THE CONSTRUCTION OF INDIVIDUAL INSTRUCTION OR JOB SHEETS IN FARM MECHANICS FOR THE USE OF STUDENTS AND TEACHERS IN VOCATIONAL EDUCATION IN AGRICULTURE IN VIRGINIA

BY

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Farm Appliances

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The Construction of Individual Instruction or Job Sheets in Farm Mechanics for the Use of Students and Teachers in Vocational Education in Agriculture in Virginia

INTRODUCTION

Since Agriculture in recent years is becoming more mechanized and the price of such farm equipment is relatively high, it becomes necessary for the farmer to be able to operate and maintain such equipment as efficiently and economically as possible. Since the village blacksmith and the wheelwright in many rural sections are disappearing, the upkeep and repair of farm machinery and equipment fall to the individual farmer. The machine age has required more skill in workmanship, thus increasing the cost which most farmers are unable to meet. A farmer must use his own judgment as to whether he can do a difficult job or hire someone to do it for him, but in case of ordinary repair and construction jobs, there is little choice. The farmer is compelled to do these jobs, if they are going to be done.

Increased emphasis has been placed on the teaching of farm shop repair and construction work in the high schools of the United States. This is especially true in the state of Virginia due to the result of some studies emphasizing the need.

In a survey of out-of-school youth taken in Virginia by the State Department of Education, it was found that the training most desired in rural communities was mechanics of the farm and home. It is very evident

that the young people are realizing their needs and are seeking a means of improving their home, thus increasing their income.

The aim of the Vocational Education in Agriculture is "to train present and prospective farmers for proficiency in farming". Proficiency in modern farming necessarily includes considerable ability to work with tools, machinery and to construct and make simple repairs about the farm. Training in farm mechanics is essential to successful farm managment and operation.

The farm mechanics program has been recognized as an integral part of the program of Vocational Education in Agriculture and it should be designed to teach the boy the common construction and repair skills necessary to do the job on the farm of the type he will most likely operate.

It is also recognized that farm mechanics as it has functioned in the past has contributed greatly to enriching the training program of the Vocational Agriculture student and has proved valuable to him on the farm after leaving school. However, it is believed that a great deal can be done to improve upon the present farm mechanics program in Virginia.

The purpose of this study is to prepare individual job sheets in farm mechanics for the use of students and teachers of Vocational Educational in Agriculture in Virginia.

PROCEDURE AND SOURCE OF INFORMATION

The listing of jobs which good farmers attempt in the relm of farm mechanics was the first step in this study. This list was made according to type of farm work shop. The jobs were classified under five main headings. They are as follows: Tool Use and Care, Soldering, Harness Repair, Painting, and Farm Appliances. This study contains sixty-six jobs which are classified under the headings listed above. A suggested list of jobs including those worked up in this study and others are found in the back of this publication.

A study of instruction in farm mechanics at the high school level was made in order to determine the type of jobs needed and the best possible form to use in performing these jobs.

Jobs were worked up by the author using his own experiences and various reference material. Information was secured from specialists in Industrial and Agricultural Engineering Departments of Virginia Polytechnic Institute, from skilled mechanics in public and private employment, and from books and bulletins. The procedure was checked and approved by members of the Agriculture Engineering Department. They also made the final drawings and ran off the blue prints.

A large number of the jobs were tried out by the author and others in order to prove that the procedure was correct and that the plans were workable.

The author has attempted to select the jobs and perform them in such a way as to develop those skills most needed on the home farm.

TOOL USE AND CARE

Cleaning and Oiling Tools

Cleaning and oiling tools is something to which most farmers should give more attention. Knowing how to care for tools is exceedingly important, since their usefulness depends to a large degree upon their care. Keeping tools well cleaned, oiled, and free from rust is essential, not only for ease in handling, but also for lengthening their service and keeping them looking good. Rust on iron or steel is caused by oxidation due to the action of air and moisture. This rust is prevented by covering polished parts with a thin oil.

Equipment and Materials: Kerosene, sweet oil, finely pulverized unslaked lime, emery cloth, pumice stone.

Procedure:

Operation 1 Care of Tools

1. Handle tools with care. Be sure not to drop them on any hard surface.
2. Avoid bringing edge tools into contact with any metal or nicking may may result.
3. Keep tools clean and free from rust by treating them with oil when not in use.
4. Always keep tools sharp, if good work is expected.
5. Tools should not be exposed to the weather. Dampness rusts metal tools and warps wood constructed tools. They should be kept in an inclosed chest or tool cabinet when not in use.
6. Choose the proper tool to do the job at hand. Do not expect a crosscut saw to do satisfactory ripping.

Operation 11 Cleaning and Oiling Tools

There are many methods of cleaning and oiling tools, but two of the most practical methods are discussed below.

Method A

1. Apply kerosene to the tool with a piece of old flannel, and let set for several hours.
2. Then rub the rust from the tool with some soft piece of material.
3. Polish the rusted area with pumice stone or emery cloth to the desired luster. Pitted marks in badly rusted tools probably cannot be removed entirely.
4. Apply a light film of oil to the surface with the flannel cloth before putting away. (See step 5 under Method B)

Method B

1. Cover the rusted surface with sweet oil, rubbing it in well with a cloth.
2. Let set for forty-eight hours.
3. Then rub with finely pulverized unslaked lime.
4. Polish to the desired luster with emery cloth.
5. Apply any good oil dressing such as:

   a. Equal parts of turpentine and linseed oil.
   b. Vaseline.
   c. 3 in 1 Oil.
   d. Light cylinder oil.

Questions:

1. Why is it not advisable to use salty fats for cleaning metal?
2. What causes tools to rust?
3. What are the purposes of cleaning and oiling tools?
4. Explain how tools can be cleaned with pumice stone and water.

References:

1. Cook, G. C., Scranton, L. L., McColly, H. F., "Farm Mechanics", Page 52, Interstate Printing Company, Danville, Illinois.

2. Dickerson, Sherman, "Job Operations in Farm Mechanics", Page 30, The Interstate, Danville, Virginia.

3. Field, A. M., Olson, R. W., Nylin, V. E., "Farm Mechanics", Page 99, The Century Company, New York.

4. Roehl, Louis, M., "Fitting Farm Tools", Page 39, The Bruce Publishing Company, New York.

Marking Farm Tools

Shop tools marked with owner's initials or school initials are not lost as frequently as unmarked ones. There are three ways of marking tools.

A. Marking With Acid

Equipment and Materials: Wax, nitric acid, tool, hot rag.

Procedure:

1. Warm tool to approximately 100° F.
2. Rub wax or hard tallow over the surface to be marked about one-sixteenth of an inch thick covering a slightly larger space than size of initials (fig. 1).
3. Place tool on something solid and level. With some sharp object print the desired letters through the wax until the tool surface is slightly scratched (fig. 1).

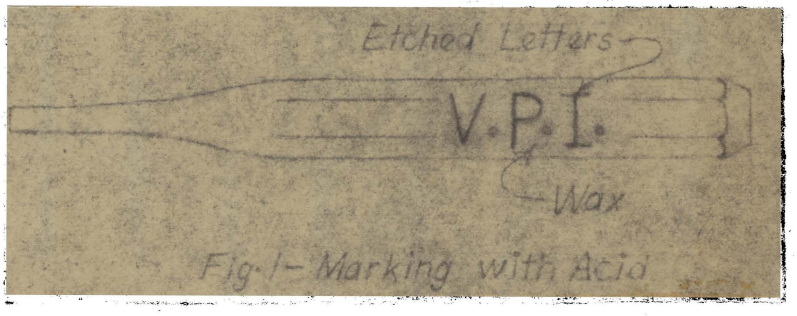


Fig. 1 - Marking with Acid

4. Pour small amounts of acid in these initials and let it remain three to five minutes. The acid will eat out the letters quickly. Be sure the initials are cut properly in the wax before pouring the acid. If not, the acid may ruin the tool.
5. Wash the acid off with water.
6. With a warm rag wipe the wax off of the tool and the letters will be properly etched.

B. Marking With Steel Letters

Equipment and Materials: Proper steel letters, hammer, tool.

Procedure:

1. If tool does not have one flat side, make one large enough for the initial with file or grindstone.
2. Place tool in anvil or in vise so that it will be held firmly.
3. Set the steel letter at the desired place on the tool and hit it hard with a hammer. Repeat for each letter or initial (fig. 2)

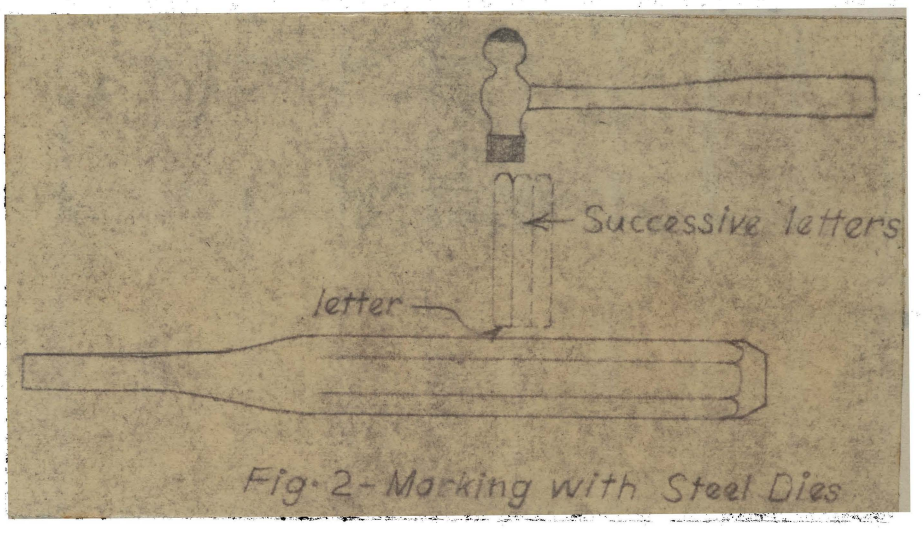


Fig. 2 - Marking with Steel Dies

It is a good plan to try marking on some old piece of tool first. By doing this you will know how hard to hit with the hammer in order to make the desired dint.

Do not attempt to mark tempered or case hardened steel. Such an attempt may damage the steel letters.

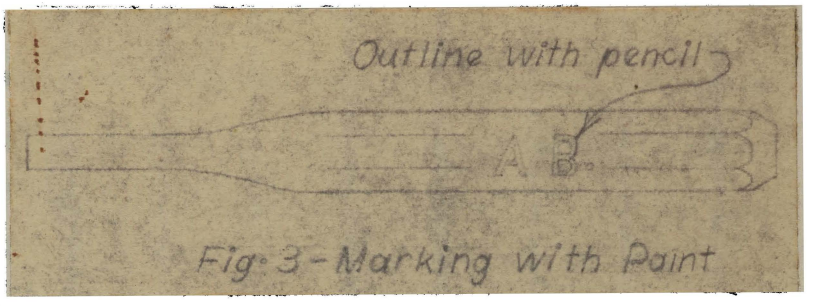
C. Marking With Paint

Equipment and Materials: Paint, small brush, kerosene, pencil or chalk.

Procedure:

1. Clean tool with kerosene or gasoline.
2. With a pencil or chalk print initials on the tool so that painting will be made easier (fig. 3).

3. Use a small brush and paint the initial made with the pencil. Have some sort of cloth at hand, so that in case the paint smears you can wipe it off before drying. Use a good grade of paint and preferably red or white.



Questions:

1. What is the reaction of nitric acid on steel and metal?
2. Which is the cheapest method of marking? Most durable?
3. Why must you have a solid, flat surface when marking with steel letters?
4. Why should tool be cleaned before painting?

References:

1. Davis, K. C., "Farm Enterprise and Mechanics", Page 16, Lippencott Publishing Company, New York.
2. Schmidt, G. H., Ross, W. A., Sharp , W. A., "Teaching Farmshop Work and Mechanics", Page 199, The Century Company, New York.

Sharpening a Hand Saw

Sharpening saws calls for patience, good eyesight, and a sense of proportion and uniformity. However it is a job that every boy should know how to do because dull saws discourage the worker and make a poor job.

Equipment and Materials: Saw clamp or vise, twelve inch mill file, saw set, saw, file of correct size.

Operation 1 Jointing

Procedure:

1. Do the jointing in front of a window or where the light shines directly on the teeth.
2. Fasten the saw securely in a clamp or vise with the teeth about two inches above the clamp.
3. Grasp the mill firmly in both hands and run it forward over the teeth length parallel with the blade. Repeat until the teeth are all of even length and the point of each tooth is flat and shiny. It is best to use a jointer or a home made guide in order to keep the file square with the saw blade.
4. If the teeth of a saw are all about the same length and even, very light jointing is all that is necessary, and can best be done with a worn or dull file .

Operation 2 Setting

1. After the saw has been jointed, it should next be set, unless the teeth are very uneven in size and shape as is shown in fig. 1, in which case they should be filed to the proper shape and size before setting, and then filed again after setting.

2. The setting is done by means of a spring saw set, which is a tool for bending. Place the saw blade in the saw clamp or vise with the handle of the saw to the worker's right, the teeth about two inches above the jaws of the clamp or vise.

3. Adjust the set to the number which indicates the "pointing." The "pointing" is the number of saw points to be counted in one inch. This is stamped on the heel of the saw on the left-hand side. Begin at one end and set every other tooth, being careful to bend the teeth in the same direction they were originally set. Then reverse the saw in the clamp or vise and set the remaining teeth.

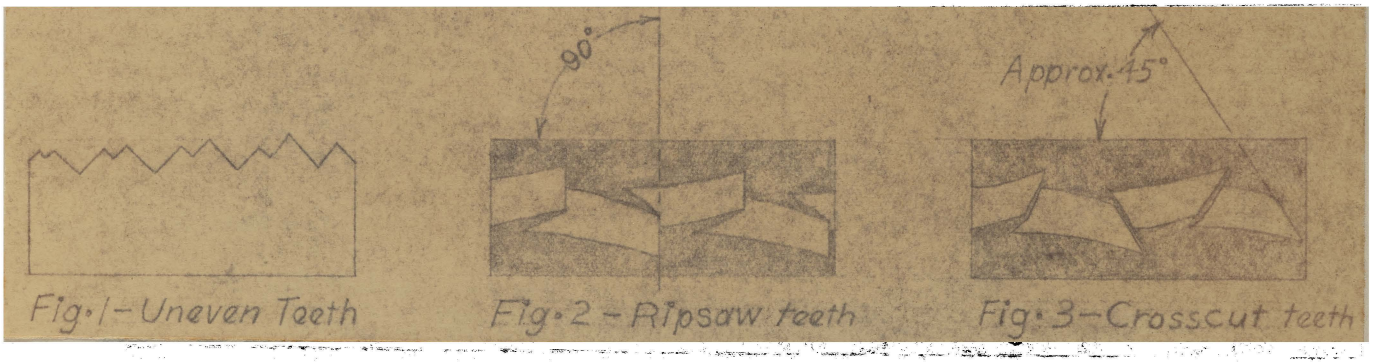


Fig. 1 - Uneven Teeth

Fig. 2 - Ripsaw teeth

Fig. 3 - Crosscut teeth

4. The amount of set which a saw should have depends upon the kind of wood to be sawed. Green or wet wood requires more set than dry, well-seasoned wood. Soft wood requires more than hard woods. For ordinary farm work the set should be heavier than that used by carpenters on finishing. Too much set or too sharp a bend in the saw tooth may result in breakage of the tooth.

5. All the points should have the same amount of set. To get this, give a uniform pressure or squeeze on the saw set when setting.

Operation 5 Filing

1. The saw should be securely held in a vise or clamp with just enough cutting edge projecting above the jaws to allow the file to clear the jaws of the vise or clamp or about one-eighth inch. If the saw blade extends too far above the jaws the saw will chatter and the file will scratch. It may be best to remove the handle.

2. If saw is poorly filed and teeth very uneven in shape and size, file before setting to approximate size and shape. Then file again after setting.

3. Select a triangular or saw file of the correct size.

Points per inch	Size and kind of file
3 to 4	7" regular taper.
4½ to 5½	6" " "
6 to 9	5" " "
10 to 12	5" slim taper.

4. Have a handle of some kind on the file before using. The workman takes his position at the left of the clamp and at the point of the saw. By filing from the point to the handle the file cuts as it moves from the workman to the edge of the tooth bringing it up keen and clean. Filing from the handle to the point, the file cuts on the return stroke or as it moves from the edge. This has a tendency to produce a wire edge.

5. To file a hand rip saw, starting at the tip of the saw, pick out the first tooth that is set toward you and place the triangular file in the gullet to the left of the tooth. Grasp the file firmly in the right hand and hold tip of file lightly between thumb and first finger of left hand, palm of left hand up. Hold file at right angle to blade of saw with tip of file slightly raised. The side of the file which files the front of the tooth should be plumb (fig. 4).

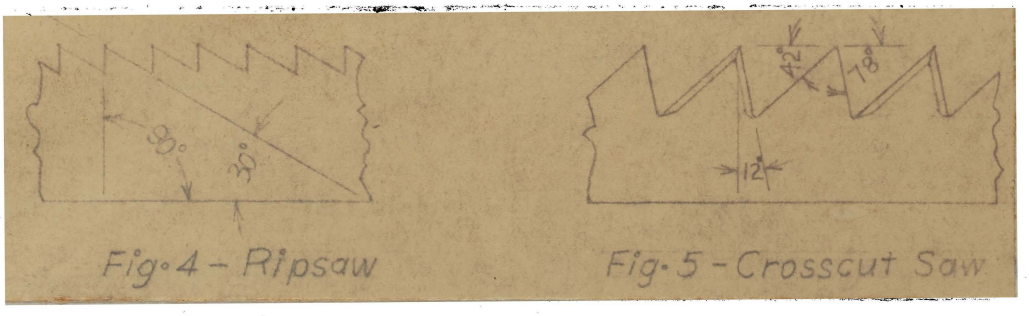


Fig. 4 - Ripsaw

Fig. 5 - Crosscut Saw

5. Use long, light, even strokes, filing front of one tooth and back of the opposite at the same time. File on forward stroke only and lift the file on the return stroke. If two adjacent teeth are of uneven size, press file harder against side of larger tooth. File every other tooth from point to heel, then reverse the saw and file the remaining teeth in the same manner.
6. The same general principles of filing a rip saw apply to filing a hand cross cut saw. The essential difference is in the angle at which the file is held. Instead of filing straight across at a right angle to the blade as in filing a rip saw, (fig. 2), let the file settle in the gullet then turn the file toward the handle until it makes an angle of 45 degree with the blade (fig.3). The side of the file which files the front edge of the tooth must be 12 degrees off plumb. (fig. 5).
7. Always work where the light shines directly on the point of the teeth.
8. For fine grade work lay the saw flat and pass a whetstone over the side of the teeth to remove burrs or wire edge from the filing.

Questions:

1. What is the chief purpose of jointing?
2. Why should the teeth be of uniform length?
3. When may a dull file be used to advantage in jointing?

4. How much set should be given a saw for ordinary use?

5. How much of the tooth should be bent? Why not more?

6. Why file from point to handle?

7. What is the essential difference in filing a rip saw and a cross cut saw?

8. Why can't we see the point of a sharp tooth?

References:

1. Henry Disston and Sons, "Tool Manual for Farm Shops," Page 50-53, Philadelphia, Pa.

2. Roehl, Louis M., "Farmer's Shop Book," Page 303-305, Bruce Publishing Company, New York.

3. Stanley Rule and Level Plant, "How to Work with Tools and Wood," Page 94-99, New Britain, Connecticut.

Sharpening a Wood Chisel

Equipment and Materials: Wood chisel or plane bit, fine emery grinder, flat oilstone, can of water, fine oil.

Procedure:

Operation 1 Grinding the Wood Chisel

1. If there are nicks in the cutting edge (fig. 1, a), place the chisel flat on the tool rest, bringing the cutting edge into contact with the grinder at right angles. Grind to the bottom of the nicks. Take care that the end is ground square.

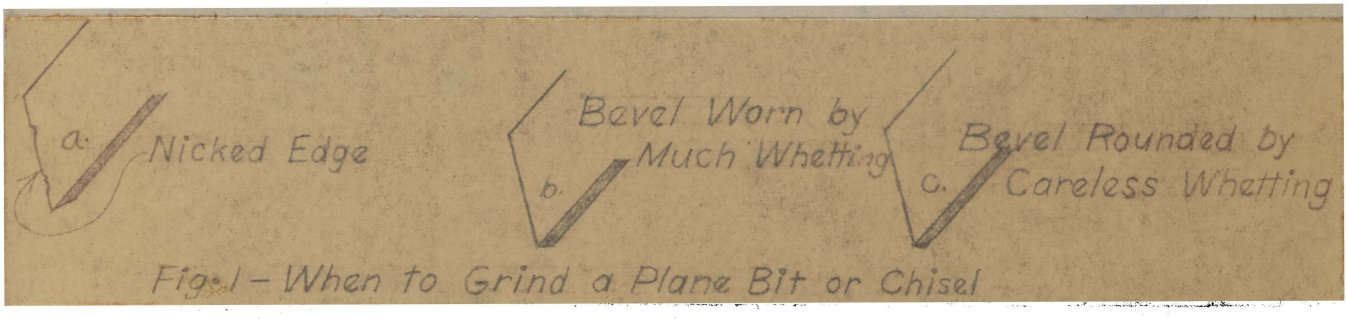


Fig. 1 – When to Grind a Plane Bit or Chisel

2. Place the chisel on the tool rest and let the back part of the bevel come in contact with the grinder. The grinder should turn toward the cutting edge. To prevent excessive heating of the edge, hold the chisel against the stone with light pressure, and occasionally cool by dipping the chisel into a can of water. Grind only the beveled side.
3. Raise the handle until the correct angle, about thirty degrees, is obtained (fig. 2). If it is difficult to determine the correct angle, a fair degree of accuracy can be reached by measuring the length of the bevel. For general work the bevel should be one-fourth of an inch long. A long thin bevel is suited to fine parting wood and a short thick bevel is best for mortising. The finished bevel should be uniform across the chisel, and it

should be straight or slightly concave due to the round stone. Grind until a wire edge is obtained and no more. The corners of the plane bit are slightly rounded.

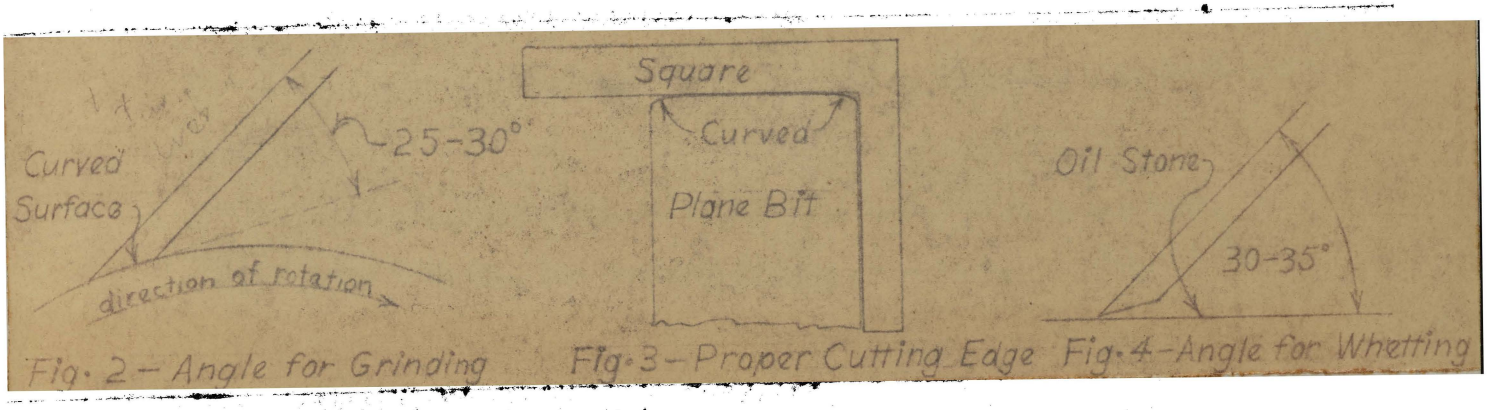


Fig. 2 – Angle for Grinding Fig. 3 – Proper Cutting Edge Fig. 4 – Angle for Whetting

Operation 11 Honing the Wood Chisel

1. Hold the chisel on the oilstone in the position shown in fig. 4. The back of the concave bevel should be raised slightly from the face of the oilstone. This makes a second bevel. Maintain this bevel during the honing. Make forward movements with the chisel over the face of the stone. Continue the honing until a feather edge has been formed. About four strokes should be sufficient.
2. Turn the chisel over with the bevel side up and hone with the chisel flat on the oilstone until the feather edge has disappeared (fig. 3). Be sure the chisel is perfectly flat on the stone.

Questions:

1. What will be the effect if the bevel is too thin? Too short and thick?

2. Why is the wire edge removed?

3. Why should the corners of the plane be slightly rounded?

4. What is the difference between the cutting edge of the plane bit and that of the wood chisel?

5. Why is a fine emery wheel preferable to a coarse one?

References:

1. Field, A. M., Olson, R. W., Nylin, V. E. "Farm Mechanics", Pages 104-105, The Century Company, New York.

2. Roehl, Louis, M., "Fitting Farm", Pages 13-15, Bruce Publishing Company, New York.

Sharpening and Using Auger Bits

Equipment and Materials: Auger bit, auger bit file.

Procedure:

Operation 1 Sharpening the Bit

1. Study fig. 1 in order that you may know the parts of the bit.
2. If the spur is worn or bent inward, very carefully tap the tip outward with a punch until its outside surface is parallel with the side of the bit.
3. Grasp the bit in the left hand and hold it against a table or work bench. Hold the file in the right hand and sharpen the spur from the inside to avoid reducing the diameter(fig. 1).
4. Hold the bit and file as in previous step letting the bit rest on a table. File the lip on the side toward the shank to avoid losing clearance at the bottom (fig. 3). The lip must be

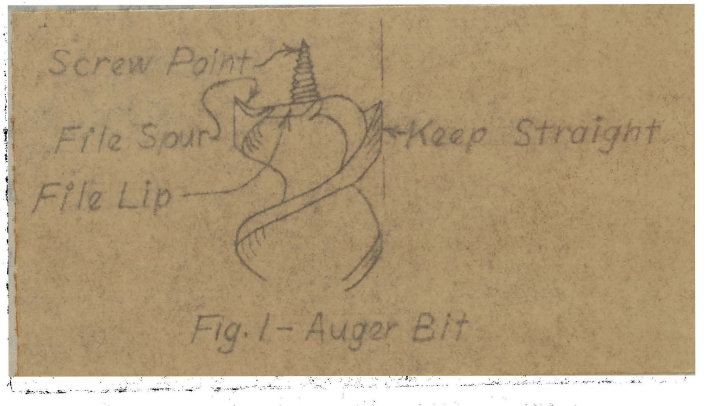


Fig. 1 - Auger Bit


Fig. 2 - Sharpening Spur

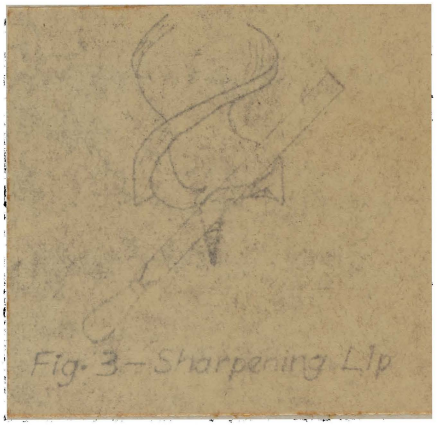


Fig. 3 - Sharpening Lip

so that it will bite down readily into the wood.

