FIGURE 40  
RESPIRATORY PROTECTION



FIGURE 42  
HEAD PROTECTION



FIGURE 43  
HAND AND FOOT PROTECTION

PERSONAL PROTECTIVE EQUIPMENT

### C. Conclusions

Visual aids have become a vital part of the safety program. They make it possible to present the safety needs to a large number of persons at one time. The old adage "seeing is believing" may be applied to visual aids. For through the mediums of safety signs and motion pictures, we find that a student retains a greater percentage of facts by seeing them displayed than by reading about them.

It should not be necessary to have to entice or convince a person to wear protective clothes. They should know these devices are provided for the protection of their health. If the potential worker will comply with all safety measures, the problem of personal safety equipment will be mastered to a great extent.

## CHAPTER X

### CONCLUSION

Although the safety movement has been gaining momentum for the past thirty years, there is still a need for a more widespread safety program. The lack of safety equipment is due to the indifference to the necessity for protection. Until recently all emphasis has been placed on production. Machines were selected for their speed, capacity and other qualities which would speed up production. Before a safety program can be a success, the public must be made to realize that a disregard for safety results in a loss to all concerned.

The stress of the recent war has done much to make the industrial owners and workers safety-conscious. Accidents resulting in a loss of time, slowing up much needed production, and a loss of money made it necessary for plant owners to adopt an extensive safety program. This organized program created a demand for the best in safety equipment for the machines used and in personal protective equipment for the workers.

Manufacturers of tools and machines have been slow to respond to the need of incorporating better safety guards in their machinery. As a result of increased pressure of safety groups as reflected by consumer demand, more and greater improvements are being made. Some improved machines include safety features as integral parts of the design; others include

as standard equipment guards which have been listed as extras.

An effort has been made in preparing this study to present information on safety equipment which can satisfactorily be used in the school shop.

The circular saw, the most essential machine of any wood-working shop, is discussed first. The accident rate is necessarily high because of the wide-spread use of the saw and the variety of work it will do. Attempts to reduce accidents have been made by the construction of guards for the power transmission apparatus and the point-of-operation. All power transmission apparatus should be enclosed with sheet metal guards. Kickback dangers and personal contact at the point-of-operation are somewhat eliminated by the use of the hood guard, the splitter, and the anti-kickback dogs. The hood covers the portion of the saw blade above the table; the splitter prevents the binding of the saw and the anti-kickback dogs hold the stock against the table and prevent it from being thrown backward. Although these guards give adequate protection to the operator during the acts of ripping and cross-cutting, many other operations as rabbetting, dadoing, chamfering, grooving, etc. can not be successfully guarded. The accident rate for the circular saw will continue to be high until all operations are successfully guarded.

The jointer, like the circular saw, is indispensable to the woodworking shop. Jointer accidents are frequent and of a serious nature. The most common injury is the loss of the fingers caused by coming in contact with the revolving cutter



head. Designers of machine guards have effectively guarded the jointer for edge planing through the use of the leg-of-mutton guard. This spring pivoted guard is the most common of all jointer guards. Another guard used and considered more effective for surface planing is the stock riding guard. This guard covers the head at all times and serves as a hold-down for the material being planed. The portion of the cutter head behind the fence is guarded by a sheet metal guard attached to the fence. Any adjustment of the fence automatically adjusts the back guard.

The scroll band saw, used primarily for curved sawing, has found a permanent place in the woodworking shop. Accident hazards include breaking blades and personal contact at the point-of-operation. The most extensive guarding designed for the band saw is the enclosing of all moving parts except the point-of-operation. There are one or two guards which may be obtained for the point-of-operation. An automatic braking device should be incorporated in all band saws. The ability to stop the blade quickly when the work is completed or in case of a breaking blade would greatly reduce accidental injuries.

The surfacer, unlike most other woodworking machines, performs only one operation. It can be used for thickness planing only. It is considered one of the safest of all woodworking machines. All power transmission apparatus of the surfacer is completely enclosed and the cutter head is guarded with a sheet metal cover. The possibility of kickbacks and getting the fingers caught between the in-feed rolls are the chief accident

hazards of the surfacer. The Surty Sectional Safety guard which may be attached to any surfacer will provide some protection against both dangers.

The high speed with which the knives revolve places the shaper on the highly hazardous list. Careless contact with the moving knives and the possibility of being struck by flying knives and kickbacks are some of the dangers encountered while operating the shaper. Although several types of shaper guards have been designed, they all have their limitations. The best guard against flying knives is the use of a solid cutter head. The initial cost is greater, but the added safety value offsets the cost.