5. If the thread which pulls the bit into the wood is battered, it may be traced around with a small triangular file until well threaded.

Operation 11 Using the Brace and Bit.

1. Select the bit for the work to be done. Small bits below one-fourth of an inch when used for wood work should be of the drill type. Drill bits run in small sizes run in thirty-seconds; auger bits usually run in sixteenths. The size is stamped on the shank of the bit, an eight meaning eight-sixteenths.
2. Open the jaws of the chuck, insert the bit and tighten the jaws firmly by turning the handle of the brace to the right.
3. To bore a verticle hole, hold the brace and bit perpendicular to the surface of the work. Apply pressure to head of brace with left hand and turn the handle with the right. Test with try square by holding it against the bit.
4. To bore a horizonal hole, hold the head of the brace in the left hand, with the back of the hand against the stomach. This gives perfect control of the brace.
5. Stop boring when the screw point is through and finish from the other side. This will avoid splitting the other surface.
6. When boring a hole in a corner or where some object prevents making a full turn with the handle use the ratchet brace. To operate the ratchet, turn the cam ring to the right. This will allow the bit to turn right and vice-versa.

Questions:

1. Why file the inside rather than outside of spur?
2. What will happen if the bit is dull?
3. What will the result be, if the cutting edge is filed so the clearance is too great?
4. Why should the bit be held firmly in the brace clamp?

References:

1. Cook, G. C., Scranton, L. L., and McColley, H. F., "Farm Mechanics," Pages 73-74, The Interstate Printing Company, Danville, Illinois
2. Roehl, Louis M., "Farmer's Shop Book", Pages 27-28, Bruce Publishing Company, New York.
3. Roehl, Louis M., "Fitting Farm Tools", Pages 32-35, Bruce Publishing Company, New York.

Sharpening a Draw Knife

The draw knife may be sharpened on a small, fine grinder or on a combination whetstone. Knives in fairly good condition are usually sharpened by the whetting method.

Equipment and Materials: Draw knife, whetstone, fine grinder, light oil.

Procedure:

Operation 1 Sharpening with Grinder

1. If there are nicks in the draw knife, place the knife flat on the tool rest, bringing the cutting edge into contact with the grinder at right angles. Grind to the bottom of nicks, making the edge smooth and slightly rounded. Be sure to hold the knife with both hands in order to make the work uniform.
2. Then place draw knife on rest, letting the bevel part come in contact with the grinder. With the grinding wheel turning toward the cutting edge, move the knife back and forth across the grinder. Grind only bevel side.
3. While grinding raise handles of knife until a 30^{o} angle is obtained, or $\frac{1}{4}$" bevel is made. The bevel should be uniform and the knife slightly rounded throughout. Stop grinding when you get a wire edge.
4. Use the whetstone as described below for finishing the job.

Operation 11 Whetting the Knife

1. Put end of draw knife on something solid and hold it at a 45^{o} angle (fig. 1).

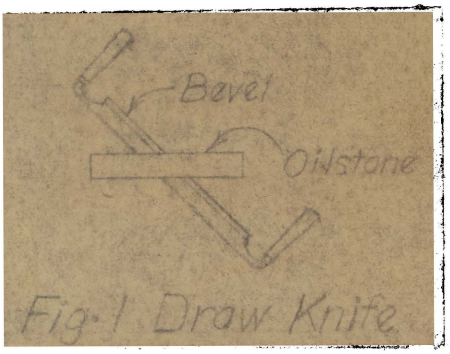


Fig. 1 Draw Knife

2. With coarse side of oilstone rub with a rotary motion over whole surface of bevel until fine edge is obtained. Keep the bevel $\frac{1}{4}$" long.

3. With the same motion use the fine side of stone and whet to a feather edge.

4. Turn bevel side of knife toward you and rub until feather edge disappears.

Questions:

1. Why grind nicks out before trying to sharpen?

2. What other tools require a bevel somewhat like the one on the draw knife?

3. Why is a fine emery wheel preferable to a coarse one?

4. Why is it important to hold the knife with both hands?

References:

1. Roehl, Louis M., "Fitting Farm Tools", Pages 13-15, Bruce Publishing Company, New York.

2. Thurmond, M. F., "Farm Shop Laboratory Manual", Book 1, Page 11, College Station Texas.

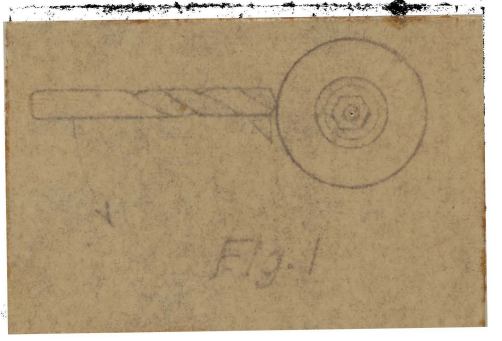
Fitting and Using the Drill Bit

Equipment and Materials: Drill bit, grindstone or emery stone.

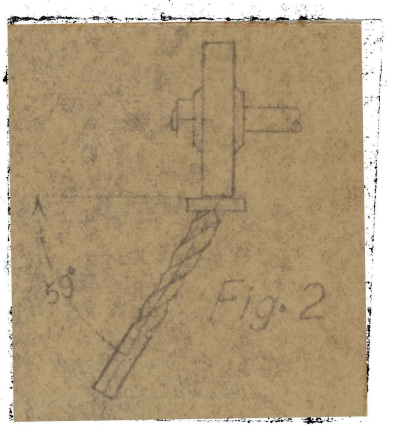
Procedure:

Operation 1 Sharpening the Drill Bit

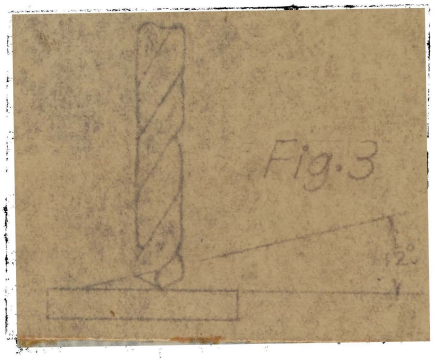
1. Hold the bit firmly on the rest of the grinding stone, letting the drill rest on the crease or groove of the first joint. The drill bit is held at an angle of 59° to the face of the wheel (fig. 2).



2. As the drill bit is held against the stone, lower the shank slightly while rotating it clockwise.



3. The surface should be made smooth and continuous with the lip or cutting edge more exposed than any of the surface back of it. If this is not true, the bit will fail to bite. If too acute, it will jump or break. The drill should have a bevel or curved surface from the cutting edge to the trailing edge. This bevel should be about 12° (fig. 3).



4. Dip the drill in water frequently to avoid over heating while grinding.
5. Remove the wire edge with the oil stone.

Operation 11 Using the Drill Bit

1. Select the proper bit. (Refer to job on Fitting and Using Auger Bits).
2. Place the bit in the brace. For light work on wood or metal, the hand drill should be used. For more heavy work, use the brace and power drill.
3. Center punch the hole to be drilled in the metal or steel before starting the drill. This will help to center and locate the drill. When using wood start the hole with an awl or sharp punch.
4. Place the bit in the hole started by the punch and start drilling. If hand drill or brace drill is used, care should be taken to see that hole is bored straight. Apply a few drops of oil to the cutting edge frequently. This will avoid heating.
5. When drilling through metal, remove the pressure slightly before breaking through. This will keep the bit from breaking.

Questions:

1. Why is it necessary for the cutting edge to be more exposed than the surface back of it?
2. Why dip the drill in water while grinding?
3. Why use the oil stone in finishing the job?

References:

1. Cook, G. C., Scranton, L. L., and McColley, H. F., "Farm Mechanics", Pages 74-75, The Interstate Printing Company, Danville, Illinois.
2. Dickerson, Sherman, "Job Operations in Farm Mechanics", Page 38, The Interstate Printing Company, Danville, Illinois.
3. Roehl, Louis M., "Fitting Farm Tools", Page 36, Bruce Publishing Company, New York.

Use and Care of Ripsaw

Ripsaws, as the name implies, are used for ripping timber with the grain. The teeth, filed squarely across the blade, form a surface of chisels. The points of the teeth are bent outward, one tooth in one direction and the next tooth in the opposite direction (fig. 2). The saw blade is thus made thicker on the tooth edge of the blade than elsewhere, permitting the saw to pass through the wood without binding while it makes its cut or kurf.

Equipment and Materials: Ripsaw, board to rip.

Procedure:

Operation 1 Using the Ripsaw

1. Grasp the handle of the saw in the right hand, placing the index finger and thumb on the side of the handle. Use the left hand as a guide for setting the saw to start the cut. Do this by grasping the edge of the timber with the fingers and placing the thumb against the saw blade to steady it.
2. Gently draw the saw backward two or three times, keeping the saw, right eye, elbow and shoulder in the same vertical plane to insure against cutting under.
3. Continue after the second or third stroke by pushing the saw downward,

exerting pressure only on the downward strokes, keeping an angle of 60° between the board and the saw blade (fig. 3). Make long, smooth strokes. If the saw leaves the line, twist the handle slightly to draw it back in line.

4. If smoothing is desireable, saw the piece about 1/16" oversize.

Operation 11 Holding Timber for Ripsawing

1. For short pieces of lumber use the vise, being sure to have the board perpendicular to the vise.

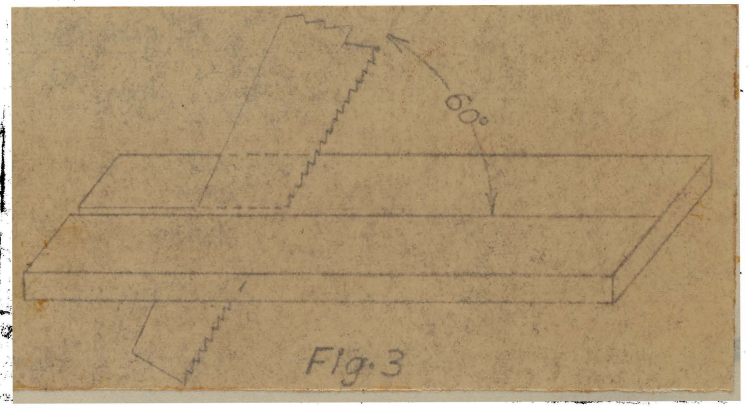


Fig. 3

2. For ripping long pieces of lumber, the student should be equipped with an open sawhorse especially made for ripping. The open top not only furnishes a support for the board but allows the saw to pass through, thus giving the student a balanced position at all times.

Operation 111 Care of Rip Saw

1. While using the rip saw, be careful not to strike the teeth of the saw against any metal objects. Such abuse results in a blunted tooth or teeth thus making it harder to saw an even cut.
2. When finished with the saw, it should be placed in the saw rack. Place the handle of the saw on the bottom, and set it vertically in a separate stall with the tooth edge against the wall, or hang it on a nail by the handle with the tooth edge downward being careful not to swing it against metal objects. Be sure the saw is thoroughly clean and dry before it is put away.

3. If the saw gets rusty it should be cleaned as described in previous job. When cleaning is complete, apply a light coat of good oil.

Questions:

1. How do you determine the coarseness and fineness of a saw?
2. How are the teeth of a rip saw arranged?
3. Compare the teeth of the rip saw with those of the cross-cut saw?
4. On what stroke is the pressure exerted in ripping? Why?

References:

1. Chawshaw, F. D., Lehman, E. W., "Farm Mechanics", Pages 41-45, The Manuel Arts Press, Peoria, Illinois.
2. Cook, G. C., Scranton, L. L. McColley, H. F., "Farm Mechanics", Pages 58-59, Interstate Printing Company, Danville, Illinois.
3. Sharp, M. A., Sharp, W. M., "Principles of Farm Mechanics", Pages 56-57 John Wiley & Sons, New York.

Use and Care of Hack Saw

The hack saw is indispensable about the farm. Since it is a very important tool everyone should know how to use it. It is used for cutting pipes, various iron and steel stock, bolts, etc.

Equipment and Materials: Hack saw frame, blade, small file, vise for holding the work to be cut.

Procedure:

Operation 1 Choosing the Correct Type of Blade for Job.

1. Blades for farm use should be about 12 inches long, because this length gives good strength of blade and permits a long stroke in cutting.
2. Fine teeth blades should be used for cutting thin material, tubing, sheets, etc.
3. Coarse teeth blades are used for larger sections and softer materials.
4. For small pipes, tubing thinner than 18 gage, electric conduit, etc., use blade with 32 teeth to the inch.
5. For pipes, angles, channels, tubing heavier than 18 gage, use blade with 24 teeth to the inch.
6. The most popular blade for general work is one with 18 teeth to the inch. It is used mostly on cast iron, bronze, rail, machine and tool steel.
7. For faster cutting on larger sections, bronze, aluminum, low carbon steel, slate, etc., use a coarse blade with 14 teeth to the inch.

Operation 11 Inserting Blades into Frame

1. Use only good durable frame.

2. Hold frame by the handle and blade with teeth away from it.
3. Slip pin of front stretcher through the hole in the front end of the blade.
4. Then fit rear hole of blade over rear stretcher pin, turning frame so that blade does not fall off.
5. Turn the thumb screw and tighten the blade until a vibrant note is easily recognized when blade is picked with the thumb. When a vibrant note is recognized, the blade has the correct tension.
6. After blade is used for a few cuts, it will stretch slightly. Give the thumb screw one or two turns to retighten it.

Operation 111 Using

1. Fasten work securely in vise before starting to cut. To hold oval or circular work in vise, use wood or leather pieces to grip work and to prevent scarring. Place the work to be sawed close to jaws of vise.
2. File a notch on a sharp edge before sawing.
3. Stand facing work with feet at least twelve inches apart and body approximately thirty degrees to left of direction of cut.
4. Use both hands in cutting. Clasp the handle with right hand and front end of frame with left.
5. In beginning a cut, raise handle slightly and tilt front of frame downward, start cut slowly, and as cut deepens bring blade to horizonal position.

6. Take long even strokes and apply a light uniform pressure on forward stroke so that teeth will cut instead of slip. Too much pressure, however, may ruin blade.
7. Lift blade slightly on each return stroke to avoid dulling teeth, but do not lift saw out of cut.
8. Do not cut faster than 40 to 60 strokes a minute.
9. Is is not advisable to use a new blade in a cut where a worn blade has been broken, as the new blade has a little more set and is likely to stick and break. It is better to turn the piece and start a new cut.
10. Generally hack saws should not be oiled for hand use. Save worn and broken hacksaw blades, as they will come in handy around the shop.

Questions:

1. How would you go about choosing the correct type of blade to use for some particular job?
2. What will happen if the teeth slip instead of cut?
3. Why is it necessary to use two hands on hacksaw and only one on crosscut saw?
4. Would you apply same pressure on all kinds of work? Explain.
5. Of what value are worn and broken blades to the shop?

References:

1. Dickerson, Sherman, "Job Operations in Farm Mechanics", Page 103, The Interstate , Danville, Illinois.
2. Henry Disston and Sons, "Disston Hack saw Charts", Philadelphia, Pennslyvania.

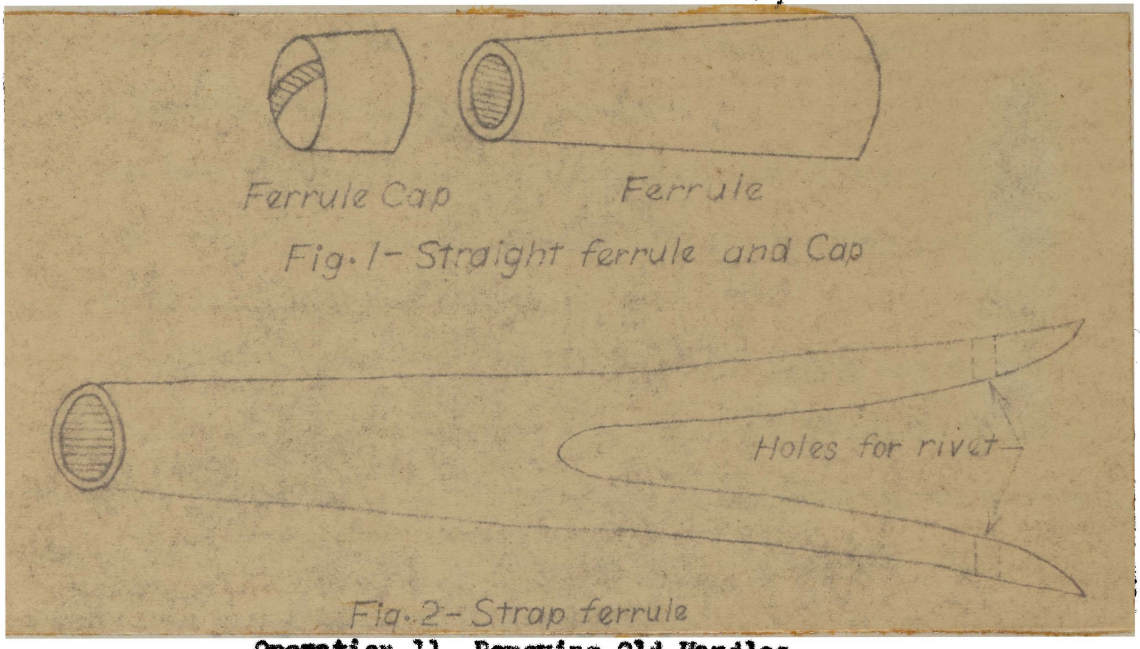
Fitting Pitch Fork Handles.

Equipment and Materials: Pitch fork, handle, punch, draw knife, brace and bits, hack saw or cold chisel, wooden mallet, rivet.

Procedure:

Operation 1 Selecting the Handle.

1. Fork handles may be straight or bent, the latter usually being preferred for handling manure and the former for pitching hay. Select those handles that are made of straight grained hard wood, free of swirls and knots and smoothly finished. Handles may be bought with or without ferrules. The difference in price is small and a better job can be done when the ferrel comes already attached. The ferrule protects, strengthens and holds the fork in position. There are several kinds of ferrules (fig. 1 & 2).



Operation 11 Removing Old Handles.

1. Tap the fork close to the handle and drive it out of the ferrule.

2. With the hack saw or chisel, cut off the end of the rivets through the ferrule and drive the rivets out with the punch.
3. If the ferrule is a strap type, open up and pull out the old handle. It may be necessary to burn the old handle. If this is done be sure that the ferrule does not become too hot or it may be damaged too much for further use. Use gentle blows in forcing the fork out of or into the handle because the fork is made of steel and is easily broken.
4. If the ferrule is straight, drill the old wood out with an iron drill until the ferrule becomes loose.

Operation 111 Fitting the New Handle

1. Place the handle in the wooden vise and bore a hole into the end of the handle the length of and slightly smaller than the fork shank. Be sure that the hole is not too large or the fork will drop out. Care should be taken to bore this hole straight.
2. With the draw knife or spoke shave, trim the end of the handle so that the ferrule can slip all the way into place. Then place the ferrule on the handle.
3. Put the cap into position over the end of the ferrule and insert the fork shank. With a wooden mallet drive the fork in firmly by striking the end of the handle. If the fork will not go entirely on by driving with the mallet, then use a rectangular bar of iron that will fit in between the prongs and hammer it lightly.
4. Bore a hole the size of the rivet through the handle at the holes provided in the ferrule and drive the proper size of rivets through.

5. Place the head of the rivet on something solid and with a hammer do the riveting. With the straight type of shank, no rivet is used.

Questions:

1. Which type of ferrule is preferable? Why?
2. In choosing a good fork handle, what are some good points to look for?
3. How does fitting fork handles compare with fitting shovel handles?
4. What may you do that will materially weaken the fitting of the fork in the handle?

References:

1. Roehl, Louis M., "Fitting Farm Tools", Pages 85-88, Bruce Publishing Company, New York.
2. Roehl, Louis M., "The Farmer's Shop Book", Pages 297-298, Bruce Publishing Company.

Replacing Hoe Handle

Handles may be purchased at local hardware or implement stores. Purchase a handle made from hickory or ash with a straight grain. If suitable material is available, the handle may be made in the shop.

Equipment and Materials: Hoe with broken handle, new handle, hand drill, one nail ¼" shorter than the outside diameter of the ferrule, hammer, chisel and wood file.

Procedure:

Operation 1 Removing the Broken Handle

1. Fasten the hoe with broken handle in the vise just back of the blade.
2. With the hammer or some other suitable tool, draw the nail which is found on the under side of the ferrule.
3. If the handle is rusted in place and cannot be loosened, bore a hole, in the wood with a 1/2 or 3/4 inch drill. Any remaining wood may be pried out with a small cold chisel or other suitable tool. The method of removing the stub by burning is undesirable because it damages the metal and is liable to remove the temper from the blade.

Operation 11 Fitting the Handle

1. With the wood file or rasp fit the handle to the ferrule (fig. 1). The wood should fit the ferrule snugly. Check size of handle carefully while fitting to see that it does not become too small.
2. The fit can be checked by applying starch or chalk to the wood before driving it into the ferrule. The fitting marks will show the high places.

Fig-1 = Fitting the new handle

Operation 111 Attaching the Handle

1. Drive the fitted handle into the ferrule by tapping the end of the handle lightly.
2. Fasten the hoe in the vise with the blade pointing upward (fig.2).
3. With the handle in place in the ferrule, drill a hole slightly smaller than the diameter of the nail and about half way through the handle.
4. Insert the nail to prevent the handle from loosing in the ferrule.

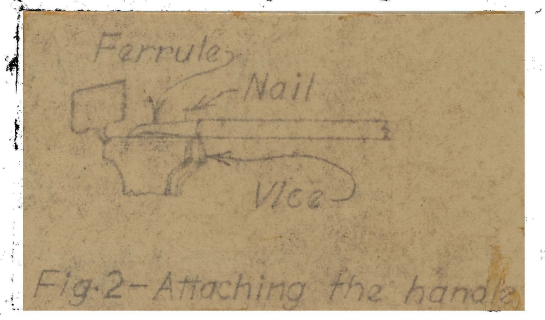


Fig.2-Attaching the handle

Questions:

1. Why purchase a handle with straight grain and made of hickory or ash?
2. Why is it best to drill a hole in the handle through the ferrule?
3. Why not drill the hole all the way through the handle?
4. How will heating the ferrule enable the handle to be removed easily?

References:

1. Radebaugh, G. H., "Repairing Farm Machinery and Equipment", Pages 46-49, Bruce Publishing Company, Milwaukee, Wisconsin.

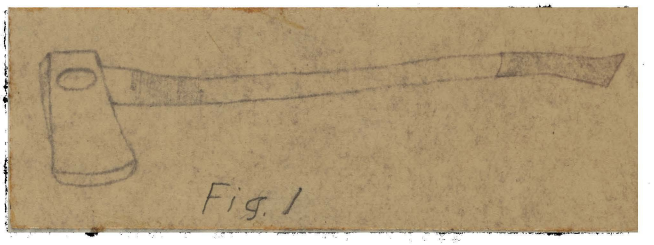
Repairing an Ax Handle

Very often an ax handle will split near the blade and the handle is discarded because it appears to be of no more use. If the split is not too serious, the handle can be made to last some time by repairing. This is practical, especially when time would be lost going long distances after a new handle. The repairing is very simple.

Equipment and Materials: Small gauge, soft wire, preferably copper, small nails or large tacks, Hammer.

Procedure:

1. Drive a small nail into the handle about an inch beyond the end of the split.
2. Wrap the wire end once around the nail.
3. Drive the nail in tightly.
4. Begin winding the wire around the handle always keeping it as taut as possible. Keep it even and close together (fig.1).



5. Wind 4" to 8" back on the handle, or to the end of the split part. Drive another nail and fasten as in the beginning.
6. This process cannot be followed on the upper two-thirds of the handle as it would interfere with holding the ax.

Questions:

1. Would it be practical to make this repair if you had a new handle all ready to be put in? Explain.
2. To what other tools might you apply this method of repair?

Fitting a Shovel Handle

Equipment and Materials: Shovel, new handle, sledge, rivets, rip saw, vise, punch, metal drill, plane, wood rasp.

Procedure:

Operation 1 Selecting the Handle

1. When buying the handle, match it with the shovel by holding it beside the ferrule. A pattern of the ferrule can be made of cardboard by which the handle can be selected. Much care should be taken in the choice of a new handle as there is a great variety of bends. A shovel will not hang right if the handle has an incorrect bend.

Operation 11 Removing the Old Handle

1. Place the shovel in the vise or on the anvil.
2. Cut off the rivet heads with a cold chisel or hack saw. The rivet heads can also be drilled off with a brace and metal drill.
3. With a punch, drive out the old rivets, spread the straps of ferrule and remove the handle. The old rivets can be removed also by cutting lengthwise through the handle and rivets with a hack saw and removing the pieces of rivets from both sides.

Operation 111 Fitting the New Handle

1. Fasten the handle in the vise to reduce it. The manner of shaping will be determined by the shape of the shovel, ferrule, and handle.
2. Remove stock, first with the saw and then with the plane. It may be finished off with the wood rasp.
3. Force the handle into place by tapping it on the end with a hammer. Special care should be taken to make the shovel hand true. It should not tilt to the right or left nor be twisted out of line.

4. Fasten in the vise so the ferrule will be drawn together on the handle. Bore a hole for the middle rivet first. Direct the drill for the hole on the opposite side of the ferrule so it will come right.

5. Insert the rivet and drive it in place before the other holes are drilled.

6. Bore the other holes and complete the riveting.

Questions:

1. Is it a good practice to burn old handle out of tools?

2. In choosing a new shovel handle, what important points should be considered?

3. How would a poorly fitted handle affect the effectiveness of the shovel as a working tool?

4. Why is it best to put in the middle rivet first?

References:

1.Roehl, Louis M., "Fitting Farm Tools", Pages 80-85, Bruce Publishing Company, New York.

SOLDERING

Operating a Blow Torch

The gasoline blow torch is an instrument consisting of a gasoline tank, an air pump, and a burner which generates gas. After the tank has been nearly filled with gasoline, the air in it is compressed. This creates a pressure tending to force the gas out through the burner. Its main use is for heating the soldering copper and the object being soldered. It also comes in handy for thawing out frozen pipes in the winter season.

Equipment and Materials: Blow torch, gasoline.

Procedure:

Operation 1 Preparing the Blow Torch for Lighting

1. See that the parts of the blow torch are in working condition.
2. Unscrew the cap to the tank of the blow torch and fill the tank with clean gasoline.
3. Replace the cap and screw it on the tank so tightly that no air or gasoline will escape.
4. Wipe off any gasoline which has been spilled on the outside of the torch.
5. Push the pump handle down and turn it either right or left to unlock it, if it is of that type.
6. Pump the handle up and down twenty or twenty-five times, thus filling the torch with air.

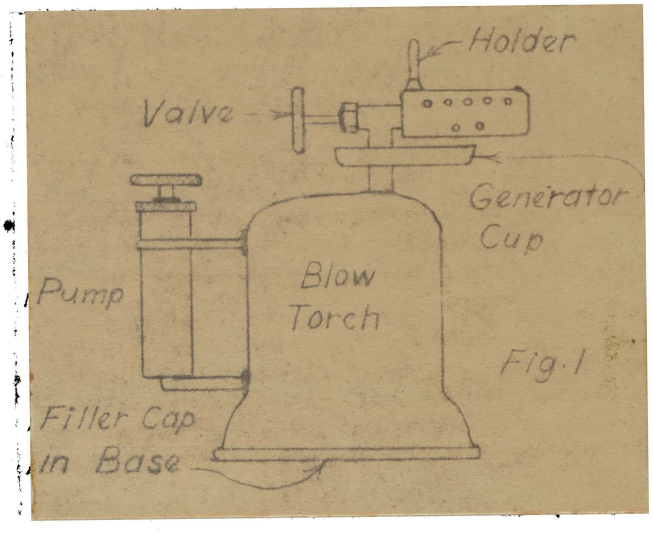


Fig. 1

7. When enough air has been forced into the blow torch, press the handle down and lock it again by turning the handle to the right or left.

Operation II Regulating and Operating the Blow Torch

1. Place the palm of the left hand over the mouth of the burner and turn on the gas valve.
2. With the hand still on the end of the burner, tip the torch a little so that the gasoline, by striking the palm of the hand, will run back into the burner cup.
3. Hold a lighted match or splint just below the burner cup to ignite the gasoline.
4. Let nearly all the gasoline burn out of the cup and then turn on the gas valve. This is to heat the barrel and valve enough to generate the gas; that is, to make it highly combustible.
5. Another very desireable way to heat the barrel and valve is to soak, or saturate, a small amount of waste material such as shavings in gasoline, and burn it in the cup.
6. Regulate the gas valve until a blue flame is obtained.
7. If the blow torch is used a long time keep up the air pressure by pumping more air into the torch when needed.

Operation III Shutting off the Blow Torch

1. Shut off the gas valve of the blow torch but not too tightly as to injure the point when it cools.
2. Unlock the air pump and let it out to release the air pressure.

3. Clean off the torch and put it away.

A blow torch which leaks, or will let gas escape from it, ought never be used because the gas vapor and gas will ignite and cause an explosion.

Questions:

1. Why should a blue flame be obtained?
2. Which portion of the flame is hottest?
3. Why should the air pressure be released from the torch before it is put away?
4. Why should gas be burned in the burner cup?
5. If the flames scatter, what are the causes?
6. Give several precautions necessary to keep foreign matter from getting into the blow torch.

References:

1. Cook, C. T., Scranton, L. L., McColley, H. F., "Farm Mechanics", Page 256, The Interstate Printing Company, Danville, Illinois.
2. Roehl, Louis M., "Farmer's Shop Book", Pages 293-294, Bruce Publishing Company, New York.

Fluxes and Metals

The function of fluxes is to clean and remove oxides from the surface. Metals become "oxidized" due to the action of the air and this oxide must be removed so that the solder will take hold. Before fluxes are used, surfaces must be clean. The first essential for successful soldering is that the surface be absolutely clean.

Operation 1 Selecting the Flux for Soldering

1. The two most common fluxes are rosin and zinc chloride.
2. Solder can be purchased with the prepared flux in it. In that case, it is called acid core and rosin core solder. With the exception of several cases, no other flux is necessary when this type is used.
3. The acid or rosin core solder is more economical to use on small jobs. On larger jobs where more solder is required, it is cheaper to use the plain solder and a prepared flux.
4. Rosin flux should be used on all electrical devices, because acid has a corroding effect on such devices. Rosin flux can also be used satisfactorily on almost any kind of metal.
5. The zinc chloride or acid flux works well on all kinds of metals, but should not be used for soldering electrical devices.

Operation 11 Preparing Fluxes

Equipment and Materials: Commercial hydrochloric acid, glass dish, small pieces of zinc, zinc chloride salt, distilled water.

There are two ways of preparing zinc chloride flux.

1. Secure some commercial hydrochloric acid from a drugstore or some other source.
2. Put about a cupful of acid in a glass dish.

3. Cut up some small pieces of zinc 1/4 " to 1/2 " long.
4. Drop these pieces of zinc into the acid a few pieces at a time until the boiling stops.
5. Add one-fourth part by volume of water. Strain the solution that is left through a cloth and keep it in an air tight container.

B. Another practical method of making zinc chloride flux is as follows:

1. Secure some zinc chloride salt and hydrochloric acid from a drugstore or elsewhere.
2. Make a saturated solution with zinc chloride salt using distilled water, and add one teaspoonful to a pint of acid.

Zinc chloride flux can be kept indefinitely.

Note: Rosin cannot be prepared economically. It is purchased either in powder or lump form.

Operation 111 Using Fluxes

1. Fluxes are used the same way and produce practically the same results on all metals.
2. Surface of metals must be absolutely clean before flux is used. (This is very important). Remove grease and rust with gasoline, sandpaper, emery cloth, muriatic acid and water.
3. Apply the flux with a feather or a similar object on small surfaces. A brush may be used in applying to large surfaces.
4. The rosin flux can be used by dusting the surface with rosin when purchased in powder form. If lump rosin is used, melt enough to cover the surface by using the heated copper.

5. For radio fixtures, a good way to apply the flux is to prepare a solution of alcohol and rosin, and drop some of this solution on the surface to be soldered. The alcohol will immediately evaporate leaving the rosin.
6. The flux will take care of a small amount of grease if surface is greasy, but if too much is present, clean it with soap and water before applying flux.
7. On new metal, file, scrape or sandpaper the surface and apply flux.
8. On old metal, file and wash until surface is bright, then apply flux.

Questions:

1. Why should the flux be kept in an air tight container?
2. Why shouldn't acid core solder be used on electrical wiring?
3. In making zinc chloride flux, why is it necessary to put enough zinc in the acid to stop the boiling?

References:

1. Cook, G. C., Scranton L. L., McColly H. F., "Farm Mechanics", Pages 254-255, The Interstate Printing Company, Danville, Illinois.
2. Roehl, Louis M., "The Farmer's Shop Book", Pages 293-296, New York.
3. Sharp M. A., Sharp W. M., John Wiley & Sons, "Principles of Farm Mechanics", Pages 21-25, New York.

Tinning the Soldering Copper

A soldering copper must be tinned in order for it to pick up and run solder properly. Tinning is a process whereby the four faces of the soldering copper are coated with solder. Exposed parts of the copper will corrode making it impossible to make solder adhere.

Equipment and Materials: A soldering copper, brick which has a low place chisled in it, file, damp cloth, bar of solder, blow torch (most desireable means of heating), and rosin.

Procedure:

1. If the bit has been pitted, the faces should be smoothed out by hammering lightly.
2. If the bit is blunt or in bad condition, it should be heated well and then while hot, clamped in a vise and filed to the point desired. File until each side of face is smooth and bright (fig. 1).

Fig. 1 - Soldering Copper

3. Rub the faces of the soldering copper with rosin. This will make the solder adhere to it. The temperature of the copper should be just high enough to melt the rosin.
4. With the aid of the hot copper melt a portion of the solder into the brick which has a low place chisled in it.
5. Rub a coat of solder on the faces of the soldering copper by twisting the copper in the low place made in the brick.

6. When properly cooled, use a damp cloth to wipe off all the excess solder left on the copper face.

In case you have no brick, melt some solder on the faces of the copper, covering it the best you can. Then shake the copper well by swinging it with the hand. This will cause the solder to spread in a thin sheet over the faces.

For retinning the copper, file off all tin until copper becomes bright and then repeat the operation.

Questions:

1. What causes copper to corrode? Explain.
2. How does zinc chloride affect the copper?
3. When is the best time to file the surface?
4. Why is copper used in making soldering irons?

References:

1. Cook, G. C., Scranton, L. L., McColly, H. F., "Farm Mechanics", Pages 257-258, The Interstate Printing Company, Danville, Illinois.
2. Roehl, Louis M., "Farmer's Shop Book", Page 294, Bruce Publishing Company, New York.
3. Crawshaw, F. D., Lehman, E. W. "Farm Mechanics", Pages 234-237, The Manual Arts Press, Peoria, Illinois.

Mending Small Holes

Both solder and mendits are used for mending small holes. Solder is used for small holes in such articles as buckets, cans, and sheet metal. If solder is used for mending holes in thick metals, it is very desireable to plug the holes with a small piece of round metal and solder over it. Mendits can be used on articles such as kettles, pans, and boilers which are used on the stove. Mendits do not melt whereas solder does.

Equipment and Materials: Zinc chloride or rosin flux, blow torch, soldering copper, solder, sand paper, a box of mendits, piece of metal that is to be mended.

Procedure:

Operation 1 Mending Small Holes With Solder

1. Clean the surface one-half inch around the hole with sand paper. (See job on Fluxes and Metals). Be sure that edge of hole is clean also.
2. Apply the proper flux to the surface of the metal which has been cleaned.
3. With the aid of the soldering copper, raise the temperature of the metal, which is to be soldered, as much as possible.
4. Melt the solder around the hole with the tip of the hot copper until it is built up one-eighth of an inch thick.
5. Move the copper slowly around behind the solder thus gradually filling the hole with solder.
6. Smooth off the excess solder with the hot copper after the mended place has cooled.
7. Wipe off the soldered place with a damp cloth.

Operation 11 Using Mendits on Small Holes

When soldering cannot be used or is not available, then use mendits.

1. Secure a box of mendits at any hardware store.
2. Clean the surface around the hole on both sides of the metal.
3. Use the most desireable size of mendit, depending on size of the hole.
4. With the tap and washer off, insert the mendit through the hole with the head going on the outside of the article.
5. Place the washer and tap on the mendit and screw as tight as possible using the small tightner which comes with the mendits.
6. In some cases if the mendits will not stop the leak, clean and solder over the head or the tap side.
7. In case you have no mendits, use a small screw the size of the hole and place a rubber washer on it from the inside of the container. This will prevent leaking.

Questions:

1. What is the purpose of filling the hole gradually with solder?
2. If the metal is thick, why is it better to plug the hole before it is soldered over?
3. What could be used in the place of mendits for stopping leaks?

References:

1. Cook, G. E., Scranton, L. L., McColly, H. F., "Farm Mechanics", Pages 263-265, Interstate Printing Company, Danville, Illinois.
2. Farm Bulletin Number 1460, "Simple Plumbing Repair in Home", United States Department of Agriculture, Washington, D. C.

Running and Soldering Joints and Seams

Joints and seams are often made when two pieces of metal are joined. Lock seams, when properly made, are the strongest joints and last longer than any other kind. Lap joints may be used where there is no great mechanical strain against the metals, such as laping shingles or making laps over holes. The lock seam is often used on pails and tin roof. If the lock seam is used on a kitchen article or milk can, the seam should be soldered well to keep out dirt.

Equipment and Materials: Blow torch, tinned soldering copper, proper flux solder, tin snips, sand paper or emery cloth, hammer and metals that are to be joined together.

Procedure:

Operation 1 Running Seams

A. The Lock Seam.

1. With a straight edge and marker, lay off the distance for the bend on each piece of metal which is usually one-fourth of an inch (fig. 1).

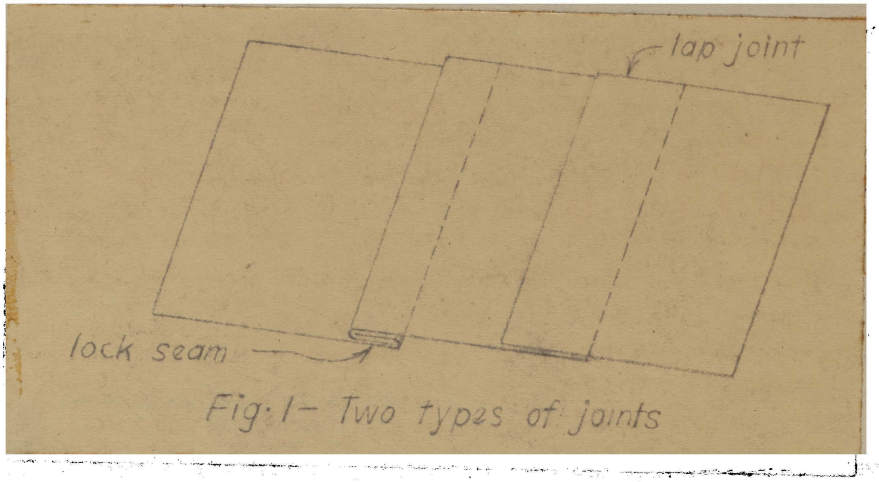


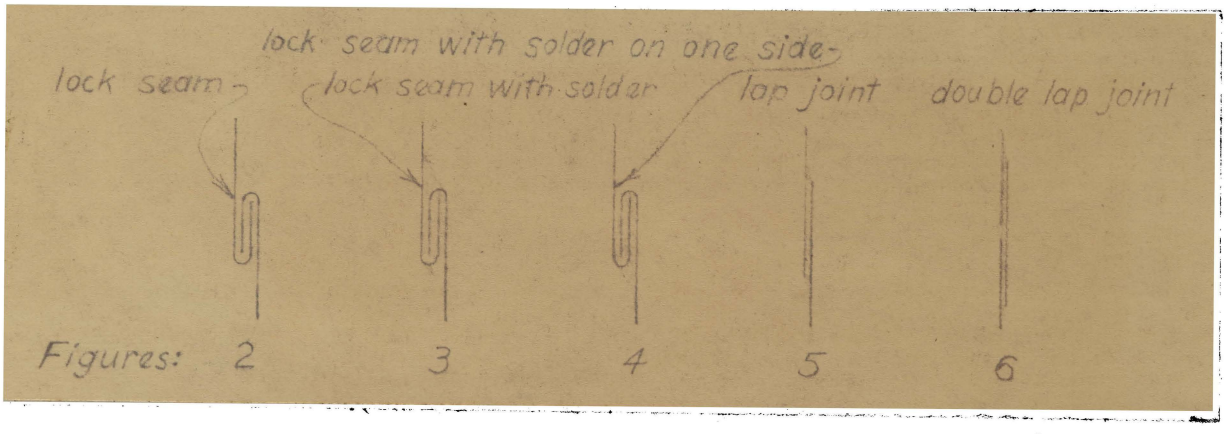
Fig: 1 – Two types of joints

2. Clamp the metal between two straight pieces of wood letting the mark come flush with the sides, and with the use of a hammer bend the edges of the metal squarely over.
3. Remove the wood after the metal has been bent and finish the bending with the hammer alone.
4. The edges can also be bent with tongs made especially for this purpose. Tongs are used when fast work is done.
5. Bend the metal evenly and accurately as shown in (fig. 1 and 2).

B. The Lap Joint.

1. The lap joint is made by laping one piece of metal over another. One-half inch laps are often used. Double lap joints are used in some cases.
2. In soldering the lap joint, use the same procedure as is used in sweating on a patch.

Operation 11



Operation 11 Soldering the Seam

1. Prepare the surface for soldering. (Refer to job on Metals and Fluxes).
2. With the hot copper, run the solder evenly and smoothly along the

seam which has been made (fig. 3 and 4). Be sure the soldering copper is heated sufficiently or the solder will spread unevenly.

Questions:

1. Why is it important that the soldering copper be properly heated before using?
2. In making a lock seam, why is it better to make the bend in the metal straight?
3. In soldering a seam in a milk can why should the faulty seam be cleaned thoroughly?

References:

1. Cook, G. C., Scranton, L. L., McColly, H. F., "Farm Mechanics", Pages 260-261, Interstate Printing Company, Danville, Illinois.
2. Jones, Mack M., "Manual of Farm Shop Work", Page 73, University of Missouri, Columbia, Missouri.

Sweating on a Patch

This method of soldering is used to mend holes that are too large to mend by merely plugging. However, it should be used if the hole is the least bit large because it tends to strengthen the metal, while merely soldering leaves a weak place. This same procedure is used in making a lap joint.

Equipment and Materials: A patch of the same kind of material as to be soldered, and $\frac{1}{2}$" larger on all sides than the place to be soldered, zinc chloride, flux, blow torch, soldering copper.

Procedure:

1. Cut a patch any shape needed but $\frac{1}{2}$" larger on all sides than the place to be soldered.
2. Clean the surface of the patch thoroughly on both sides, and on the edges. (See job on Fluxes and Metals).
3. Clean the surface around the hole at least $\frac{1}{2}$" back, and trim all ragged edges around the hole.

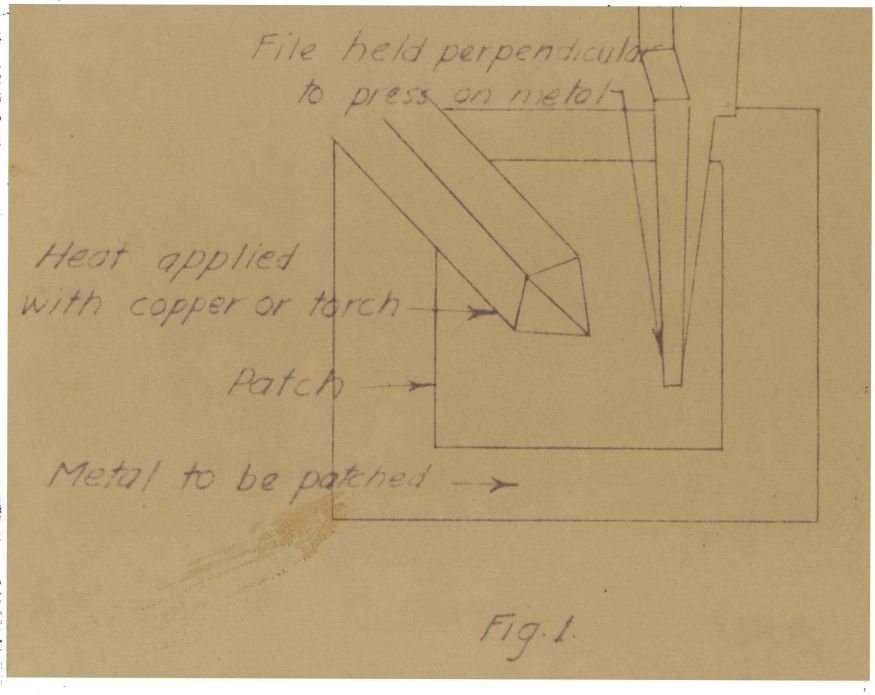


Fig. 1.

4. Heat both metals to be soldered as much as possible with a heated soldering copper.

5. Apply the zinc chloride, flux to both surfaces. This will clean thoroughly the patch and the surface around the hole.

6. Apply a thin coat of solder to each piece of metal. Refer to job on Tinning the Copper.

7. Place the patch over the hole making sure the patch touches all edges around the hole.

8. With a file or punch, hold the patch firmly in the position it is to be soldered (fig. 1).

9. Apply the heated copper or blow torch to the top surface of the patch, shifting position to melt completely all of the solder.

10. Hold the patch firmly in its place until the solder is completely cooled.

11. Apply a slight ridge of solder around the edges of the patch with the tip of the soldering copper, letting the solder lap over the edge of the patch about ¼" (fig. 2).

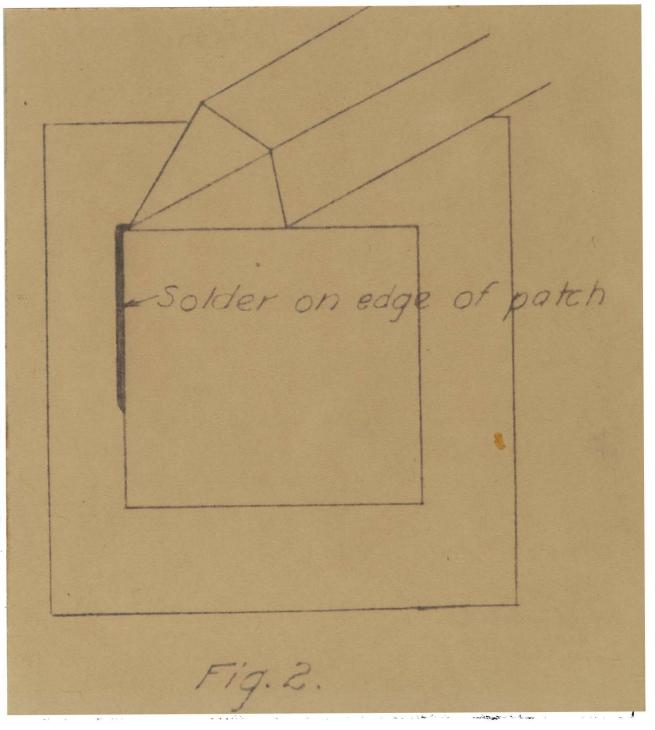


Fig. 2.

12. After the solder and patch have completely cooled, clean the exposed surface of the solder with heated copper (fig. 2).

13. After the solder has completely cooled, clean the exposed surface of the solder with a damp cloth or brush.

Questions:

1. Why should the patch be of the same material as that to be soldered?
2. Why should the patch be held tightly until the solder has cooled?
3. What is the reason for having the solder extend over the edge of the patch?
4. Why should the patch and solder be allowed to cool before the solder is smoothed?
5. Why is the term "sweating" used in this operation?

References:

1. Cook, G.C., Scranton, J. L., McColly, H. F., "Farm Mechanics", Page 263, Interstate Printing Company, Danville, Illinois.
2. Dickinson, Sherman, "Job Observations in Farm Mechanics", Page 84, Interstate Printing Company, Danville, Illinois.
3. Roehl, Louis, M., "Farmer's Shop Book", Page 295, Bruce Publishing Company, New York.

Repairing Copper Tubing and Oil Pipes

Small pipes, of somewhat flexible metal such as copper or lead, which have frozen and burst or have holes in them may be repaired very satisfactorily. Two methods are given here, the first making a stronger and more durable job than the last.

Equipment and Materials: Copper tubing, sandpaper or emery cloth, a round punch of a larger size than the tubing, blow torch, solder, soldering copper, pipe, soldering flux, hack saw, hammer, knife with a small blade.

Procedure:

Operation 1 Preparing the Tub for Soldering

1. With the use of the hack saw, cut out the section of tubing which has been damaged. Make the cut as even and smooth as possible, cutting out no more of the pipe than necessary.
2. Hold one piece of tubing very tight and insert the small end of a punch in one end of it (fig. 1).
3. Tap the punch with a hammer in order to make the hole large enough for the other piece of tubing to fit into it snugly.
4. With the use of the knife and sandpaper or emery cloth, clean thoroughly the inside of the tubing which has been enlarged, and the outside of the other tube about one-half an inch from the end.
5. If the pieces of tubing are too short to make connections, obtain a short piece of tubing and treat it so that two connections can be made.

Operation 11 Soldering

1. If the bar solder is being used, apply a solution of muratic acid or zinc chloride flux to the inside of the tube which has been made larger, and on the outside of the tube which has to be fitted into it (fig. 1).
2. With the use of the heated soldering copper, apply a thin coat of solder to the inside of the enlarged tube and to the outside of the tube which is to be fitted into it.

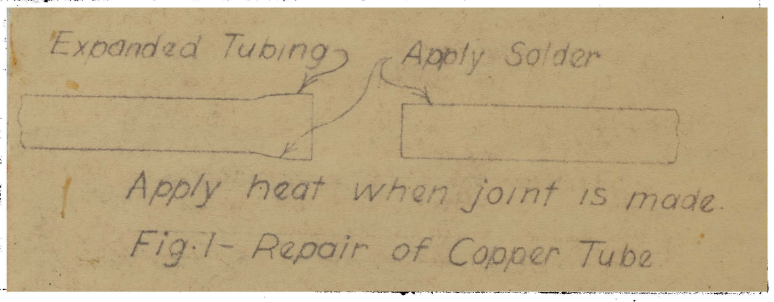


Fig. 1- Repair of Copper Tube

3. When the solder has completely hardened, insert the end of the normal size tube into the enlarged tube about one-half an inch making a snug fit.
4. Holding the tubes in this position, run the heated soldering copper or blow torch over the joint which has been made, thus melting the solder again and jointing the two pieces of tubing.
5. Hold the tubing in this position until the solder has become hard.
6. Solder the rough edges, which is left from the outer pipe.
7. After the metals have cooled, wipe off all grease or flux which has been deposited on the outside of the tube.