The tool grinder, generally considered a metalworking machine, is found in most woodworking shops where a large number of hand tools are used. Accidents on the tool grinder are very infrequent if the wheels are properly cared for and used. The eyes receive the brunt of grinding wheel injuries. Flying sparks and dust particles cause eye injury and infection. Eye protection should be heavily stressed. Goggles should be provided to protect the eyes whenever the grinder is not equipped with a protective eye shield. Broken wheels are sometimes thrown with enough force to cause severe injury to the operator or a by-stander. To help eliminate this hazard, the wheels should be guarded with a metal hood with a cutting aperture of not more than 90 degrees.

Safeguarding the machinery does not eliminate all accident hazards of the woodworking shop. A sheet of safety rules

should be placed near each machine and all operators should be required to observe these rules carefully. The use of safety signs and safety films serve to reduce accidental injuries by impressing upon the worker or student the necessity of practicing safety precautions. Special personal protective equipment as hoods, gloves, hats, and shoes should be provided whenever the job requires their use for personal safety.

Now that machine manufacturers, industrial plants, vocational and high school shops are stressing safety, the chief problem of the safety groups lies in reaching and educating small industries and home craft shops in the need of using safety equipment.

One of the purposes of this investigation is to present specific information concerning machine guards and protective equipment so that the consumer may be better able to judge their effectiveness.



## APPENDIX A

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## APPENDIX B

In response to a letter of request, (APPENDIX C) manufacturers of woodworking machinery cooperated splendidly in the preparation of this study by furnishing illustrated catalogs, technical booklets and other data.

Baxter D. Whitney and Son, Incorporated  
Winchendon, Massachusetts

Bell Machine Company  
Oshkosh, Wisconsin

Boice-Crane Company  
930 West Central Avenue  
Toledo, Ohio

Crescent Machine Company  
Letonia, Ohio

Delta Manufacturing Company  
600 East Vienna Avenue  
Milwaukee 1, Wisconsin

Diamond Tool Company  
3429 East Olympic Boulevard  
Los Angeles, California

Ekstrom, Carlson and Company  
Rockford, Illinois

William H. Field Company  
323 Dorchester Avenue  
Boston 27, Massachusetts

Flohr Manufacturing Company  
Buffalo 17, New York

Greenlee Brothers and Company  
Rockford, Illinois

Hart Industrial Supply Company  
308 East 4th Street  
Tulsa, Oklahoma

Helios Manufacturing Corporation  
Buffalo, New York

Huth Brothers Saw Manufacturing Company, Incorporated  
1290 University Avenue  
Rochester, New York

Moak Machinery and Tool Company  
Port Huron, Michigan

Noble Machinery Company  
924 Hayden Street  
Fort Wayne 1, Indiana

Oliver Machinery Company  
Grank Rapids, Michigan

Orton Machine Company  
390 Fremont Street  
San Francisco, California

Parks Woodworking Machine Company  
Cincinnati 22, Ohio

L. Power and Company  
2815 Oakford Street  
Philadelphia 46, Pennsylvania

Porter Cable Machine Company  
Syracuse 8, New York

B. M. Root Company  
York, Pennsylvania

Rice Machinery Company  
1218 North Western Avenue  
Oklahoma City 6, Oklahoma

Stanley Electric Tools  
New Britain, Connecticut

Sureway Manufacturing Company  
2427 North Second Street  
Philadelphia 33, Pennsylvania

Surty Manufacturing Company  
4139 West Kinzie Street  
Chicago 24, Illinois

The Tannewitz Works  
Grand Rapids, Michigan

United States Safety Service Company  
1215 McGee Street  
Kansas City 6, Missouri

Walker-Turner Company, Incorporated  
Plainfield, New Jersey

J. D. Wallace and Company  
134 South California Avenue  
Chicago 12, Illinois

S. A. Woods Machine Company  
27 Danrell Street  
Boston, Massachusetts

Woodworkers Tool Works  
222-224 Jefferson Street  
Chicago, Illinois

Wooster Products Incorporated  
Wooster, Ohio

Wysong and Miles Company  
Greensboro, North Carolina



APPENDIX C

Dear Sirs:

As a significant part of my graduate work, I am doing some research on guards for woodworking machines.

Would you please send to me any pictures, literature or other information you might have in your files concerning the position, effectiveness and necessity of guards as used on your woodworking machines.

If you do not manufacture the guards for these machines will you please supply a list of guard manufacturers?

Any information, pictures or lists you are able to furnish will be deeply appreciated as I am planning to incorporate all of the information which I receive into a thesis.

Yours truly,

Richard Kisner

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TYPED BY:

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3104 South Detroit  
Tulsa 5, Oklahoma

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