Operation 11 Mending the Pipe With Wire

1. Clean the surface around the hole (fig. 1).

2. Apply the suitable flux to the cleaned surface.

3. Obtain a small piece of copper wire.

4. Wrap the wire tightly around the pipe, one layer thick, covering the hole completely.

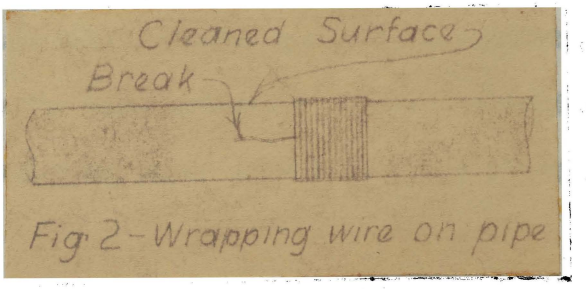


Fig 2 - Wrapping wire on pipe

5. Clean the wire with a flux.

6. Solder the complete surface of the wire, covering it all the way around the tubing.

7. When the solder has cooled, wipe it off with a damp cloth.

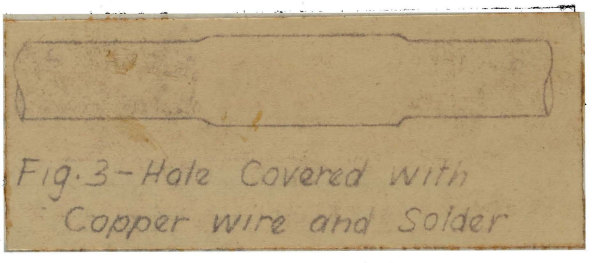


Fig. 3 - Hole Covered with Copper Wire and Solder

Questions:

1. Why is a snug fit necessary for a joint to be soldered as shown in fig. 1?

2. What are the advantages of making joints in the tubing over mending with wire?

3. Why does the joint method apply so well to copper tubing?

References:

1. Cook, G. C., Scranton L. L., McColly, H. F., "Farm Mechanics", Page 254, Interstate Printing Company, Danville, Illinois.

2. Field, A. M., Olson, R. W., Nylin, V. E., "Farm Mechanics", Page 157, The Century Company, New York.

Soldering Galvanized Iron

Every farm boy should know how to solder galvanized iron because it is used quite extensively about the farm. Roofs, gutters, tanks, etc., frequently need repair. Practically the same procedure is used in soldering galvanized iron as is used in soldering other metals with the exception of fluxes in some cases.

Equipment and Materials: Bar solder and zinc chloride, or wire solder with acid core, blow torch, sandpaper, scraper, soldering copper.

Procedure:

1. If the iron is old, clean thoroughly with sandpaper, or scraper if necessary, the surface of the metal which is to be soldered.
2. If the iron is new, do not attempt to clean it.
3. Apply the flux to the surface which has been cleaned, if the flux is not included in the core of the solder. Rosin or zinc chloride flux can be used. Apply flux with feather or brush.
4. Heat the copper with the torch and rub it over the surface of the metal in order to raise its temperature. The metal should be almost as hot as the melting solder. If the article can be placed on a stove or some other hot surface to raise the temperature, better results will be obtained.
5. Melt solder on the copper, then apply it to the metal by moving the copper slowly over the spot to be repaired.
6. After the soldering has been accomplished let the solder and the metal cool.
7. Smooth the surface of the solder with the heated soldering copper.
8. When the soldering has been completed and the work has cooled, clean the surface of the soldering spot with a damp cloth.

Questions:

1. Why is it necessary to clean the surface to be soldered?
2. Why is it important to raise the temperature of the metal in soldering?
3. Why should the soldering spot be wiped off after the job has been completed?
4. What would be the cheaper to use, rolled acid core solder, or flux and bar solder?

References:

1. Cook, C. E., Scranton, L. L., McColly, H. F., "Farm Mechanics", Page 267, The Interstate Printing Company, Danville, Illinois.

HARNESS REPAIR

Knowing Parts and Fitting Harness

In studying and working with harness, it is essential to know the names of the different parts. The drawings below show the more important repair parts with the exception of leather and harness thread. The parts and fittings may be divided into four general classes: (1) those used for guiding the horses, (2) those used for pulling, (3) those used for holding back, (4) those used for support or connection.

Equipment and Materials: Charts or pictures of harness with parts and names, complete set of several kinds of harness if these can be obtained.

Procedure:

1. Obtain pictures and charts with labeled parts of as many different kinds of harness as possible. (See "Farmer's Shop Book", Pages 359-360, and "Harness Repairing", Page 6, by Louis M. Roehl.)
2. Match the parts of the real harness with the parts shown on pictures or charts.
3. Learn names of the parts and fittings of the bridle or control part.
4. Name the parts and fittings of the harness related to drawing a load.
5. Name the parts and fittings of the harness related to holding back the load.
6. Locate and distinguish the parts and fittings used for connection and support.
7. Study the repair parts (fig. 1). Only the more important parts are shown in the figure.
8. Determine the use of the various repair parts.

Questions:

1. Name the different types of harness?
2. Why are light draft and heavy draft harness made up differently?
3. How does plow harness differ from road harness?

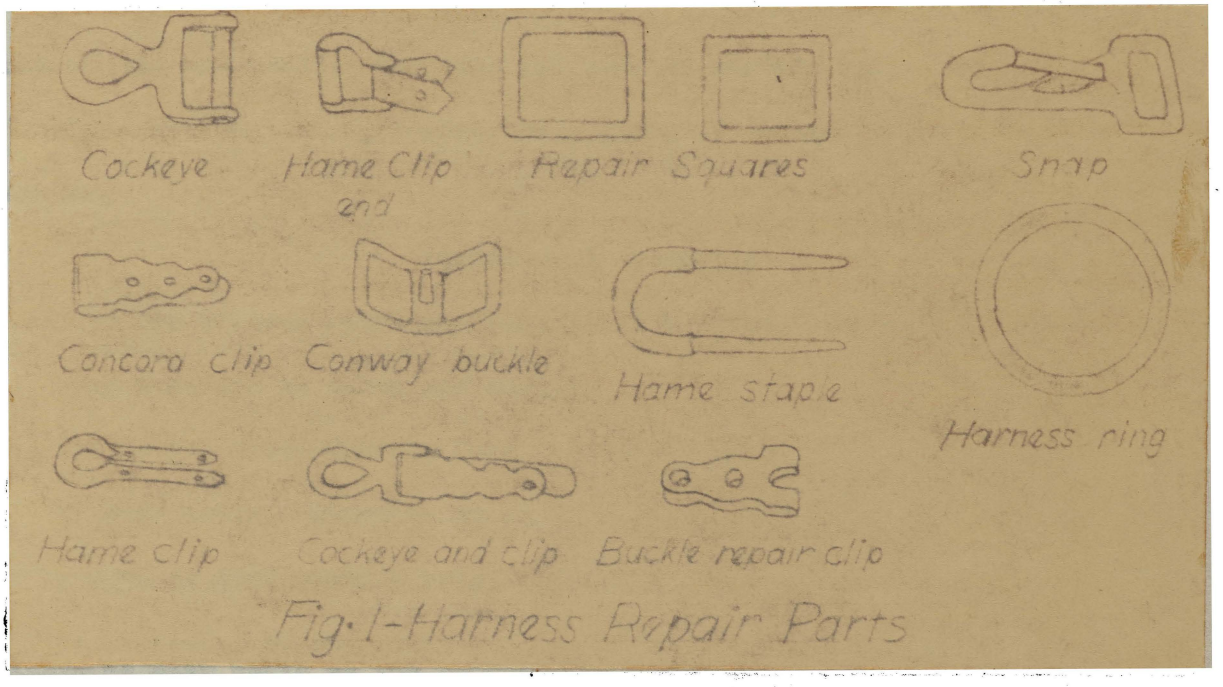


Fig. 1-Harness Repair Parts

References:

1. Cook, G. C., Scranton, L. L., McColly, H. F., "Farm Mechanics", Pages 196-198, The Interstate Printing Company, Danville, Illinois.
2. Roehl, Louis M., "The Farmer's Shop Book", Pages 359-360, Bruce Publishing Company, New York.
3. Roehl, Louis M, "Harness Repairing", Pages 6-8, Bruce Publishing Company, New York.
4. Struck, F. T., "Construction and Repair Work for the Farm", Page 358, Houghton Mifflin Company, Boston, Massachusetts.

Cleaning and Oiling Harness

Cleaning and oiling harness should be regarded as one of the necessary jobs in operating a farm. Not only will the appearance of the team and harness be greatly improved, but the length of life and serviceability of the harness will be greatly increased as well.

Equipment and Materials: Washtub, sal soda or castile soap, scrubbing brush, scrubbing board, harness oil, piece of burlap.

Procedure:

Operation 1 Cleaning

1. Take the harness apart and remove all buckles, straps, and portions that can be taken off easily.
2. Fill a tub three-fourths full of warm water. Dissolve in it a cake of good castile soap or a handful of sal soda. (Never use hot water or water containing acids).
3. Assemble the scrubbing board and place it at an angle so that it will drain into the tub (fig. 1).

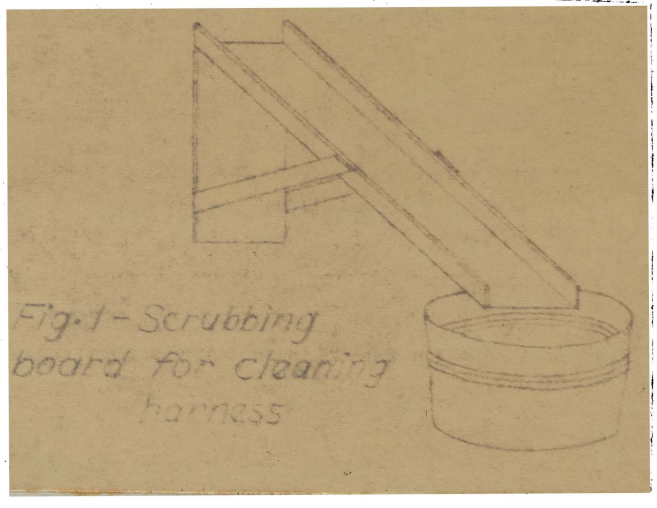


Fig. 1 - Scrubbing board for cleaning harness

4. Place the harness in the tub. The harness should not become soaked, as soaking is detrimental to the leather.
5. Take out one piece at a time on the drain board and scrub thoroughly with a stiff brush until clean. If the dirt is caked on

the harness a dull knife may be used to scrape it off, care being taken not to cut the leather or stitches.

6. Drain well, then wipe off surplus moisture and lay in clean place in the shade until dry or ready to apply oil. Spread paper on the floor and, as each piece is cleaned, lay it by itself on the paper to dry. Do not dry the harness in the sunlight or near a hot stove.

Operation 11 Oiling

1. Use a good grade of oil. The oil may be prepared harness oil or oil made by mixing tallow and cod liver oil, or tallow and Neat's Foot oil.
2. After each piece of harness has dried sufficiently, apply the oil with a sponge or rag. Oil may be applied before the harness is completely dry since it will penetrate the leather as the water evaporates.
3. Spread out on a clean plane and let dry over night.
4. Apply as many coats as the condition of the harness necessitates.
5. Wipe off all excess oil with burlap.
6. Assemble the harness and hang up.

Questions:

1. Why not dry the leather near the stove or in the sunlight?
2. Why should harness be washed thoroughly once a year?
3. What benefits are derived from oiling harness?
4. Why should water and grease containing acids be avoided?
5. What will determine the amount of oil to be applied?

References:

1. Cook, G. E., Scranton, L. L. , McColly, H. F., "Farm Mechanics", Pages 207-209, The Interstate Printing Company, Danville, Illinois.

2. Dickerson, Sherman, "Job Operations in Farm Mechanics", Page 70-71, The Interstate Printing Company, Danville, Illinois.

3. Field, A. M., Olson, R. W., Mylin, V. E., "Farm Mechanics", Pages 89-90, The Century Company, New York.

4. Roehl, Louis M., "Harness Repairing", Pages 51-52, Bruce Publishing Company, New York.

Making a Waxed Thread and Threading

A very important step in harness repair is the preparation of the sewing thread or waxed end, as it is commonly called. A waxed end consists of three or more linen threads waxed tightly together to form one strong, uniform, durable thread, a sewing needle is attached to each end.

Equipment and Materials: 1 ball of linen thread, harness wax, harness needles, 1 piece of beeswax.

Procedure:

1. Pull a piece of thread of suitable length from the center of the ball. Length up to five feet can be handled conveniently.
2. The thread should not be cut or broken off squarely, but it should be untwisted and the fibers torn off in such a way as to make a long tapering end. To do this, hold the thread between the thumb and the finger of the left hand until the twist is removed from the fibers composing the thread. Stop untwisting when all the twist is out of the thread in the six or eight inches of thread next to the left hand. Separate the threads at this point by grasping between the thumb and fingers. Clasp the thread firmly near the ends and tear it. If all of the twist is out, it will tear evenly and easily. The unevenness will tend to make a fine point on the finished thread.
3. Draw three, four, five or six threads in like manner; the number depending on the use to be made of the thread. For tugs and traces, six strands are desireable. For reins, hip straps, hame straps and other light straps, four threads may be used.

4. Place the threads together with the second one slightly past the first, the third slightly past the second, etc. This will make the end taper to a fine point.

5. Place a small amount of shoemaker's wax on a piece of leather about the size of the palm, near the stove or other heat, so the wax will melt on the leather.

6. Throw the thread over a hook and draw both ends towards you keeping the ends even. Clasp both ends between the thumb and finger of the left hand and wax the ends by drawing the wax pad quickly and vigorously over the end. Then twist the ends by rolling each over the right thigh.

7. Draw the two waxed ends apart and twist the threads by rolling first one-half length then the other half length over the right thigh with the palm of the right hand.

8. Equalize the twist in each half of the thread by drawing the twisted threads back and forth several times over the nail. In case two people are doing the job, the thread can be twisted from both ends at the same time, one twisting the opposite way from the other.

9. Wrap the ends of the thread two or three times around the first two fingers to protect the taper.

10. Wax the entire thread by a brisk forward and backward movement of the wax pad.

11. Smooth thread by rubbing between thumb and finger of right hand.

12. Draw the end of the thread through the eye of the needle about two inches, and double the thread back.

13. Clamp the thread close to the needle with the thumb and index finger.

14. Turn the needle between the thumb and finger and gradually move the left hand back on the thread away from the needle. The finished thread should be round and smooth.

Questions:

1. Why is it better to have the threads tear unevenly rather than evenly?

2. Why are the threads assembled with uneven ends?

3. Why is the wax drawn so vigorously over the thread while waxing?

4. If the thread becomes sticky, how can it be remedied? Explain.

References:

1. Cook, G. C., Scranton, L. L., McColly, H. F., "Farm Mechanics", Pages 198-200, Interstate Printing Company, Danville, Illinois.

2. Dickerson, Sherman, "Job Operations in Farm Mechanics", Page 66, The Interstate, Danville, Illinois.

3. Roehl, Louis M., "Harness Repairing", Pages 9-14, Bruce Publishing Company, New York.

4. Struck, F. T., "Construction and Repair Work for the Farm", Pages 361-362, Houghton Mifflin Company, Boston, Massachusetts.

Making a Stitching Splice

The most satisfactory method of splicing a strap is by stitching with a waxed thread. A stitching splice is stronger than one made with rivets and is smoother and neater in appearance. More time is required for making stitched splices, but the job is more substantial.

Equipment and Materials: Knife, awl, stitching clamp, wax, ruler, pricking and finishing wheel, straps to be spliced.

Procedure:

Operation 1 Prepare the Strap for Riveting.

1. Cut ends of the strap off square.
2. Skive or bevel the flesh side of each strap off by holding the strap upside down on the edge of the bench and shaving it down with a sharp plane or knife.

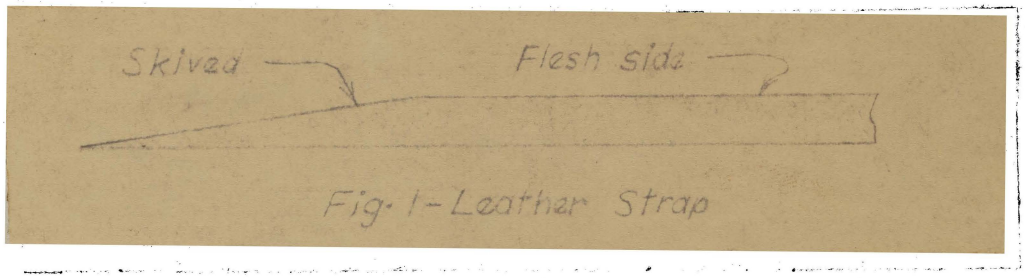


Fig. 1 - Leather Strap

3. Run the pricking wheel down each side and across each end of one of the pieces to be stitched to mark it for stitching, use a straight edge as a guide.

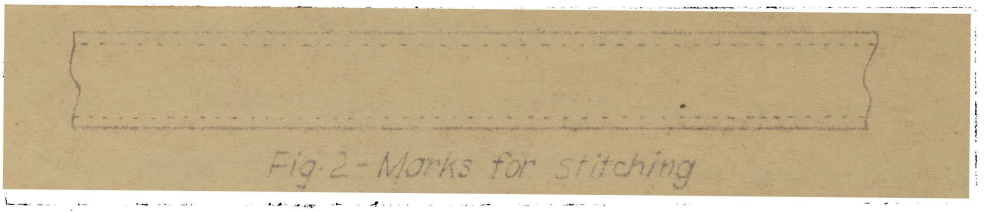


Fig. 2 - Marks for Stitching

Fig. 3 - The two beveled surfaces placed together for stitching

4. Place the two straps together in the stitching clamp. Clamp the strap so the stitches will be close to the jaws of the clamp.

Operation 11 Stitching

1. Having prepared the thread and threaded the needle, hold the awl in the right hand and punch a hole at the first mark. Then pass the wax thread through the hole half way between the needles.
2. Holding one needle in the left hand, one needle and awl in the right hand, make the second hole at the next mark. The awl marks should be at angles and not in a straight line.

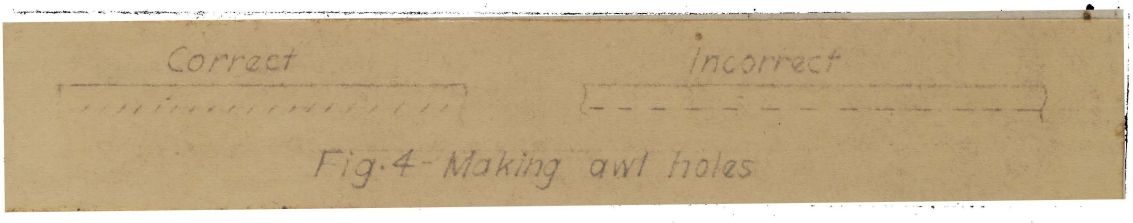


Fig. 4 - Making awl holes

3. Place the left needle in the hole, grasp it with the right thumb and index finger, draw it about three inches, then hook the hand over it and draw it about a foot.
4. Pass the needle of the right hand thread through the upper corner of the hole and grasp the needle with the left hand. Draw it through about three inches, then hook the hand over it and draw it through as far as the other thread.
5. Still holding the needle and awl, either lap a finger of each hand

around the thread or hold thread between the forefingers and thumb and draw the thread up tight.

6. Continue to the last mark or until the stitch leaves the splice and prepare to tie as follows: (1) The left needle is passed through all the way and pulled down in the lower corner of the awl hole, (2) The right needle is inserted above. (3) The thread from the first needle is then passed around the second needle twice. (4) The second is then passed through and both threads pulled up tight. (5) Cut the threads off. This leaves the threads twisted tightly together inside the leather (fig. 5).

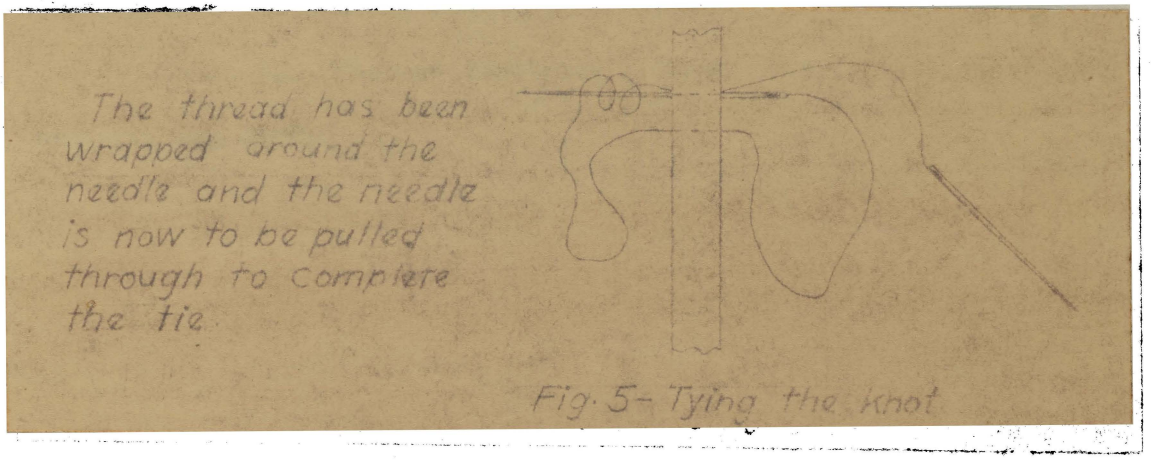


Fig. 5- Tying the knot

7. In stitching, the leather must be soft. Old, stiff leather must therefore be soaked or sponged with oil.

8. The work can be finished neatly by running a finishing wheel over the stitching, tapping the leather lightly while laid flat and touching over with harness dressing.

Questions:

1. How can the flesh side of the leather be distinguished from the hair side?

2. Which is the stronger side?

3. How can the splicing of the thread by the needle be avoided?

4. Why should the first needle be pulled through a distance of a foot before the other one is started?

References:

1. Cook, G. E., Scranton, L. L., McColly, H. F., "Farm Mechanics", Pages 200-203, Interstate Printing Company, Danville, Illinois.

2. Dickerson, Sherman, "Job Operations in Farm Mechanics", Page 67, The Interstate Printing Company, Danville, Illinois.

3. Field, A. M., Olson, R. W., Nylin, V. E., "Farm Mechanics", Pages 82-83, The Century Company, New York.

4. Roehl, Louis, M., "Harness Repairing", Pages 14-19, Bruce Publishing Company, New York.

Repairing a Mid-Section of a Trace

It often becomes necessary to repair traces in the mid-section. This is best done by splicing. However, in the case where the break is near the belly band billet, a trace square and two wrought concord clips can be used.

Equipment and Materials: Trace, punch, knife, rivets, trace splicer, trace square, concord clips, hammer, anvil.

Procedure:

Operation 1 Repairing a Break by Splicing

This is best done before the trace has completely broken.

1. If broken, cut the ends square.
2. Place the two square ends together. Then lay the splicer in the proper position and mark the holes on the tug. The splicer should fit in between the side stitches (fig. 1).

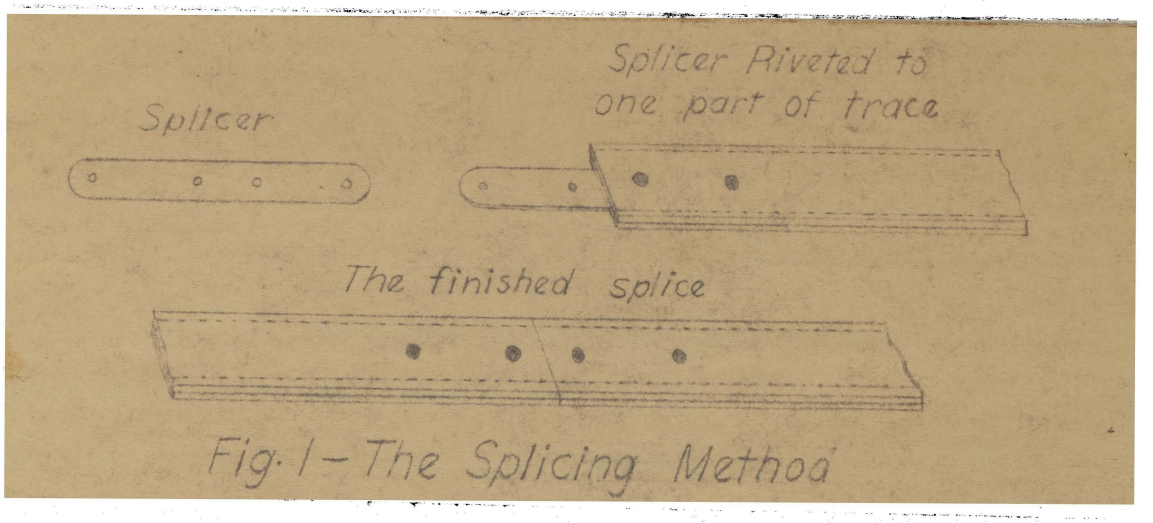


Fig. 1 – The Splicing Method

3. Punch the holes through the trace.

4. Place the splicer in the center of the trace so that the holes in each will correspond (fig. 1).

5. Insert the rivets from the horse side, place the caps or burs on the rivets, tap them in place, and rivet them, using the hammer and anvil.

6. Home made splicers can be made from thin, smooth metal, by filing the edges. The size will depend upon the need.

Operation 11 Repairing With a Trace Square and two Wrought Concord Clips.

1. Cut the ends square.

2. Place the square in the clips, and place the clips in position on the ends of the trace (fig. 2).

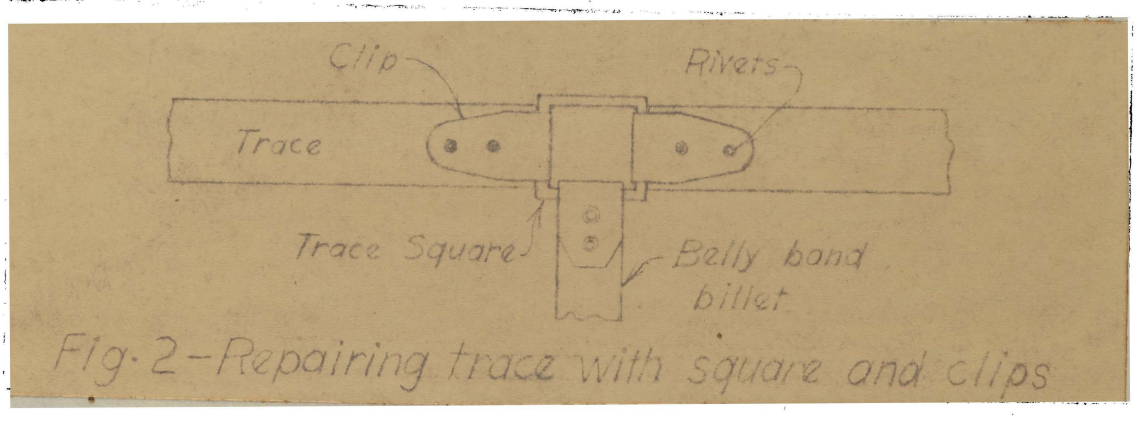


Fig. 2 - Repairing trace with square and clips

3. Mark the holes for the rivets on the trace and then remove the clips.

4. Punch the holes for the rivets.

5. Place the trace in the clips so that holes of each will correspond.

6. Insert the rivets from the horse side and rivet them smoothly using the hammer and anvil (fig. 2).

Questions:

1. Why is the splicing method considered better?

2. What is the best kind of rivets to use in splicing?

3. How is the belly band billet attached to the trace square?

References:

1. Roehl, Louis, M., "Farmer's Shop Book", Pages 377-378, Bruce Publishing Company, New York.

2. Roehl, Louis, M., "Harness Repairing", Pages 27-29, Bruce Publishing Company, New York.

Repairing Trace Ends

Traces should be examined frequently and kept in good repair. It is easier to repair the trace before it breaks than afterward. When a trace breaks in use it generally results in a loss of valuable time.

Equipment and Materials: Tugs, punch, knife, rivets, hame clip, trace chain, wrought concord clip, eyebolt, hammer, anvil.

Procedure:

Operation 1 Repairing a Tug When Broken Near the End

1. Trim the broken end.
2. Place the hame clip in correct position on the trace and mark the place for the rivet holes.
3. Punch the holes with a leather punch.
4. Insert the hame clip through the swirl of the chain (fig. 1).
5. Place the clip on the trace and close it tightly by several light blows with a hammer.

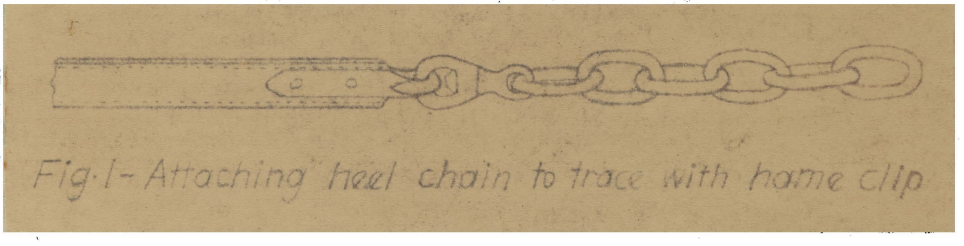


Fig. 1 - Attaching heel chain to trace with hame clip

6. Line up the holes in the clip with the holes in the trace by forcing some small object through them.
7. Insert the rivets from the horse side of the trace. If they are too long, cut them off before riveting.

8. Place the clip on an anvil and rivet smoothly.

Operation 11 Repairing the End With a Wrought Concord Clip

1. Cut the end of the trace square. If the leather is old or badly torn, it may be stitched.
2. Place the clip in right position of the trace and mark holes for rivets. Be sure to leave enough space so that the eookeye can swing freely.
3. Punch the holes with a leather punch.
4. Connect the cook-eye to the clip.

Fig. 2- Repairing trace with a concord clip.

5. Place the clip in position on the trace, insert the rivets from the horse side, and rivet smoothly (fig. 2).

Questions:

1. What other used are made of concord clip and repair eookeye?
2. Why is it advisable to stitch badly torn ends of the trace before attaching the clip?
3. What is the best way to repair a broken trace chain?

References:

1. Roehl, Louis, M., "The Farmer's Shop Book", Pages 375-377, Bruce Publishing Company, New York.
2. Roehl, Louis, M., "Harness Repairing", Pages 26-27, Bruce Publishing Company, New York.

Attaching Snaps and Buckles

Equipment and Materials: Strap, buckle, rivets (copper, tubular, split), punch, knife, riveting machine, hammer.

Procedure:

Operation 1 By a Rivet Loop

1. Place the strap on a board with the rough or flesh side up, and with a knife or jack plane skive about two inches of the end to a wedge shape (fig. 1).
2. With a knife or some sharp tool, taper the end so it will not make a bundlesome splice.
3. Punch four holes with a leather punch leaving a space one and one-half inches between the middle two. Punch the holes the size of the rivets (fig. 1). If the tubular or split rivets are used, holes are not necessary.
4. Fold the ends back, so the holes will line up, and hold firmly with the left hand. Then cut an opening into the folded end to receive the tongue of the buckle. This can be done by punching two holes one-half inch apart and cutting out the area between the holes (fig. 1).

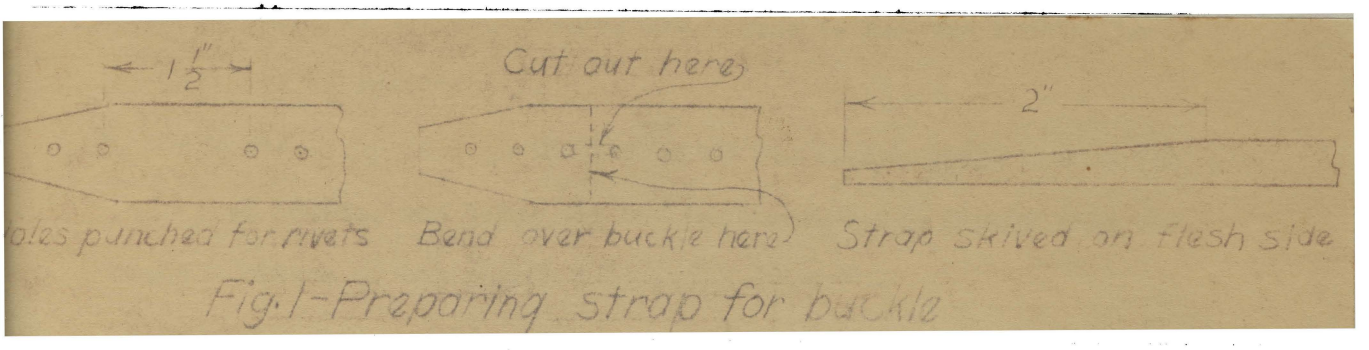


Fig. 1 - Preparing strap for buckle

5. A loop, if desired, can be made from a small leather strap. The ends of the loop are skived, and tacked together, before placed between the two rivets (fig. 2).

6. Refer to job on "Making a Riveted Splice" for riveting.

Fig. 2 - Attaching Buckle

Operation 11 By a Stitched Loop

1. Prepare the ends of the strap in the same manner as described above.

2. Fasten by stitching (Refer to job on "Making a Stitched Splice").

Operation 111 By a Conway Loop

1. Square the end of the strap.

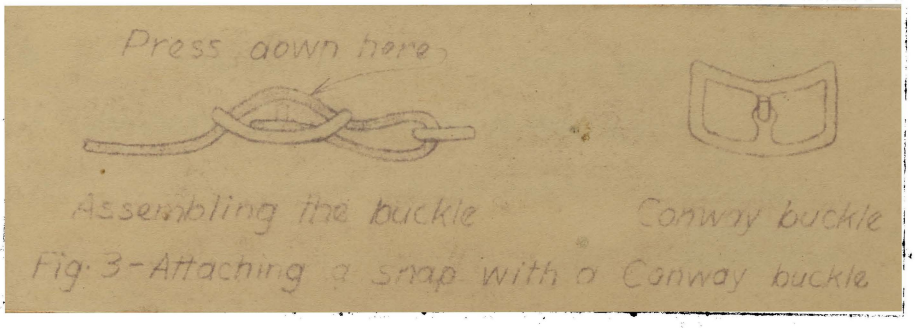
2. Punch a hole on the center line from one-half to seven-eights inches from the end of the strap large enough for the tongue of a conway loop.

3. Punch a second hole three and one-half to five inches from the first depending upon the size of the loop needed.

4. If a buckle is to be attached, cut a slot to fit the buckle, as described in operation 1.

5. Place the strap through the brades of the conway loop, around the snap or buckle, and bring the end back underneath itself into the first branch of the conway loop (fig. 3).

6. Insert the tongue of the conway loop first into the hole at the end of the strap, and then into the other hole (fig. 3) and draw it tight.



Questions:

1. Which method of attaching buckles is the best? Why?
2. Which method is easiest?
3. If riveted, what type of rivet should be used? Why?

References:

1. Cook, G. C., Scranton, L. L., McColly, H. F., "Farm Mechanics", Pages 205-206, Interstate Printing Company, Danville, Illinois.
2. Field, A. M., Olsin, R. W., Nylin , V. E. , "Farm Mechanics", Pages 84-86, The Century Company, New York.
3. Roehl, Louis, M., "Harness Repairing", Pages 20-21, Bruce Publishing Company, New York.

Making a Riveted Splice

A broken strap may be quickly and easily spliced by riveting. Such a splice is not so serviceable as a well stitched splice, but is quite commonly used, especially as a temporary fastening. The strap ends are square, slightly skived or beveled off and lapped together like a stitched splice. Ordinarily three rivets should be enough for each splice. The method of riveting will depend upon the type of rivet used.

Equipment and Materials: Leather punch, round knife, riveting machine, hammer, different kinds of rivets and leather straps.

Operation 1 Preparing the Straps for Riveting

1. Square the ends of the strap with the round knife.
2. Bevel back on the flesh side of each strap with the round knife by holding the strap upside down on the edge of the bench. The bevel should cover the distance which the straps will lap (fig. 1).

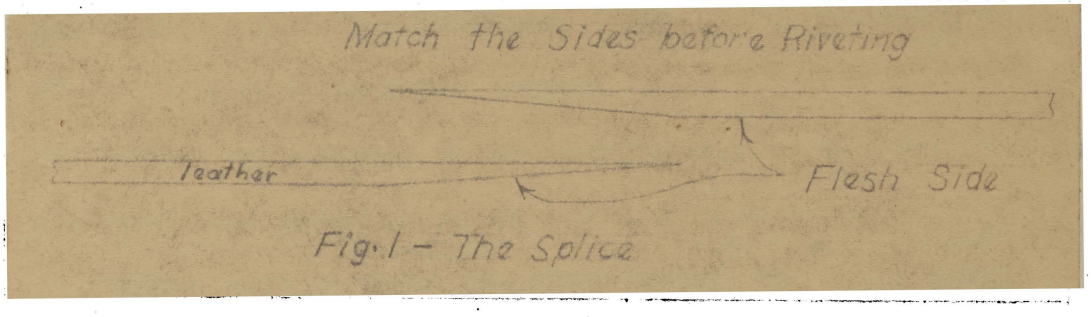


Fig. 1 – The Splice

Operation 11 Placing and Clinching Rivets

1. Solid Copper Rivets:

a. With the leather punch, make holes in the lapped straps where rivets are to be placed.

b. Place the rivets through the holes with the hand on the smooth side of the strap. The end of the rivets should extend through the splice about one-eighth of an inch.

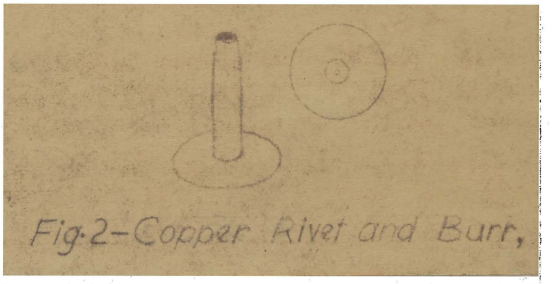
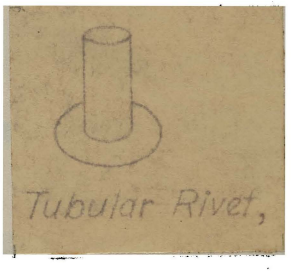


Fig. 2—Copper Rivet and Burr.

c. Place a burr or washer on each rivet and drive down firmly with the rivet set.

d. With the head of the rivet resting on the anvil or a solid surface, rivet down with a ball-peen hammer. Do not draw the rivet so tight that the strap will be injured.

2. Tubular Rivets:


Tubular Rivet.

a. Select the rivets of proper length.

b. Using the special riveting machine clinch the rivets. The rivet cuts its own hole as it is forced through the leather and clinched on the opposite side of the riveting machine. The rivet head should be on the smooth side of the strap. If you have no riveting machine, drive the rivet through the straps and rivet with the hammer as previously shown.

3. Split Rivets:


Split Rivet

Place the rivets in position, drive them through the splice and clinch the ends on the opposite side. These should be used

only for a temporary splice to be replaced with stitches at the first opportunity.

Questions:

1. When should each of the different types of rivets be used?

2. What will be the result if the rivets are clinched too tightly?

3. What are the advantages of using rivets for splicing?

References:

1. Cook, G. C., Scranton, L. L., McColly, H. F., "Farm Mechanics", Pages 203-204, Interstate Printing Company, Danville, Illinois.

2. Dickerson, Sherman, "Job Operations in Farm Mechanics", Page 68, The Interstate Printing Company, Danville, Illinois.

3. Roehl, Louis, M., "Harness Repairing", Pages 20-21, Bruce Publishing Company, New York.

Renewing Hame Clips and Staples

Equipment and Materials: Hame clip, cold chisel, vise, hammer, leather punch, iron rivets, anvil, hack saw.

Procedure:

Operation I Renewing the Hame Clip.

1. Place the clip and tug in a vise and cut off the heads of the rivets with a cold chisel.
2. Drive the rivets out and remove the clip.
3. Place the new clip in position and mark the holes for punching.
4. Punch the holes the size of the rivets.
5. Slip the clip through the hame staple. Place the tug in position and put the rivets in from the horse side and rivet on the anvil (fig. 1).

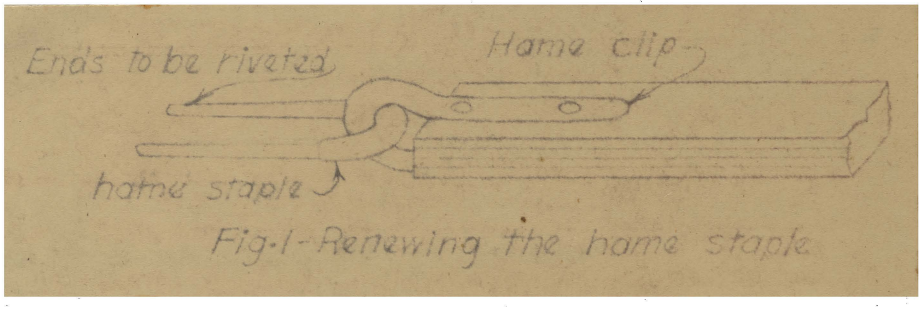


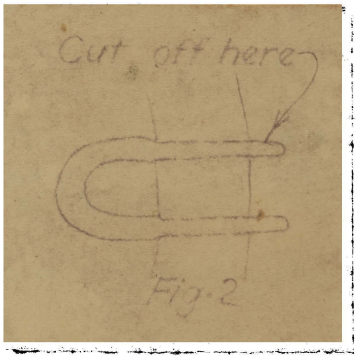
Fig.1-Renewing the hame staple

Operation II Renewing the Hame Staple.

1. Remove the staple by filing or chiseling off the riveted end while the hame is held in the vise.
2. If the riveted ends are sunken in the wood, then the staple must be broken out. Break the staple into two parts by clamping in the vise and then twisting hame back and forth or cut with a bolt cutter or hack
3. Then clamp firmly one-half of the staple in the vise and twist the

hame up and down until the staple snaps off at the shoulder. Repeat for the other half. Care must be taken not to break the hame while twisting it.

4. The ends can then be driven out or at least far enough out so they can be filed down to be removed as in step 1.
5. If a drill press is available, the old staple may be removed after drilling a short distance into the riveted end.
6. Insert the new staple, driving it in snugly.
7. Place in the vise and cut the excess ends off with the hack saw.
8. Place two washers on the ends and rivet down smoothly.



Questions:

1. What are some important things to remember in riveting?
2. After repairing a trace or hame, is it necessary to check the trace length? Why?

References:

1. Field, A. M., Olson, R. W., Nylin, V. E., "Farm Mechanics" Pages 87-88, The Century Company, New York.
2. Roehl, Louis M., "The Farmer's Shop Book", Pages 371-375, Bruce Publishing Company, New York.
3. Roehl, Louis M., "Harness Repairing", Pages 22-25, Bruce Publishing Company, New York.

Calculating Quantity of Paint

The quantity of paint required to cover a given surface may be calculated by reducing the area to be painted to terms of square feet, and by dividing by the number of square feet a gallon of paint will cover on that particular type of surface. Most buildings can be measured in the terms of triangles and parallelograms.

Equipment and Materials: Paper, pencil, rule.

Procedure:

Operation 1 Estimating the Amount of Surface to be Covered.

1. The area to be painted should always be measured in the terms of square feet.
2. Measure the distance around the house and multiply it by the height, (not including gable) to get the total side area.
3. Measure the demensions of the gable or triangle and multiply its height by half its width. This will give the area of gable.
4. Calculate the area in all other parts of the house to be painted and find the total square feet.

Example of how the area of house is calculated: Total side area (distance around x height)

110' x 22' = 2420 sq. ft.

One gable height (height x ½ width)

8' x 12½' = 100 sq. ft.

2' x 100' = 200 sq. ft. in two gables.

Total area = 2520 sq. ft.

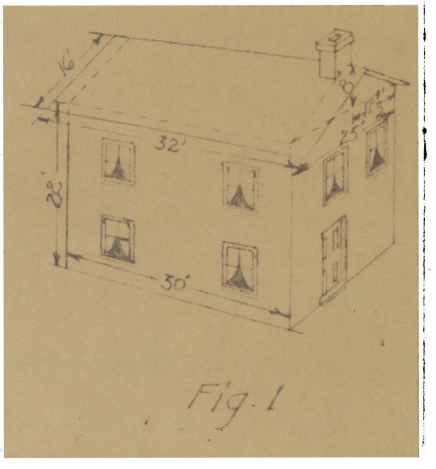


Fig. 1

Operation 11 Determining the Number Gallons of Paint Needed

1. Decide on number of coats to apply.
2. Consult table to find number of square feet a gallon of paint is estimated to cover.
3. To determine the amount of paint needed, take the number of square feet in the area to be covered and divide it by the number of square feet a gallon of paint will cover according to table. Note differences in requirements for different surfaces, and in variations according to the number of coats to be applied.

Remember in securing paint, it is better to have a little too much than not enough. Any left over paint can be used on odd jobs.

Questions:

1. Why does a rough surface require more paint than a smooth surface?
2. Why should surfaces be reduced to square feet?
3. How many coats of paint should be applied to new wood for satisfactory results?
4. Which requires more paint, the first or second coat?

References:

1. Dickerson, Sherman, "Job Operations in Farm Mechanics", Page 40, Interstate Printing Company, Danville, Illinois.
2. Cook, G. C., Scranton, L. L., McColly, H. F., "Farm Mechanics", Pages 115-116, Interstate Printing Company, Danville, Illinois.
3. Farmer's Bulletin 1452, United States Department of Agriculture, Washington, D. C.
4. Van Vlack, C. H., "Selecting and Applying Paints", Pages 22-25, Extension Service, Iowa State College of Agriculture and Mechanics, Ames, Iowa.

TABLE

Chart showing estimated surface that one gallon of paint will cover taken from United States Department of Agriculture Bulletin 1452

Coating Material	Character of Surface	Surface covered by one gallon of paint (sq. ft.) 1 coat	2 coats	3 coats
Oil Paint (glass finish)	Smooth wood	600	325	225
	Rough wood	350	200	135
	Metal	700	340	230
	Cement (smooth)	350	200	150
Oil Paint (flat finish)	Smooth wood on wall board	500	275	200
	Plaster	400	225	160
	Rough Cement (Stucco)	150	75	
Enamel Paint	Smooth Paint with undercoats	500	250	--
Exterior Spar Varnish	Smooth wood	500	275	200
Shellac	Smooth Wood	600	300	--
Interior Finishing Varnish	Smooth wood	450	250	175
Asphalt roof Paint	Smooth	250	--	--
	Rough	150	--	--

Preparing Surfaces for Painting

It is not possible in this job to cover all types of work in preparing surfaces for painting, but the object of this job is to give a general outline to follow.

uipment and Materials: Putty, sandpaper, scraper, blow torch, orange shellac, steel wool or curled horsehair, rags, wire brush, soap and water.

ocedure:

Operation I Preparation of New Unpainted Woods

1. New unpainted wood usually needs little preparation.
2. Dust off loose dirt, remove mortor, plaster, or cement with scraper or sandpaper.
3. Fill in loose joints and nail holes with putty after priming coat is dry. If the putty is too dry, add a small amount of linseed oil, or if too thin, add some whiting.
4. If the wood is resinous, waxy, or contains knots and coarse grain figures full of rosin and pitch, apply a thin coat of orange shellac before surface is painted. The shellac will seal all pores and prevent any pitch from coming through. The shellac also helps the paint adhere to the knots.
5. Resinous wood such as yellow pine should be brushed over with turpentine before painting.
6. Solvent naptha or benzol is used on cypress.

Operation II Preparing Surfaces That Have Been Painted

1. A painted surface that is simply chalky needs only to be dusted.
2. Remove all paint that has started to scale or peel by scraping with a wire brush.
3. Remove all loose putty from nail holes, joints, and cracks and put fresh putty in after the first coat of paint has dried.

Operation III Preparing Surfaces That Have Been Varnished or Enameled.

1. Rub with fine sandpaper, curled horsehair, or steel wool until gloss is removed. Glossy paint washed in ammonia water will also remove the gloss and prevent the new paint from crawling.
2. For marred surfaces, use prepared varnish remover and smooth with steel wool after wood is dry.
3. Varnish wood work in kitchen and bathrooms should be washed with soap and water and then rinsed with clear water.
4. In refinishing old furniture, it is best to remove all paint with some sort of paint remover.

Questions:

1. Describe how to get putty in proper condition to use to fill nail holes.
2. Why cover knots with shellac?
3. What is the purpose of putting turpentine on yellow pine?
4. Why should the priming cost of paint be applied before holes are filled and smoothed with putty?

References:

1. Cook, G. C., Scranton, L. L., McColly, H. F., "Farm Mechanics", Pages 117-118, Interstate Printing Company, Danville, Illinois.
2. Dickerson, Sherman, "Job Operations in Farm Mechanics", Page 44, Interstate Printing Company, Danville, Illinois.
3. Newell, A. C., "Coloring, Finishing and Painting Wood", Page 389, The Manual Arts Press, Peoria, Illinois.
4. Holman, H. P., "Painting on the Farm", Farmers Bulletin No. 1452, U. S. Department of Agriculture, Washington, D. C.

Mixing Paints

To mix paint efficiently, have all things needed when the job is started. Exercise cleanliness. Be sure to follow directions set forth on containers.

Equipment and Materials: Clean buckets or containers, wood paddle, prepared paint, raw linseed oil, turpentine, white lead paste, Japan drier pigments used to obtain desired color.

Procedure:

Operation 1 Mixing Prepared Paints

1. Stir the prepared paints in the container using a wooden paddle.
2. After the paint has been well stirred, it should be poured back and forth from one container to another until all the paint is of uniform color and thickness.
3. Be sure that none of the pigment part of the paint, which has a tendency to stick to the bottom and sides of the container, is left unmixed.

Operation 11 Thinning Prepared Paint

1. Follow the directions on the container as to the amount of thinner to be used.
2. When adding linseed oil or turpentine add only a small quantity at a time and mix thoroughly before adding more. Use wooden paddles for mixing.
3. The finishing coat should be made thin enough to spread well, but care should be taken not to make it to thin, for excessive thinning will cause the paint to run.

Operation 111 Mixing Unprepared Paint

1. Secure a container of greater capacity than the amount of paint to be used.
2. Pour the soft paste white lead into the mixing tub.
3. Thin it down with proper parts of linseed oil and turpentine.
4. For priming coat, thin down the paste by mixing 3 parts paste white lead, 4 parts linseed oil, 2 parts turpentine.
5. For the body coat, mix 2 parts of paste white lead, 1 part linseed oil, 1 part turpentine.
6. For the finishing coat, mix 1 part white lead, 1 part linseed oil.
7. Add the oil slowly and stir thoroughly until a uniform mixture is secured.
8. Add drier to the paint if the linseed oil has not been boiled. Under poor drying conditions, the amount of drier should be increased.
9. If any other color than white is desired, tinting pigments will have to be added. The quantity required will depend upon the power of the pigment and the color desired. Always tint the white paint after it has been made ready for application.
10. The best method to follow in securing the proper color is to tint a small amount such as a cupful. This should be sampled frequently until the proper color is secured.

Questions:

1. Why add small amounts of oil at a time?
2. Why should paint be ready for application before pigments are added?
3. What is the result when too much turpentine is added to paint?
4. Will drier harm the paint if boiled oil is used?

References:

1. Cook, G. C., Scranton, L. L., McColly, H. F., "Farm Mechanics", Page 116, Interstate Printing Company, Danville, Illinois.

2. Dickerson, Sherman, "Job Operations in Farm Mechanics", Page 41, Interstate Printing Company, Danville, Illinois.

3. Newell, A. C., "Coloring, Finishing and Painting Wood", Page 377, The Manual Arts Press, Peoria, Illinois.

Selecting Paint Brushes

Every farmer should be able to select the kind of paint brush which is best for any particular kind of work. Many farmers simply purchase a brush with only purchase cost in mind and are not acquainted with the varying types and their uses. Good brushes of the correct size and construction are necessary for good work.

Equipment and Materials: Various kinds and quality of brushes borrowed from the local hardware.

Procedure:

1. Determine if there is an old brush on hand which can be used for the job to be done. The amount of work to be done will affect this decision. The more to be done, the more likely the need for a new brush as it might save labor and paint and result in better work.
2. In determining what brush should be purchased keep the following features in mind:

a. Select the type best suited to the kind of work to be done.

(1) Flat brushes are used for inside wall painting and outside work. Flat brushes cover rapidly but do not work the paint in so well.

(2) Special flat brushes of large capacity are used for cold water paints and white wash. These are often called calsomine brushes and are preferably 7 to 9 inches in width.

(3) Oval and round brushes are best adapted to window frames, sash and implements.

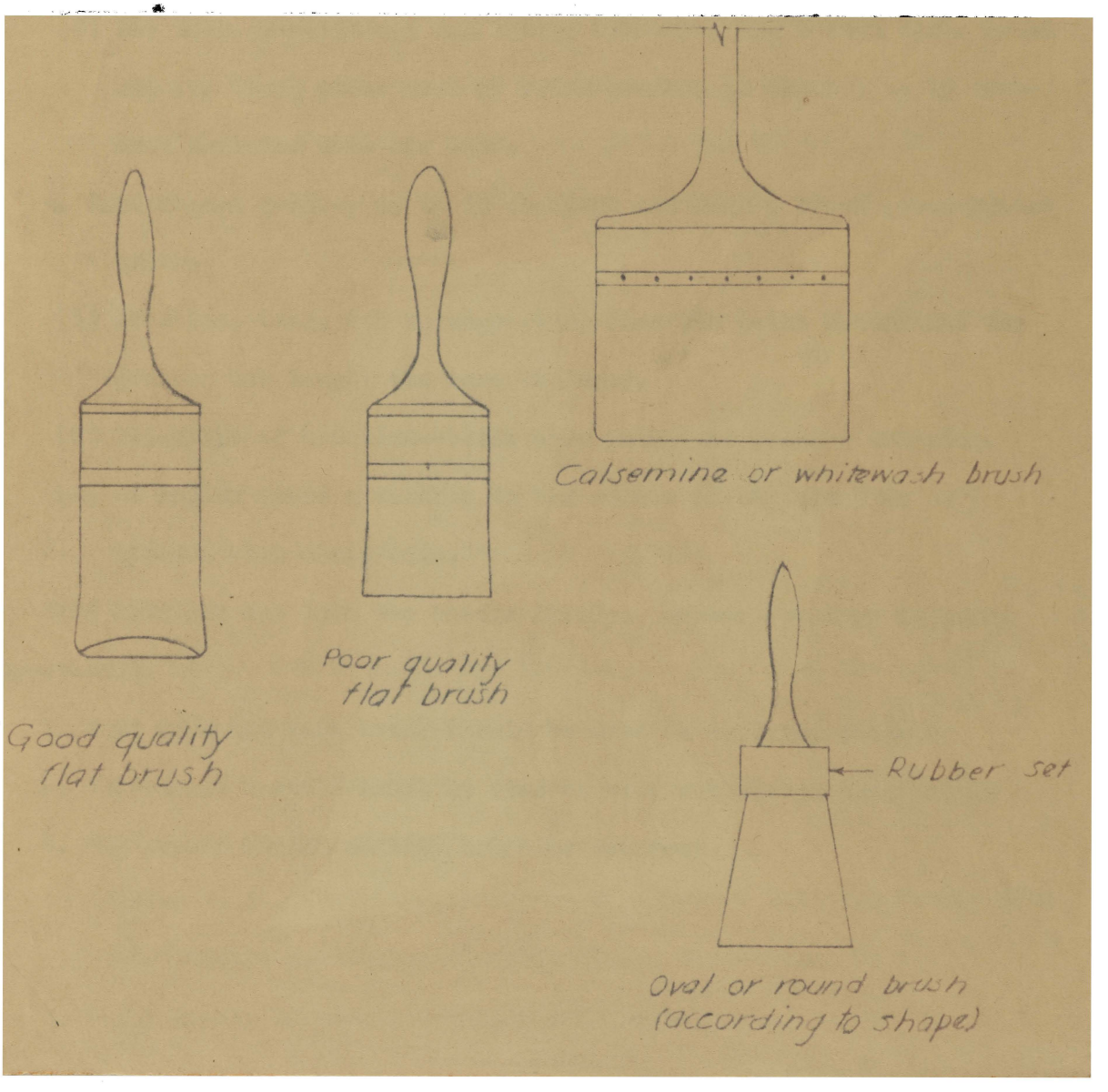
(4) Varnish brushes are either oval or flat with shorter stiffer bristles that are tapered at the end.

b. Select the size best adapted to the kind of work to be done.

(1) The best general purpose farm brush is 2 to 2½ inches width with 6 inch bristles and round in shape.

(2) For wall work, the flat brush should be 4 to 5 inches wide.

(3) For refinishing furniture, use flat or oval varnish brushes that are 2 to 3 inches wide.



(4) For trim on buildings and inside woodwork, use 3 inch width brush but for sash, other oval or round brushes of about 1 to 1½ inches with chiseled ends are best.

c. Select good quality as it is cheapest and such a brush gives better results.

(1) Bristles, long and springy--they flow the paint better and the greater the length the more the wear.

(2) Thick set of bristles--holds more paint and reduces dripping.

(3) No hollow space is noticeable in the center of the brush as is typical with cheap ones.

(4) Bristles set into the handle firmly. Rubber set type is good.

Questions:

1. What type and size of brush should be used in applying enamel?
2. Why should a stiff brush be used on wood with large open pores?
3. Why should a good quality brush be secured?

References:

1. Cook, G. C., Scranton, L. L., McColly, H. F., "Farm Mechanics", Page 116. Interstate Printing Company, Danville, Illinois.
2. Field, A. M., Olson, R. W., Nylin, V. E., "Farm Mechanics", Pages 38-39, The Century Company, New York.
3. Holman, H. P., "Painting on the Farm", Farmers Bulletin Number 1452, United States Department of Agriculture, Washington, D. C.
4. Paint supply or hardware supply catalogues.

Applying Paint

Priming is a preliminary step in preparing a surface for painting. A surface is primed by coating it with a thin paint which will penetrate the wood. The second and third coat being thicker, give a smooth finish and the desired color.

Equipment and Materials: Paint, linseed oil, turpentine, paint brush, ladders, pails, cloth, stirring paddle, hook for pail.

Procedure:

Operation 1 Priming

1. Prepare the surface as described in previous job.
2. Mix the priming coat for new wood by using one gallon of correctly mixed paint, two quarts of linseed oil, one pint of turpentine, and by mixing thoroughly. For old wood, half paint and half linseed oil should be used. If the paint contains too much pigment, the oil penetrates the pores of the wood, leaving the pigment on the surface.
3. Use a large brush, and spread the paint evenly by applying a moderate even pressure. A piece of cloth should be carried in the painters pocket to be used for wiping the hands and cleaning off undesirable paint spots that may have dropped while painting.
4. Brush the paint out well and be sure that each brushful laps evenly onto that put on before it.
5. Begin painting at the highest point and paint down. Paint in strips until bottom is reached. Apply the paint with the grain of wood.
6. When applying paint, avoid getting too much paint on the brush. Dip it not over half way into the paint, depending on the amount desired. When removing the brush from the pail draw it across the edge to remove the surplus paint from the sides. Do not redip the brush into

the paint until the brushful is used up.

7. After the priming coat has dried, apply a second coat as soon as possible.

Operation 12 Applying After Priming

1. Allow the preceding coat to dry thoroughly and see that the surface is dry and free from dirt.
2. Mix the paint according to the coat that has been applied and to the number of coats to be applied. This will depend upon the kind of surface. For old wood more oil is used and for new wood less oil is used.
3. Holding the brush between the thumb and first two fingers, begin at the highest point and work down. Paint across the surface following the same procedure as that for priming.
4. It is best not to have more than two quarts of paint to carry at one time. This should be stirred frequently.
5. Brush the laps out well so they will not show.
6. Apply the next coat as soon as the previous one is thoroughly dry. Each coat should be a little thicker than the previous one.

Questions:

1. What causes blistering and how may it be avoided?
2. Why is turpentine used in the paint?
3. What is the purpose of the priming coat?
4. Which coat requires the most paint? Why?
5. Should paint be applied with the grain or across it? Why?

References:

1. Cook, G. C., Scranton, L. L., McColly, H. F., "Farm Mechanics", Pages 117-118, Interstate Printing Company, Danville, Illinois.

2. Dickerson, Sherman, "Job Operations in Farm Mechanics", Pages 42-46, The Interstate, Danville, Illinois.

3. Field, A. M., Olson, R. W., Nylin, V. E., "Farm Mechanics", Pages 43-44, The Century Company, New York.

4. Holman, H. P. "Painting on the Farm", Farmers Bulletin Number 1452, United States Department of Agriculture, Washington, D. C.

Caring for Brushes

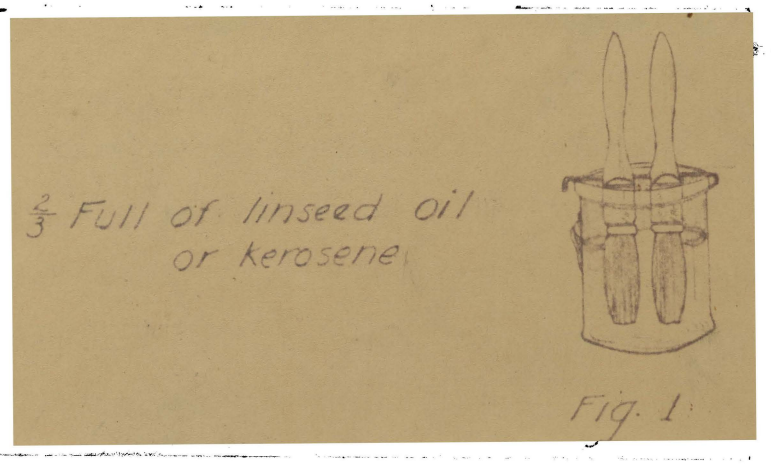
Brushes properly cared for last longer than ones treated carelessly. Proper care also insures better service while brushes are being used. If the paint in a brush once hardens, cleaning becomes almost impossible, and the bristles will never be the same afterwards. It is often cheaper to throw away the brush than to try to clean it.

Equipment and Materials: Turpentine, linseed oil, gasoline, kerosene, heavy paper, putty knife, wire, buckets, cloth.

Procedure:

1. When using a brush, never dip it into paint more than one-half the length of the bristles.
2. Always clean the brushes immediately after use if they are not going to be used again within several days.
3. Clean the brushes using one of the following practices:
   - A. Soak the brush in turpentine or gasoline and work out the paint with a putty knife and cloth. Straighten out the bristles and allow the brush to dry. Wrap the bristles carefully in oil paper or other heavy moist proof paper. Put the brush away in such a manner that the bristles will remain straight.
   - B. Remove most of the surplus paint from the brush as described above, and suspend the bristles in a pail containing equal parts of turpentine and raw linseed oil. Several brushes may be kept in the same pail. Drill a hole through the handle and by means of a wire suspend the brush into the oil. This will prevent the brush from resting on its bristles. Cover the pail to keep out dust and dirt.

4. Brushes that are in use for several days can be suspended in the paint itself, or in linseed oil when not in use. Do not allow the brush to rest on its bristles for more than a few minutes.



5. If the paint has hardened in the brush, it will be rather hard to remove. Use some commercial paint remover if bristles are hard and stiff. If they are only slightly stiff, washing in gasoline or turpentine is beneficial.
6. Clean and keep shellac brushes in alcohol. If thoroughly cleaned, they may be laid away until used again.
7. Varnish brushes are kept in turpentine.

Questions:

1. Why not let the brush rest on its bristles more than a few minutes?
2. Why should a brush never be put in water?
3. Is kerosene a good solution in which to leave a brush? Why?
4. Why is it better not to dip the brush into the paint more than half the length of the bristles?

References:

1. Cook, G. C., Scranton, L. L., McCelly, H. F., "Farm Mechanics", Pages 116-117, Interstate Printing Company, Danville, Illinois.
2. Dickerson, Sherman, "Job Operations in Farm Mechanics", Page 43, The Interstate, Danville, Illinois.

3. Field, A. M., Olson, R. W., Nylin, V. E., "Farm Mechanics", Pages 38-41, The Century Company, New York.

4. Roehl, Louis, M., "Farmer's Shop Book", Page 403, Bruce Publishing Company, New York.

Filling

The purpose of filling, the second step in any finishing operation, is to close the pores of the wood and give a perfectly level and smooth surface for the varnish, wax, or shellac. There are two kinds of fillers: (1) paste filler, which should be used in open-grain woods such as ash, chestnut, hickory, oak, and walnut, (2) liquid fillers, which are used in close-grained woods, such as basswood, birch, Douglas fir, cypress, maple and pine. Fillers are prepared in several colors to correspond with the various colors of stain.

Equipment and Materials: Wood filler, brush, coarse cloth.

Procedure:

1. Prepare the surface to be filled by staining properly or by cleaning and smoothing the natural finish.
2. Determine the kind and color of filler to use, and be sure to secure enough to do the job. Paste filler is usually the most satisfactory and may be secured in natural colors.
3. Pour a quantity from the can into a dish and thin with a small quantity of the kind of stain that was used on the wood to make the filler the same shade as the stained wood.
4. If necessary to thin further, add a little turpentine. The filler should be as thick as cream.
5. Apply the filler with a stiff brush or a cloth, rubbing it well into the wood both ways of the grain. It is not necessary to brush out the work, as the surplus will be rubbed off.
6. Use a coarse cloth and rub the surface thoroughly a few minutes after the filler has been applied. Rub first across the grain and then with it, in order to fill all the pores in the wood.

7. Be sure to remove all surplus filler from the corners and edges by scraping with some full object such as a putty knife.

8. Let stand for 24 hours before adding the other finish.

Questions:

1. Of what is filler made?

2. Why use wood filler?

3. What is sometimes used instead of wood filler to fill the pores of the wood?

4. When should a liquid filler be used?

References:

1. Cook, G. C., Scranton, L. L., McColly, H. F., "Farm Mechanics", Page 124, Interstate Printing Company, Danville, Illinois.

2. Dickerson, Sherman, "Job Operations in Farm Mechanics", Page 48, The Interstate, Danville, Illinois.

3. Roehl, Louis, M., "Farmer's Shop Book", Page 405, Bruce Publishing Company, New York.

4. Schultz, L. C., Schultz, L. J., "School and Home Shopwork", Pages 88-90, Allyn and Bacon, New York.

5. Struck, F. T., "Construction and Repair Work for the Farm", Page 54, Houghton Mifflin Company, Boston, Massachusetts.

Staining

Staining is one of the first steps in finishing furniture. The purpose of the stain is to change the color, beautify the wood, and make it harmonize with the surroundings. Another use for stains is found in giving the appearance of age to wood. Staining is an under coat to all other finishes. There are three major steps in one finishing operation. These are staining, filling and final coating.

Equipment and Materials: Various stains, turpentine, drop black, brushes, cloths, plane, No. 00 and 000 sandpaper, filler.

Procedure:

Operation I Preparing the Surface

1. Plane and scrape the surface of the wood to remove all irregularities.
2. With medium or fine sandpaper, according to the needs of the piece, sand the surface until smooth. Rub with the grain. Sanding across the grain will make scratches which will show in the finished work.
3. Use double or triple naught sandpaper for fine work.
4. Remove all dust from surface after it is smoothed properly.
5. Fill all cracks and holes with some sort of filler. Commercial fillers such as plastic wood or putty or sawdust mixed with glue may be used. Use a filler that takes stain.
6. After the filler has hardened, it should be rubbed smooth. This work is done before the wood is stained.

Operation II Choosing a Stain

1. There are many kinds and colors of stains. Your choice will depend upon the type of wood and where it is to be used.
2. The kinds of stains on the market are:

a. Oil stains - These are easy to apply and are most commonly used. These are best for soft wood such as pine.

b. Acid stains - As a rule they are injurious to wood, and are not recommended for use on the farm.

c. Spirits stains - These stains are more penetrating than oil stains. They are harder to apply. Shellac should not be used directly over a spirits stain.

d. Water stains - These stains require skill in using, but give good results when applied properly. They are recommended on the farm.

e. Aniline stains - Not commonly used on farms.

f. Varnish stains - One that stains and varnishes the wood with the same application. The use of such stain is not generally recommended.

3. Try the stain on a piece of wood to make sure it gives the desired color.

4. Oil stains may be darkened by adding a small quantity of drop black or lightened by adding a small amount of turpentine.

Operation III Applying Stain

1. Select the color to use.

2. Apply the stain with a medium size brush, working it quickly with long, smooth strokes.

3. Let stand a few minutes, then rub lightly with a piece of cloth. The amount of rubbing and length of time to leave the stain on the wood before rubbing will depend upon the darkness of the color desired.

Every particle of stain must either be rubbed into the wood or wiped off.

4. Apply a second coat if the first does not give the desired color.
5. Clean the brush in turpentine or gasoline and put it away. (Refer to job on Care of Brushes).
6. When the stain has become thoroughly dry, examine the wood carefully, noting whether or not the grain has been raised. If not smooth, a light sanding with No. 00 paper will be necessary before proceeding with the next operation.

Questions:

1. Why do we use stain on wood? Give several reasons.
2. Why is a "varnish stain" seldom used?
3. Why are oil stains the best for farm purposes?
4. Give some advantages and disadvantages of spirits stains and water stains.

References:

1. Cook, G. C., Scranton, L. L., McColly, H. F., "Farm Mechanics", PP. 121-123, Interstate Printing Company, Danville, Illinois.
2. Dickerson, Sherman, "Job Operations in Farm Mechanics", P. 47, The Interstate, Danville, Illinois.
3. Roehl, Louis, M., "Farmer's Shop Book", PP. 404-405, Bruce Publishing Company, New York.
4. Struck, F. T., "Construction and Repair Work for the Farm", PP. 53-54, Houghton Mifflin Company, Boston, Massachusetts.

Varnishing

Varnish is one of the best known and most commonly used finishes. It is very satisfactory but quite expensive. There are many varieties and commercial brands of varnish. Since cheap grades of varnish are usually unsatisfactory, a high grade should always be used. Varnish is composed of vegetable gums, linseed oil, naphtha, and turpentine. The cheap varnishes do not withstand either heat or water as well as the better grades of varnish. Spar varnishes contain a larger amount of oil than the common kind and are tougher, more elastic, and stand exposure better.

Equipment and Materials: Good varnish, good varnish brush, No. 00 and No. 000 sandpaper, pumice stone, felt pad.

Procedure:

1. Inspect all surfaces to see that they are smooth, clean, dry, and free from dust and grease. The most satisfactory way of removing old varnish is to use commercial varnish and paint remover.
2. Select a good grade of varnish and a good brush. A 1½" brush is suitable.
3. Work in as nearly a dust-free situation as possible.
4. Secure a temperature as near 70-80 degrees as possible. In cold weather, it is best to warm the varnish by placing the can in warm water.
5. For the first coat, add about one part of turpentine to seven parts of varnish. It is not necessary to thin after the first coat.
6. Dip the brush into the varnish about one-half the length of the bristles. Draw the brush lightly over the edge of the container to

remove surplus varnish.

7. Apply the varnish from the center of each face to its ends to prevent runs over the edges. Spread carefully, using a soft brush and a long smooth stroke.

8. Even up the surface with light, feathering strokes along the grain.

9. Clean the varnish brush in turpentine after using and store it away properly.

10. Allow the varnish to become thoroughly dry, unless a quick drying varnish is used. It usually takes 24-48 hours.

11. When the first coat has completely dried, rub smooth with very fine steel wool or triple naught sandpaper. Remove any coarse particles of grit from the paper by rubbing them together several times. Rub lightly and with the grain.

12. Wipe the surface carefully to remove oil, water, or dust particles.

13. Apply the second coat following instructions given in first.

14. Allow to dry at least 48 hours.

15. Rub this coat with No. 000 sandpaper and polish off with pumice stone.

16. Three or four coats should be sufficient for most work.

17. Apply the final coat with the utmost care and allow it to dry for several days.

18. When ready to rub down, use a felt pad instead of sandpaper. Moisten the felt with rubbing oil. Also use the pumice stone. Rub in direction of the grain.

19. Remove all excess pumice stone with oil and polish with a dry soft cloth.

Questions:

1. From what is varnish made?
2. What is spar varnish?
3. Why apply the second and third coats?
4. How should the hands be protected against paint of any kind?

References:

1. Cook, G. C., Scranton, L. L., McColly, H. F., "Farm Mechanics", Page 124, Interstate Printing Company, Danville, Illinois.
2. Dickerson, Sherman, "Job Operations in Farm Mechanics," Page 51, The Interstate, Danville, Illinois.
3. Roehl, Louis, M., "Farmer's Shop Book", Page 405, Bruce Publishing Company, New York.
4. Schultz, L. C., Schultz, L. J., "School and Home Shopwork", Pages 91-93, Allyn and Bacon, New York.
5. Struck, F. T., "Construction and Repair Work for the Farm", Pages 52-53, Houghton Mifflin Company, Boston, Massachusetts.

Shellacing

Shellac is frequently used as the final step in finishing wood surfaces. It is also used as an undercoating for varnish or wax. It closes the pores of the wood, sets rapidly, and is attractive as a finishing coat. It may be purchased in either orange or white. Shellac should not be used as a final finish where it will come in contact with water, as moisture causes it to turn white. When shellac is used as a final finish, it should be built up with several thin coats. Each coat should be sandpapered before applying the next coat.

Equipment and Materials: Shellac, brush, sandpaper.

Procedure:

1. See that the preliminary operation of staining, or filling, or both, has been properly completed.
2. Be sure that the surface is clean, smooth, and dry.
3. Select shellac, either orange or white, depending upon whether you want the surface to maintain its natural color or to be darkened. White shellac is transparent and does not alter the color of the surface treated. Orange shellac has a tendency to darken the surface slightly.
4. If necessary to thin the shellac, use wood alcohol or specially prepared denatured alcohol. It should be thin enough to spread easily.
5. Apply with a brush using long, smooth strokes, and working rapidly as shellac dries quickly.
6. Do not go over the wet surface a second time, because it may result in a roughened surface.

7. After the desired number of coats, usually five or six, have been applied and properly rubbed down between each coat, give a final rubbing with No. 00 sandpaper.
8. Polish with a soft dry cloth.
9. Clean and put away the shellac brush after finishing with it. (Refer to job on Care of Brushes).

Questions:

1. Give the advantages and disadvantages of shellacking?
2. How long does it take shellac to dry?
3. What is the difference between orange and white shellac?
4. Is it always justifiable to use shellac as an undercoating for varnish or wax? Explain.

References:

1. Cook, G. C., Scranton, L. L., McColly, H. F., "Farm Mechanics", Pages 124-125, Interstate Printing Company, Danville, Illinois.
2. Dickerson, Sherman, "Job Operation in Farm Mechanics", Page 49, The Interstate, Danville, Illinois.
3. Roehl, Louis, M., "Farmer's Shop Book", Page 405, Bruce Publishing Company, New York.
4. Schultz, L. C., Schultz, L. J., "School and Home Shopwork", Pages 93-94, Allyn and Bacon, New York.

Waxing

Wax is made of vegetable wax, or beeswax which is dissolved in turpentine or some other solution. It may be purchased in liquid, paste, or powder form. Liquid wax is recommended for furniture and paste wax for floors. A good waxing leaves the floor with an artistic semi-gloss which is pleasing to some people. It is an effective and inexpensive type of finish, having a dull lustre and serving, also as a protection to the surface. Spots and finger marks can easily be removed from the waxed surface by applying more wax and rubbing. Wax may be applied directly to the stain, but better results are obtained if it is applied after the wood has been filled or shellacked.

Equipment and Materials: Paste or liquid wax, cloths, brushes.

Procedure:

1. See that the surface is clean.
2. With a soft cloth, apply the wax by rubbing evenly over the surface.
3. Allow this to dry for about ten to fifteen minutes.
4. Then by using another soft, dry cloth or felt, rub to a polish.
5. Remove the wax from edges and corner with a putty knife or similar tool.
6. Allow the first coat to dry for twenty-four hours.
7. If a higher gloss is desired, or if there are places subject to considerable wear, apply several coats.
8. The additional coats are applied similarily to the first.

Questions:

1. What are some advantages of a wax finish?
2. What are the greatest disadvantages in a wax finish?
3. How may wax which has become hardened be removed?

References:

1. Dickerson, Sherman, "Job Operations in Farm Mechanics", Page 50, The Interstate, Danville, Illinois.

2. Struck, F. T., "Construction and Repair Work for the Farm", Pages 54-55, Houghton Mifflin Company, Boston, Massachusetts.

3. Roehl, Louis, M., "Farmer's Shop Book", Pages 405, Bruce Publishing Company, New York.

Constructing a Portable Feed Trough for Lambs

A portable feed trough is a simple device used in feeding lambs. It is very useful and easy to construct. Use a soft smooth decay-resisting type of wood. It is made very light, with wide base to prevent upsetting, a top rail to keep lambs from getting into trough, and a hinged side to make cleaning easy. It is very easy to carry and thus can be moved from one place to another. This trough, if placed in a creep where older sheep cannot reach it, may be used for feeding lambs a grain ration to supplement the ewe's milk. This type of trough constructed on a larger scale may be used for adult sheep.

Equipment and Materials: Saw, plane, hammer, wood chisel, screw driver, square. Some soft and smooth decay-resisting lumber.

No. pcs.	Dimensions	Use
1	7/8" x 7½" x 10½"	bottom
2	7/8" x 23/4" x 8'	sides
2	7/8" x 5 3/4" x 17"	ends
2	7/8" x 4" x 18"	feet
1	7/8" x 3" x 8'	top rail

½ lb. 8 d common wire nails, ¼ lb. 8 d finishing nails, 3 small butt hinges with screws or leather strap hinges, 2 galvanized hooks and screw eyes.

Procedure:

Operation 1 Preparation of Material

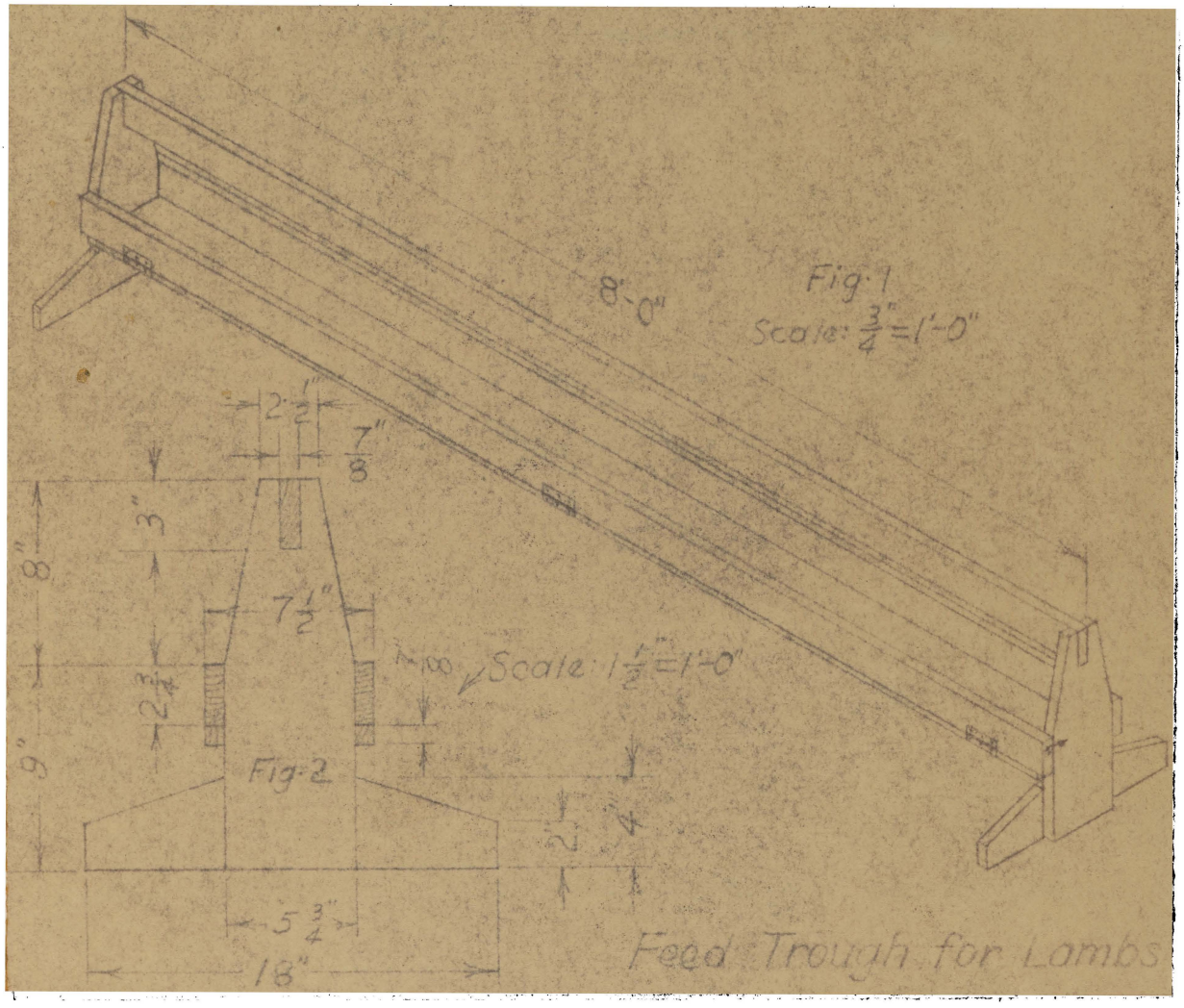
1. Reduce lumber to dimensions as indicated in bill of materials.
2. Plane side pieces to a smooth finish.
3. Cut notches in top of end pieces for top rail with hand saw and wood

chisel, using dimensions as shown in drawing. Be sure the notches are not cut wider than the top rail.

4. Taper ends and feet as shown in (fig. 2) with hand saw.

Operation 11 Arrangement of Parts

1. Fasten ends to feet using dimensions as shown in drawings.
2. Place top rail in place with finishing nails.
3. Fasten bottom of trough between the ends. Be sure that the bottom projects out seven-eighths of an inch beyond the end pieces (fig. 2).
4. Fasten one side piece directly over the projections of the bottom of the trough flush with the ends.



5. Attach three small butt hinges in a manner that the side can be turned down (fig. 1).

6. Attach hooks to each end of one side piece and screw eyes in each end piece in a position to fit the hooks (fig. 1).

7. Nail all parts well.

Questions:

1. Why are the side pieces planed to a smooth surface?

2. Why is it advisable to have the trough built so that it is easy to clean?

3. Why is a decay-resisting variety of lumber desireable for this work?

References:

1. Davis, J. B., "Farm Enterprise Mechanics", Pages 246-247, Lippincott Company, Philadelphia, Pennsylvania.

2. McWhorter, V. O., Potts, C. G., "Equipment for Farm Sheep Raising", Farmer's Bulletin 810, Pages 18-19, United States Department of Agriculture, Washington, D. C.

3. Struck, F. T., "Construction and Repair Work for the Farm", Pages 212-215, Houghton and Mifflin Company, Boston, Massachusetts.

Building Creeps for Lambs or Pigs.

The creep is an enclosure or a part of a fence or partition that has openings through which young stock such as lambs and pigs can readily go, but which excludes the larger animals. By the use of a creep, young stock may be fed special retions not accessible to the nature animals. Creeps may be built in portable as well as stationary form. The creep in this job is built for a fence corner.

The creep shown in the drawing is for lambs. If the creep is to be used for pigs, the openings should be 14" high and the height of the creep fence reduced from 2' 8" to 2' which requires less material.

Equipment and Materials: Any kind of rough lumber will be satisfactory, nails, axe, hammer, saw.

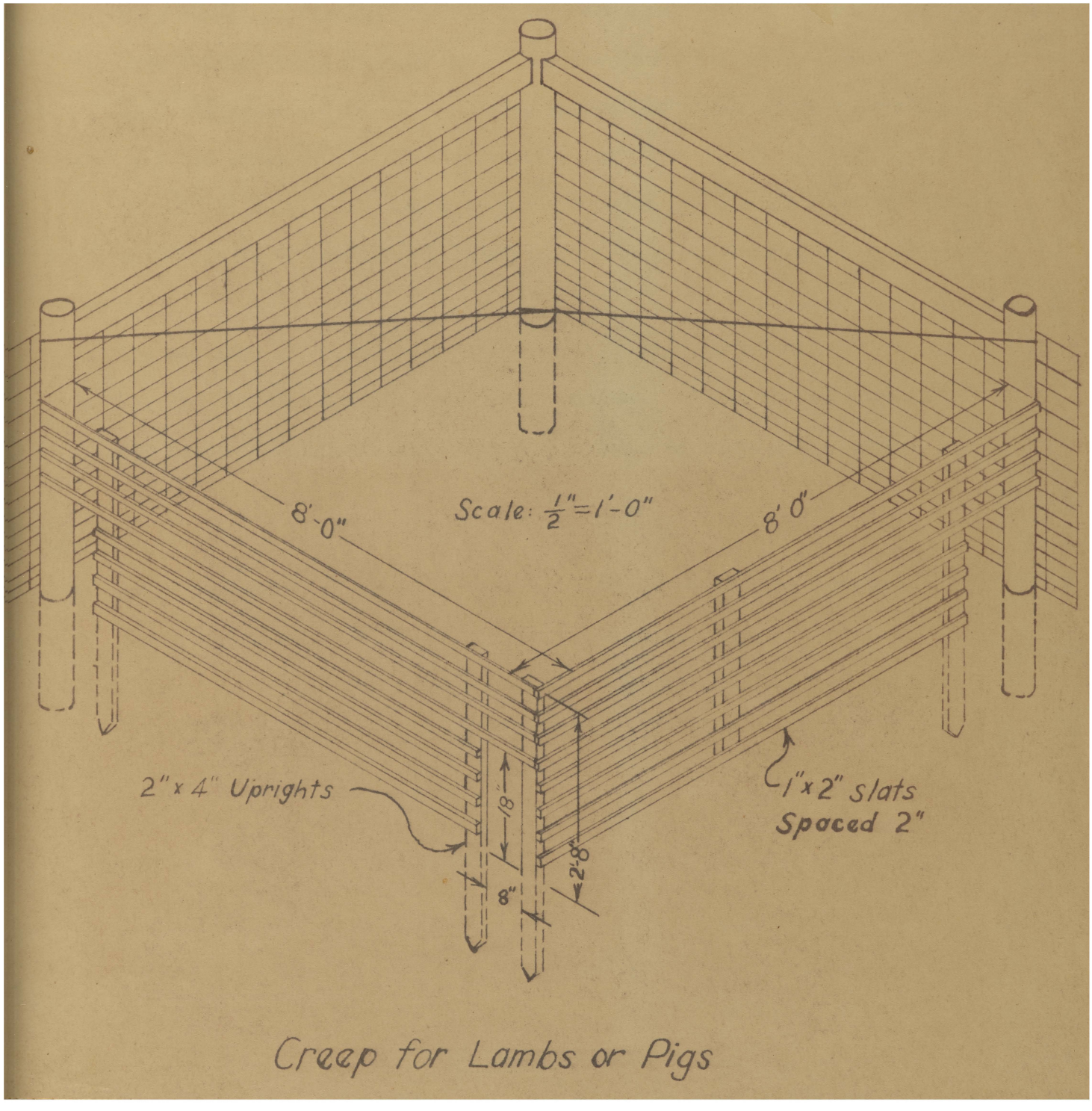
Procedure:

Operation I - Preparing Materials

1. Saw the 2" x 4" material into the desired number of pieces and with the axe sharpen one end of each (fig. 1). Allow enough length so that the stakes can be driven at least 3 feet into the ground.
2. Determine the size and shape of the creep desired and reduce the other material to the correct dimensions (fig. 1).

Operation II - Building Creep

1. Select a fence corner near the feeding barn (fig. 1).
2. With the axe or sledge hammer sink a stake into the ground 8" from the edge of each brace post forming the openings of the creep. Be sure to leave 2' 8" of the stake remaining above the ground (fig. 1).
3. Nail the top slat on to the post and stake on each side parallel to the ground. This will aid in determining where to place the other stakes.



Creep for Lambs or Pigs

4. Drive the corner stake in place where ends of the slats meet. Make sure that stakes are driven into the ground straight.
5. Sink another stake 8" from the corner one forming a third opening. Then sink the other two stakes in place, one in the center of each side (fig. 1).
6. Nail the slats in place 2" apart (fig. 1).
7. Clinch all nails well that protrude and round off corners slightly against which the young animals are likely to rub in going through the openings.

Questions:

1. Why are lamb and pig creeps so important on the stock farm?
2. Why should rough corners or edges be smoothed off around the openings?
3. How would you go about moving this particular creep if you wanted to change its location?

References:

1. McWhorter, V. D., Potts, C. G., "Equipment for Farm Sheep Raising", Farmers' Bulletin 810, U. S. Department of Agriculture.
2. Struck, F. T., "Construction and Repair Work for the Farm", Pages 214-215, Houghton Mifflin Company, Boston, Massachusetts.

Making a Hog Trough

This hog trough, if accurately constructed, is easy to clean, and will allow animals to get their food easily. This article is suitable for use on almost any farm.

Equipment and Materials: Saw, plane, hammer, wood chisel, square. Some hard wood such as oak should be used.

No. pcs.	Dimensions	Use
1	1 3/4" x 10" x 12'	side
1	1 3/4" x 8" x 16'	side and ends
1	7/8" x 4" x 3' 6"	cross pieces

Procedure:

Operation 1 Laying Out and Reducing Stock

1. Square both ends of the 1 3/4" x 10" piece very accurately, making 11' 8½" in length.
2. Saw off the 1 3/4" x 8" stock two pieces 2' in length from the ends of the trough. Square the ends of the remainder of this piece making it exactly 11' 8½" long. Plane one good straight edge on this 8" side piece so it will make a good joint (fig. 1).
3. The cross ties can be sawed and fitted after the other parts of the trough have been nailed together.

Operation 11 Assembling Stock

1. After applying white lead to the joint, nail 10" side piece on to the planed edge of the 8" side piece as shown in fig. 1.
2. Nail on the end pieces letting the vertices of the right angles formed by jointing of the side pieces fall in the center and bottom of end pieces (fig. 1).

3. Measure trough off in 3' lengths, making each length on the top side pieces. At each one of these points chisel out a space 4" wide and 7/8" deep by using wood chisel. By using the square, measure on the trough the length of cross tie needed. Saw ties to this length and plane ends so they will come flush with the upper surface.
4. Nail ties to the trough.

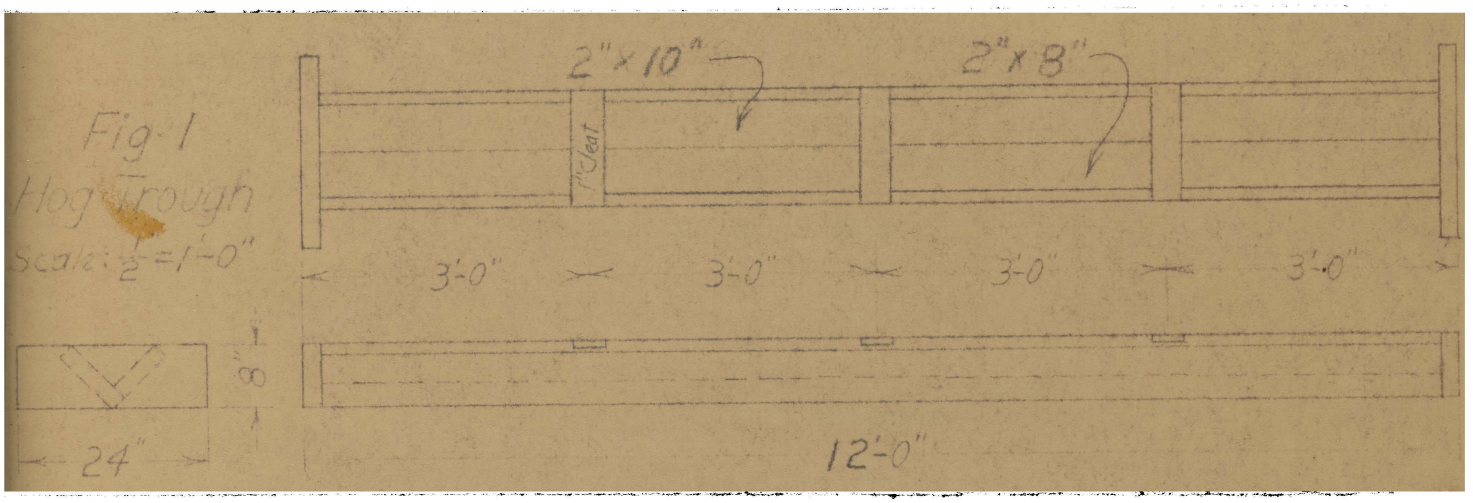


Fig-1
Hog Trough
Scale: 1/2"=1'-0"

Questions:

1. Why is white lead used in all joints?
2. What is the purpose of the cross ties?
3. What feature of this trough makes it easy for the animals to get their food?

References:

1. Blackburn, Samuel A., "Problems in Farm Woodworking", Page 84, The Manual Arts Press, Peoria, Illinois.

Constructing a Wood Clamp.

This clamp is constructed for the purpose of holding pieces of wood together after being glued. It is used in constructing table tops, dressers and other furniture where a fine finish is necessary.

Equipment and Materials: Saw, plane, wood chisel, brace and bits, screw driver, hammer. The wood used should be good strong wood such as oak.

No. pieces	Dimensions	Use
3	3" x 3" x 24"	cross pieces
2	7/8" x 2" x 5' 9"	guides

2 dowels either 5/8" wood peg or 5/8" bolt

1 iron bench screw complete with fittings,

10 1/4" x 3½" machine bolts for screw,

2 3/8" bolts to hold B in place.

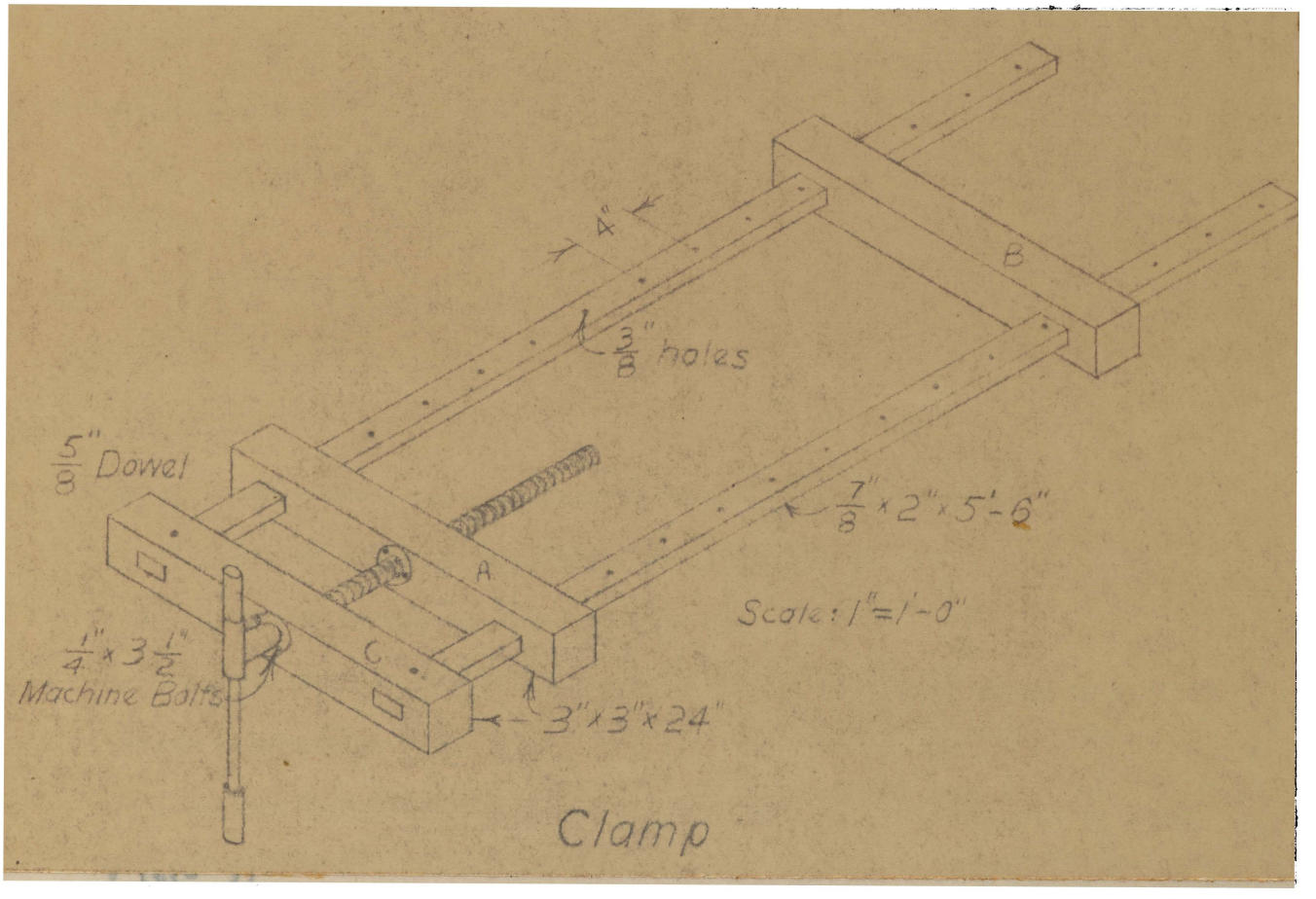
Procedure:

Operation I Preparation of Material

1. Reduce material to correct dimensions (fig. 1).
2. Plane all material in order that guides will slip through mortise without difficulty.
3. Cut mortises in cross pieces as shown in fig. 2. Be sure that guides fit mortises.
4. Bore 5/8" holes in cross piece for dowels.
5. Bore holes in guides for placing bolts 4" apart, and one 1½" from each end for dowels (fig. 1).
6. Bore hole in middle of cross pieces A and C for bench screw. The hole should be slightly larger than the screw.

Operation II Constructing the Clamps

1. Fasten the bench screw to C and A using the machine bolts to hold the washers in place. The threaded washer is attached to the left edge of A (fig. 1).
2. Slip the two guides through the mortises in A and into mortise of C and fasten with dowels (fig. 1).
3. If mortises are cut true, the guides will fit snugly as shown in fig. 1.
4. Slide B on the guides as shown in fig. 1.
5. Place bolts in holes to hold B as shown in fig. 1.
6. Turning the screw counter-clockwise causes A to approach B.



Questions:

1. Why should the pieces be smooth and even?
2. Why should mortise holes be true?
3. Why use good, strong wood for clamps?

References:

1. Roehl, Louis M., "Farmer's Shop Book", Page 38, Bruce Publishing Company, New York.

Constructing a Drag Sled

A drag sled may be used to haul plows, harrows, water, stones and many other objects about the farm. However, a low-wheeled wagon is better for this type of hauling. Clips fastened to the sides will hold upright pieces to which side boards may be attached, in case there is need for them. The drag sled is very easily and economically constructed. The runners should be made of hard wood. In case the hard wood cannot be secured less durable wood should be shoed with iron. In order to give the sled more strength angle - iron braces can be used on the inner angles where the runners meet the top.

Equipment and Materials: Hand saw, hammer, wood chisel, draw knife, brace and bit. Use locus for runners and some durable wood such as oak for top and cross ties.

No. pcs.	Dimensions	Use
2	3" x 8" x 6'	runners
4	2" x 10" x 5' 4"	top
3	2" x 4" x 3' 4"	cross ties

1 lb. 20 d and ½ lb. 16 d common nails.

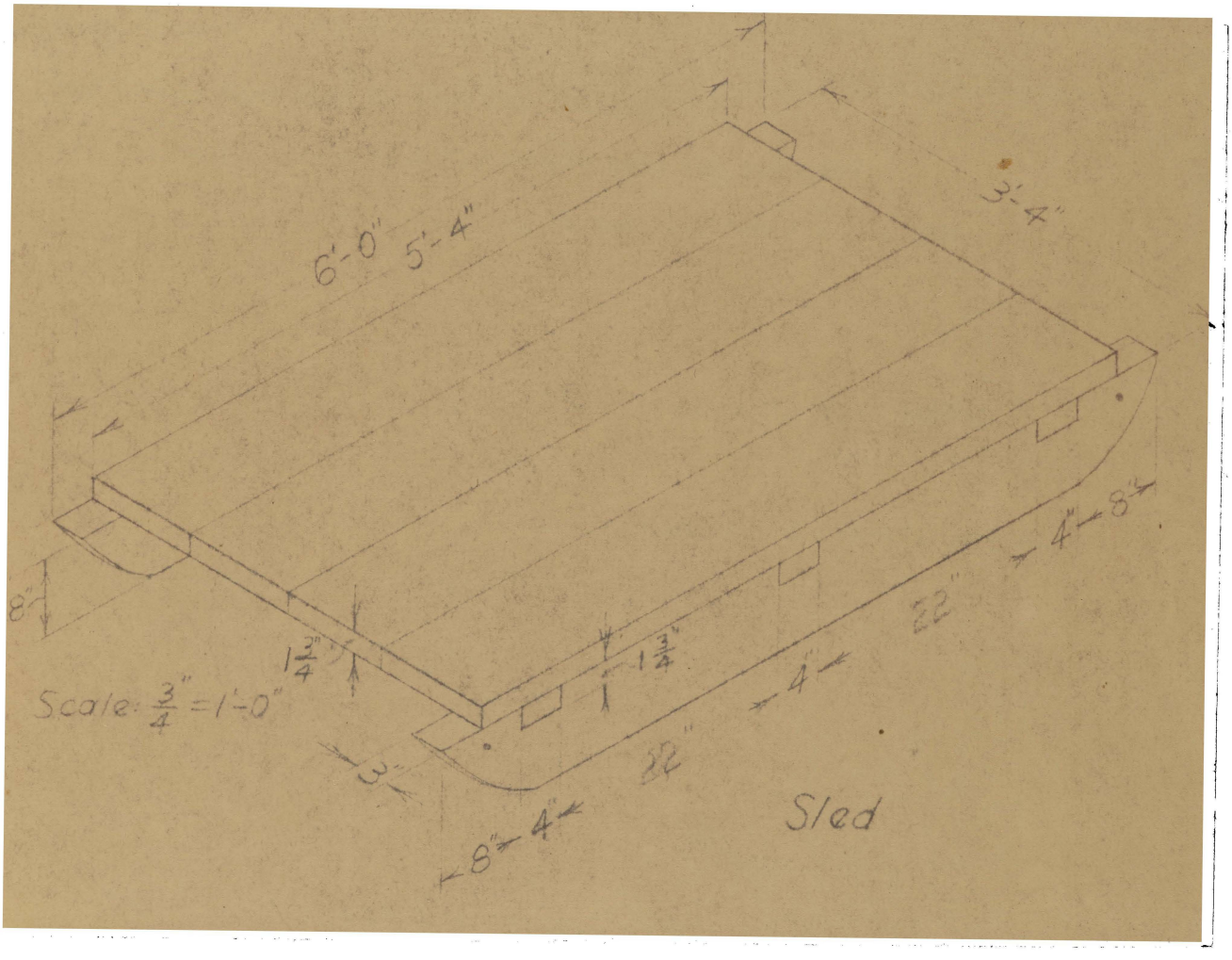
Procedure:

Operation 1 Preparing Material

1. Reduce all pieces to dimensions as indicated in bill of materials.
2. With a compass using an 8" radius lay off the curved line at each end of the runners. Remove stock to line by using drawing knife and plane if necessary.
3. Cut the mortise in the runners with the cross-cut saw and chisel. Care needs to be taken that the cross ties fit snugly into the runners.

It is easier to shave down the cross ties a bit, than it is to re-cut the notches in the runners.

4. Bore 3/8" holes at each end of runners 4" from the end and 2" from the top. If 2" x 10" material cannot be secured for the top, smaller boards can be used.



Operation 11 Assembling Material

1. Attach the cross ties to the runners flush with the outside.

2. Nail them securely so that they will stand up under heavy usage.
3. Lay the floor flush with the outer edges of the runners and 4" from each end. Nail the floor securely.
4. If braces or iron shoes for the runners are used, attach them in the proper place.

Questions:

1. Why should hard wood be used for runners?
2. Why should the cross ties fit snugly into the runners?
3. What kind of hitch are you going to use, and how are you going to attach it?

References:

1. Crawshaw, F. O., Lehmann, E. W., "Farm Mechanics", Pages 94-95, Manual Arts Press, Peoria, Illinois.
2. Struck, F. T., "Construction and Repair Work for the Farm", Houghton Mifflin Company, Boston, Massachusetts.

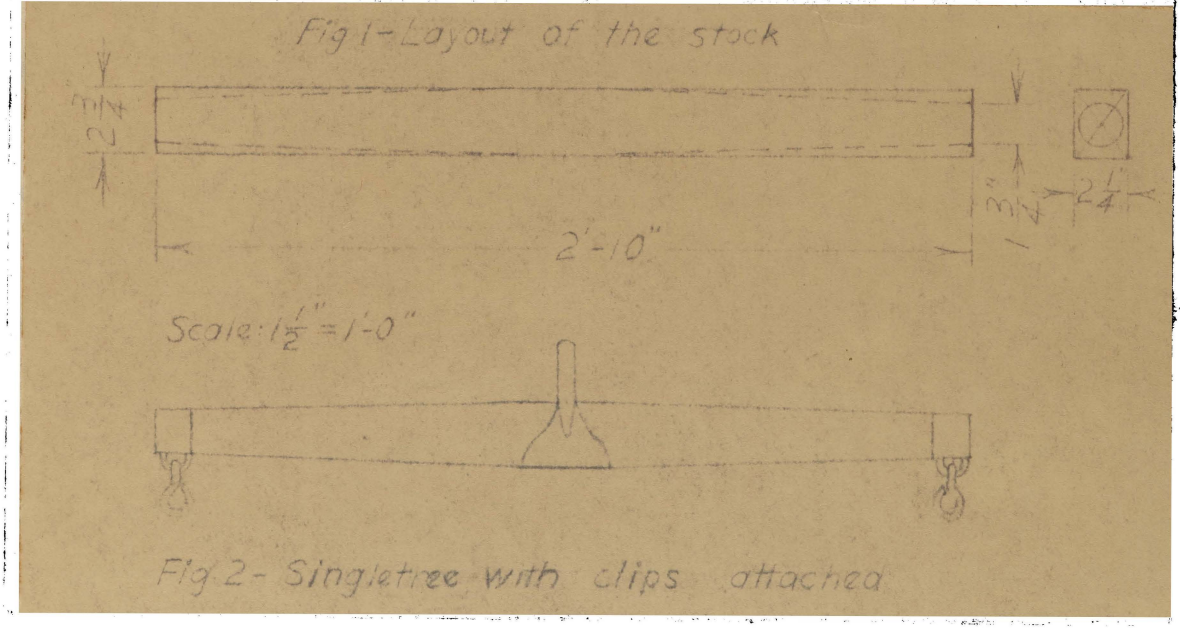
Making a Singletree.

Equipment and Materials: Square, draw knife, sharp hatchet, sandpaper, plane, dividers. One piece of select hickory or white oak 2¼" x 2 3/4" x 2' 10". Hook and ferrule, center clip and ring.

Procedure:

Operation I Shaping the Stock

1. Draw diagonal lines on the ends to find the center (fig. 1).
2. Using the intersections of the diagonals as centers, draw circles with the dividers 1 3/4" in diameter (fig. 1).
3. The center of the finished singletree should be in the shape of an oval, 2 3/4" from front to back and 2¼" thick. There should be a gradual tapering from the oval at center to the round shape at the ends. The stock may be reduced with the hatchet, draw knife, and plane. Do this work carefully to avoid gashes and uneven places in the stock. Smooth with sandpaper.



This singletree is shaped to take the type of end clips and center clip band shown in fig. 2. There are various types of attachments which would require appropriately shaped singletrees.

4. Drive the clips in place and fasten each with a one inch screw. another way to attach clips on the singletree is to heat the clips and put them on while hot. Drive into place and let cool immediately.

Questions:

1. What is the purpose of shaping the singletree to an oval instead of a round shape in the center?
2. Are there other types of metal attachments which you prefer? Why?

References:

1. Roehl, Louis M., "Farmer's Shop Book", Pages 100-102, Bruce Publishing Company, New York.

A Double Tree or Two Horse Evener

The construction of a double tree is a practical job especially if there are good clips already at hand.

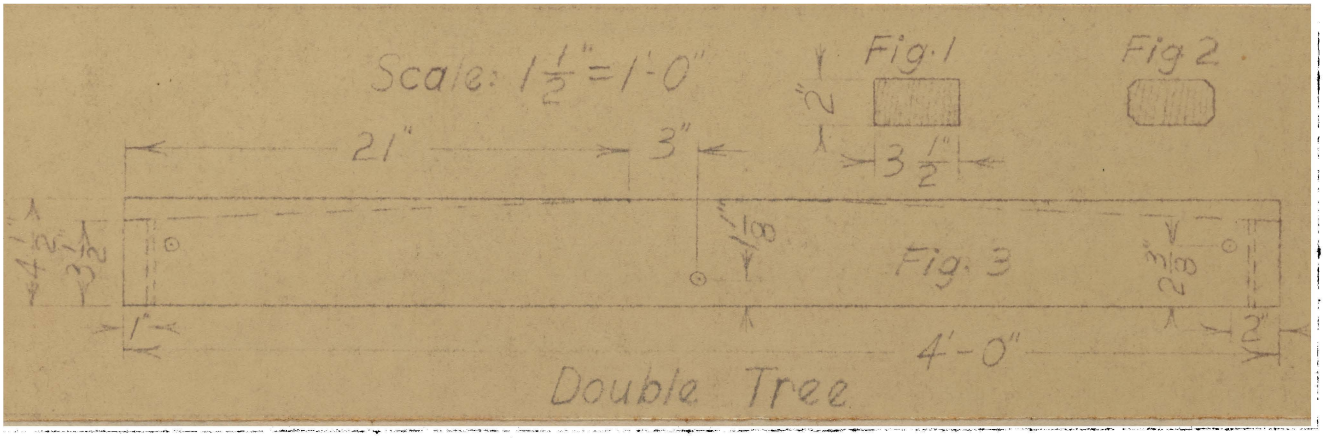
Equipment and Materials: Saw, plane, brace and bits, hammer, draw knife.

One piece of select hickory, ash, white oak, or locust 2" x 4½" x 4'.

2 iron rivets ¼" x 3 3/4" with washers.

Procedure:

1. Reduce the stock to 2" x 4½" x 4'.
2. Lay off the stock as follows: On the flat side of the stock mark a point at each end 3½" from the front edge (fig. 3). On the back edge mark points which are exactly 21" from each end. Connect these points with those on the end of the stock. This establishes the line for tapering the stock.
3. The stock can first be roughed down near the lines with the hand ax or a draw knife. It should then be dressed to the line.
4. Dress the edges off with the plane or draw knife. The cross section should look like fig. 1 and fig. 2.
5. Bore ¼ inch holes for the rivets 1 inch from each end, insert rivets, place washers, and rivet. These prevent the ends from splitting.
6. Then bore 9/16" holes at points 2 inches from each end and 1 1/8 inches from the edge of the stock which is the beveled edge.
7. At the very center between the ends and 1 1/8 inches from the edge of the stock, bore a 3/4 inch hole for the large clevis.



Questions:

1. Why not locate the holes at the ends in a direct line with the middle hole?
2. For what purpose are the rivets?

References:

1. Roehl, Louis, M., "Farmer's Shop Book", Pages 100-101, Bruce Publishing Company, New York.

Making a Three Horse Evener

The three horse evener is essential about the farm when a three horse team is being used.

Equipment and Materials: Square, saw, plane or draw knife, brace and bits. 1 piece of select hickory 1 3/4" x 5" x 4' 4". If hickory is not available white ash or white oak may be used. 1 iron rivet $\frac{1}{2}$" x 3 3/4" with washer. 1 iron rivet 1' x 5$\frac{1}{2}$" with washer.

Procedure:

Operation 1 Reducing Stock to Proper Size

1. Reduce stock to 1 3/4" x 5" x 4'4" as indicated in bill of material.
2. Taper off the one-horse end by drawing a straight line from a point on the back edge of the stock 21" from the two-horse end to a point on the one-horse end 3$\frac{1}{2}$" from the front edge (fig. 1).
3. Remove this stock to line with saw and plane.
4. Lay out and cut $\frac{1}{4}$" chamfer on the edge of the stock as indicated in drawing.

Operation 11 Spacing Hitches

1. Measure 1$\frac{1}{4}$" from each end and bore holes for rivets.
2. Place rivets in holes and rivet them securely (fig. 1).
3. Measure 2" from each end and 1 1/8" from the back edge of stock and bore 5/8" holes for clevises.
4. Locate a point 18" from the two-horse end and 1 1/8 " from the front edge and bore a 3/4" hole for main clevis pin.

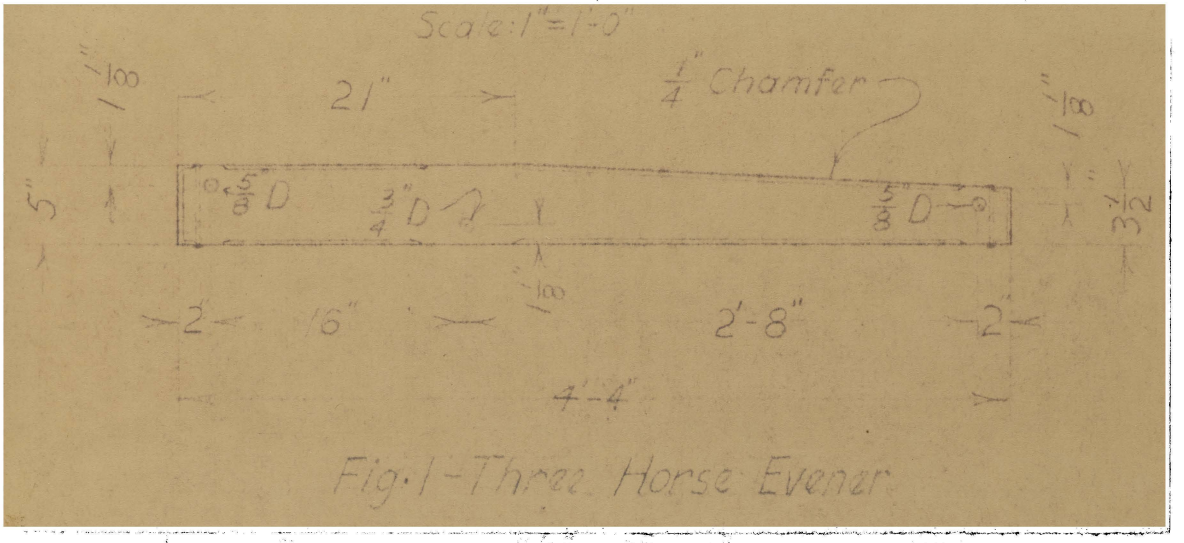


Fig. 1 - Three Horse Evener

Questions:

1. Why is a rivet placed in each end of the triple tree?
2. Why is the hole for the main clevis pin located 1 1/8" from the front edge of stock and other two holes 1 1/8" from back edge?
3. The farmer uses the triple tree mostly in doing what kind of work on the farm?

References:

1. Roehl, Louis, M., "Farmer's Shop Book", Pages 100-101, Bruce Publishing Company, New York.
2. Struck, F. T., "Construction and Repair Work for the Farm", Pages 254-255, Houghton Mifflin Company, Boston, Massachusetts.

Making a Milk Stool

Equipment and Materials: Saw, hammer, block plane, square, brace and bit, wood chisel, T bevel.

No. pcs.	Dimensions	Use
1	3/4" x 9½" x 12"	seat
1	3/4" x 9½" x 11 3/4"	back leg
1	3/4" x 9½" x 6"	front leg
1	3/4" x 9½" x 21½"	pail rest
1	3/4" x 9½" x 5"	front seat
2	3/4" x 5" x 8"	braces

Procedure:

Operation 1 Preparing Materials

1. Round edges on both ends of seat and front of pail rest to lines drawn on both sides of stock 1/8" from the ends.
2. Mark the position of the hand hole on the seat, as shown in drawing. Remove as much of the stock as possible with the brace and bit, and finish with a chisel.
3. Cut each end of the braces at a 45° angle. Use the T bevel in marking this angle.

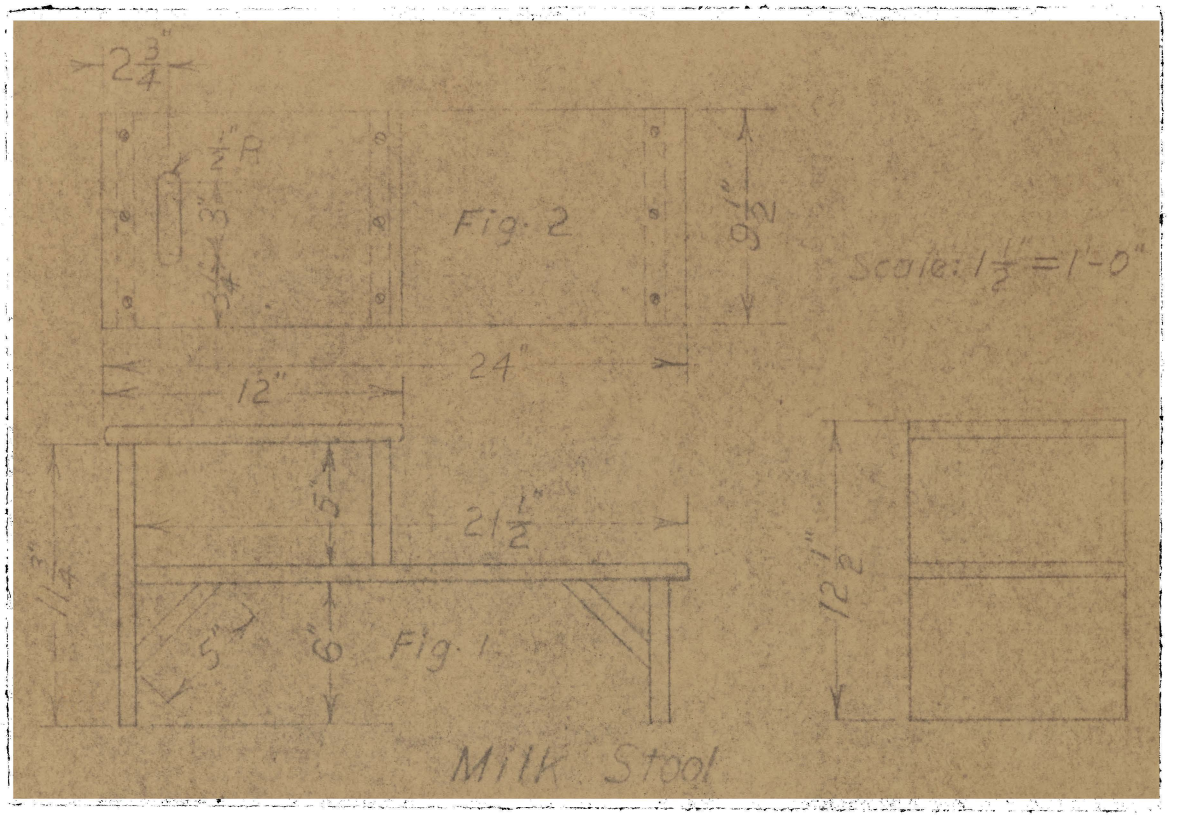
Operation 11 Assembling the Stool

1. If screws are to be used, bore three holes with a 3/16" bit, at each joint, countersink the holes and put the parts together.
2. If nails are to be used, use four 6 d common nails at each joint.

Questions:

1. Why do screws tend to form a much more substantial construction than nails?

2. Why is it so important to have good strong braces on this stool?



References:

1. Roehl, Louis, M., "Agricultural Woodworking", Pages 26-27, Bruce Publishing Company, New York.

Constructing a General Purpose Bench

A general purpose bench such as this one is very much needed about the house. It is very simple to construct and has an inestimable value because of its extensive use. The length, width and height may be changed to meet the needs. It is often used as a wash bench and in that case the height is a very important factor.

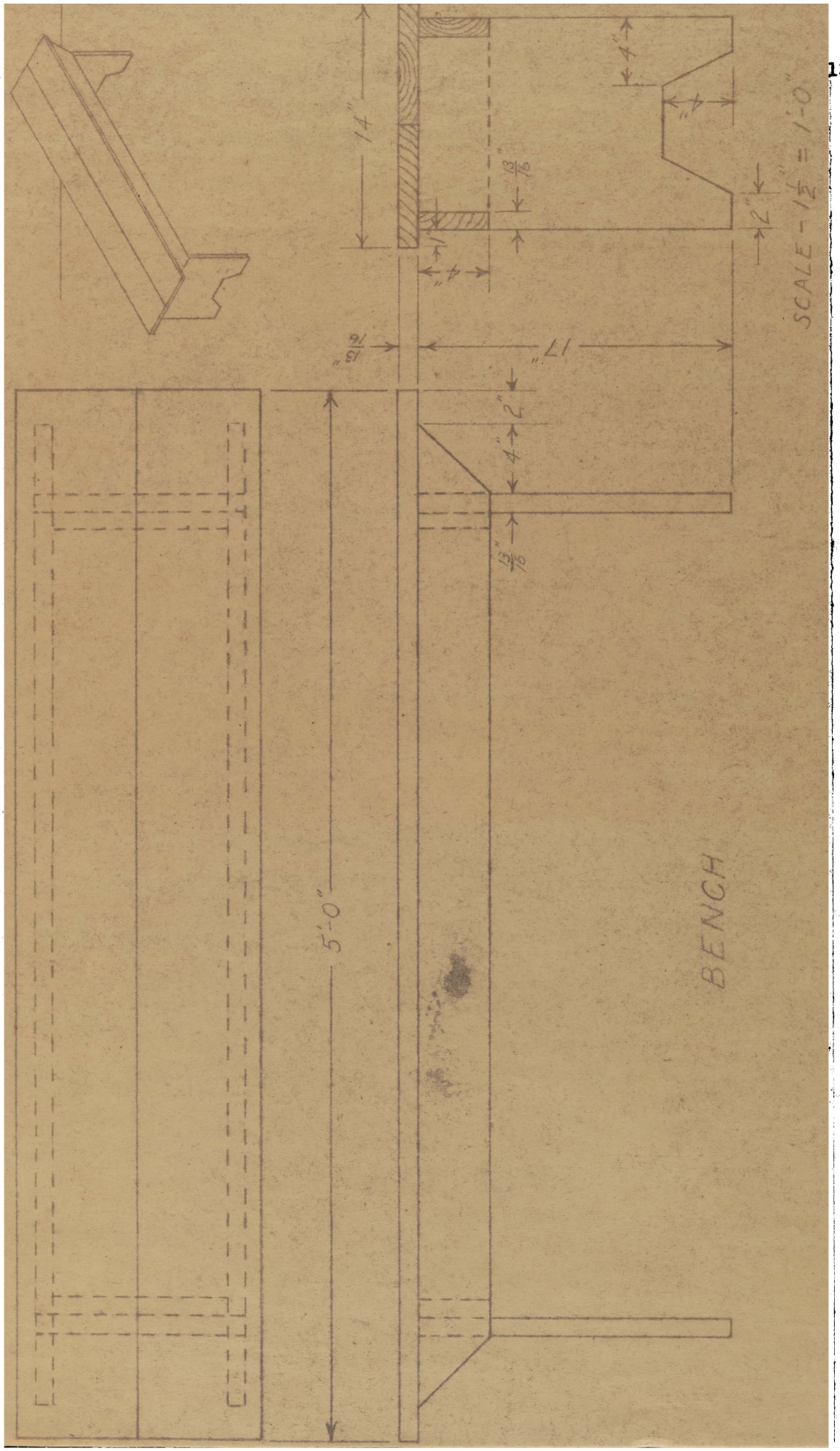
Equipment and Materials: Cross-cut saw, square, hammer, plane, screw driver, T bevel, wood chisel. White pine, cypress or cedar is desired.

No. pcs.	Dimensions	Use
2	13/16" x 12" x 17"	legs
2	13/16" x 7" x 5'	top
2	13/16" x 4" x 4' 8"	sides

Twenty 1½" No.10 flat head wood screws.

Procedure:

1. Reduce all pieces to finished dimensions as indicated in bill of materials.
2. Plane the surface of each piece until they take a fine finish. This is not necessary for benches that are used and kept in out-buildings.
3. Lay out the openings for the lower end of the legs by first marking two points 2" from either side. Then measure up 4" and across 4" on both edges of the two legs. Lay out the opening with the square using these points (see drawing).
4. Remove the stock with a saw starting at points 2" from either side.
5. Cut the ends for the sides at a 45° angle as shown in drawing. This can be laid out by using the T bevel.
6. Cut grooves 4" wide and 13/16" deep at the top of each leg for side pieces.


14"
4"
13/16"
2"
1"
4"
17"
2"
4"
13/16"
SCALE - 1½" = 1'-0"
5'-0"
BENCH

7. Bore holes with 3/16" auger bit. Countersink the holes and fasten the sides in place with three screws at each end. It is wise to make a guide line for the screws by using a try-square and marking on the outer surface. There is no chance of missing the inside piece with screws if that is done. Nails can be used instead of screws if desirable.
8. Bore holes on top with same auger bit as used before; countersink the holes and fasten top on with screws. Make a guide line for screws as before.
9. Finish the bench by applying several coats of linseed oil. Give it several coats of paint if you so desire.

Questions:

1. Why is this type of bench so much needed about the farm house?
2. Why should screws be countersunk?
3. Why should there always be guide lines for screws when they are fastened in place?

References:

1. Crawshaw, F. D., Lehmann, E. W., "Farm Mechanics", Page 57, The Manual Arts Press, Peoria, Illinois.
2. Hoehl, Louis M., "Farmer's Shop Book", Pages 96-97, Bruce Publishing Company, New York.
3. Struck, F. T., "Construction and Repair Work for the Farm", Pages 291-292, Houghton Mifflin Company, Boston, Massachusetts.

Constructing a Miter Box

This is a simple miter made of wood and is very valuable if you do not have an adjustable commercially made one. The miter box is used when timber is to be cut at an angle of forty-five degrees or exactly square. This is very convenient in such jobs as cutting molding for a house or in other such work when the lumber is so small that it is difficult to saw without something to hold it in place and to guide the saw. A person should be able to saw a piece of lumber square without the aid of a miter box because it will not always be convenient to use one, or it may not be available. However, for beginners, a miter is advisable.

Equipment and Materials: Cross-cut saw, large square, hammer, plane.

Either soft or hard, straight, well seasoned lumber.

No. pcs.	Dimensions	Use
1	7/8" x 3½" x 2'	back
1	7/8" x 4¼" x 2'	front
1	1¼" x 5½" x 2'	bottom

About 1 dozen 8 d finishing nails.

Procedure:

Operation 1 Preparation of Material

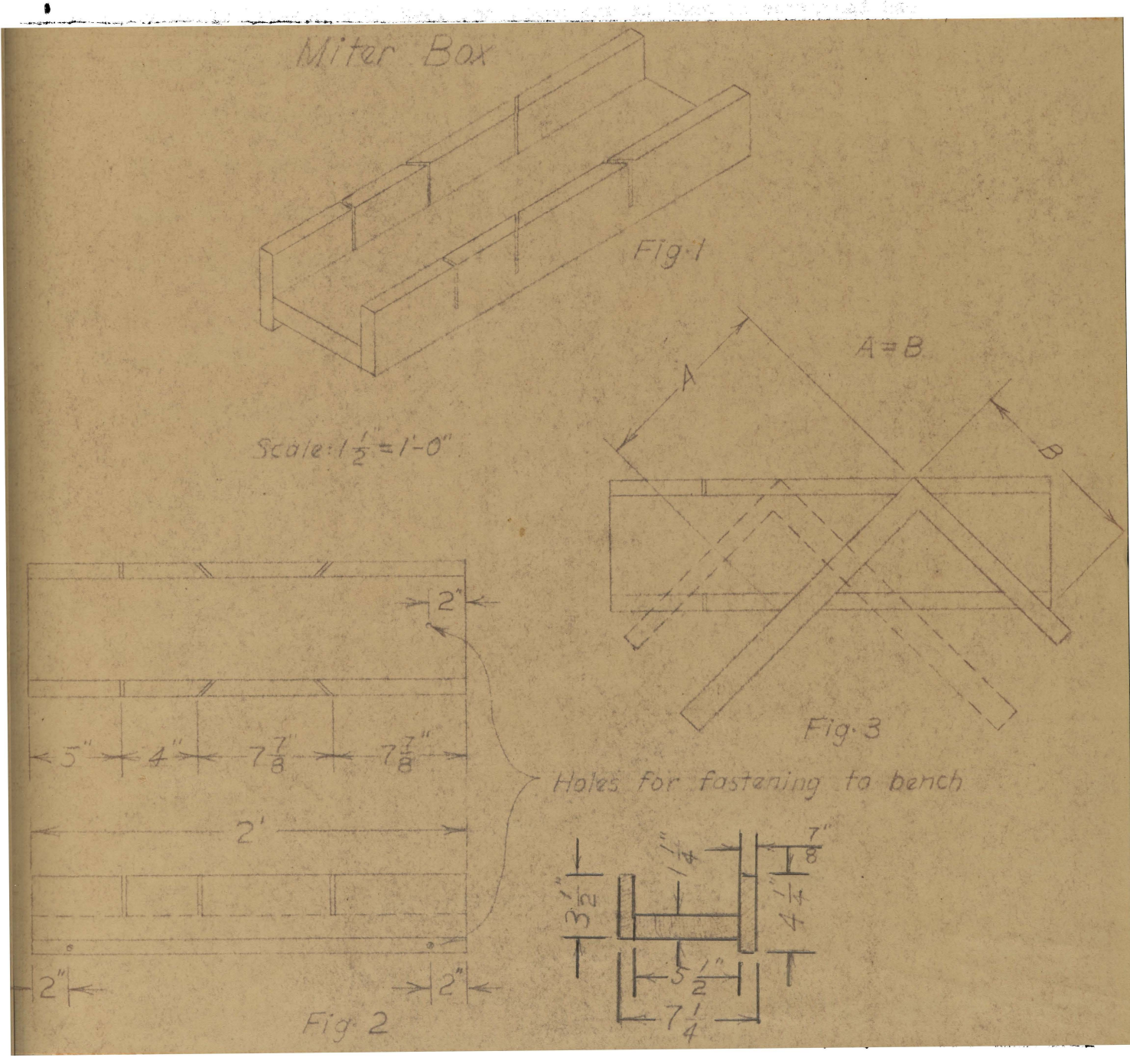
1. Plane the lumber until it has a smooth finish.
2. Reduce the lumber to dimensions as indicated in the bill of materials.

Operation 11 Assembling Parts

1. Attach with nails the sides to the bottom at each end only. Screws may be used if preferred. Have each side project above the bottom the same distance, thus causing one of the sides to project below the bottom 3/4 of an inch. Make sure the back and front are perpendicular to the bottom (fig. 1 and 2).

2. Saw one kerf five inches from the end perpendicular to the bottom and at right angles to the sides. Mark this position with a square before sawing.

3. Saw the other kerfs perpendicular to the bottom and at 45° angle with the sides (fig. 2).



The 45° angle is determined by a square so placed on the top that an equal distance on each blade of the square hits the opposite side (fig. 3).

4. Much care should be taken to keep the sawfrom running along the front and back or varying from the mark when the kerfs are made.
5. Drive nails between each kerf and place one so that in continual use it will not be in the path of the saw.
6. Bore two small screw holes in the side which extends below the bottom in the position as shown in fig. 2. Also bore a hole of the same diameter in the bottom at the position shown in fig. 2. These holes are for fastening the miter to a bench or table.

Questions:

1. Why should so much care be taken to have the front and back exactly perpendicular to the bottom?
2. Why should so much care be taken to keep the saw from varying when the kerfs are being sawed?
3. Why should the nails be so carefully placed?

References:

1. Struck, F. T., "Construction and Repair Work for the Farm", Pages 302-304, Houghton Mifflin Company, Boston, Massachusetts.

Making Racks for Lumber Storage

Equipment and Materials: Square, saw, hammer, pipe cutters or hacksaw, two 12" pipe wrenches. For materials needed see the illustrations of the different types of racks.

Procedure:

Ceiling Rack

1. The ceiling rack is used where the space is limited (fig. 1).
2. The length of the hangers and the method of attachment is determined by the use to be made of the rack, and the construction of the ceiling.
3. Assemble the rack as shown in fig. 1 and bolt it to the ceiling. Use the number of racks required.

Wall Rack

1. Screw the flangs, connections, and pipes together and bolt the assembled rack to a heavy piece of lumber. Bolt this to a wall. Use the number of racks desired (fig. 2).

Center Rack

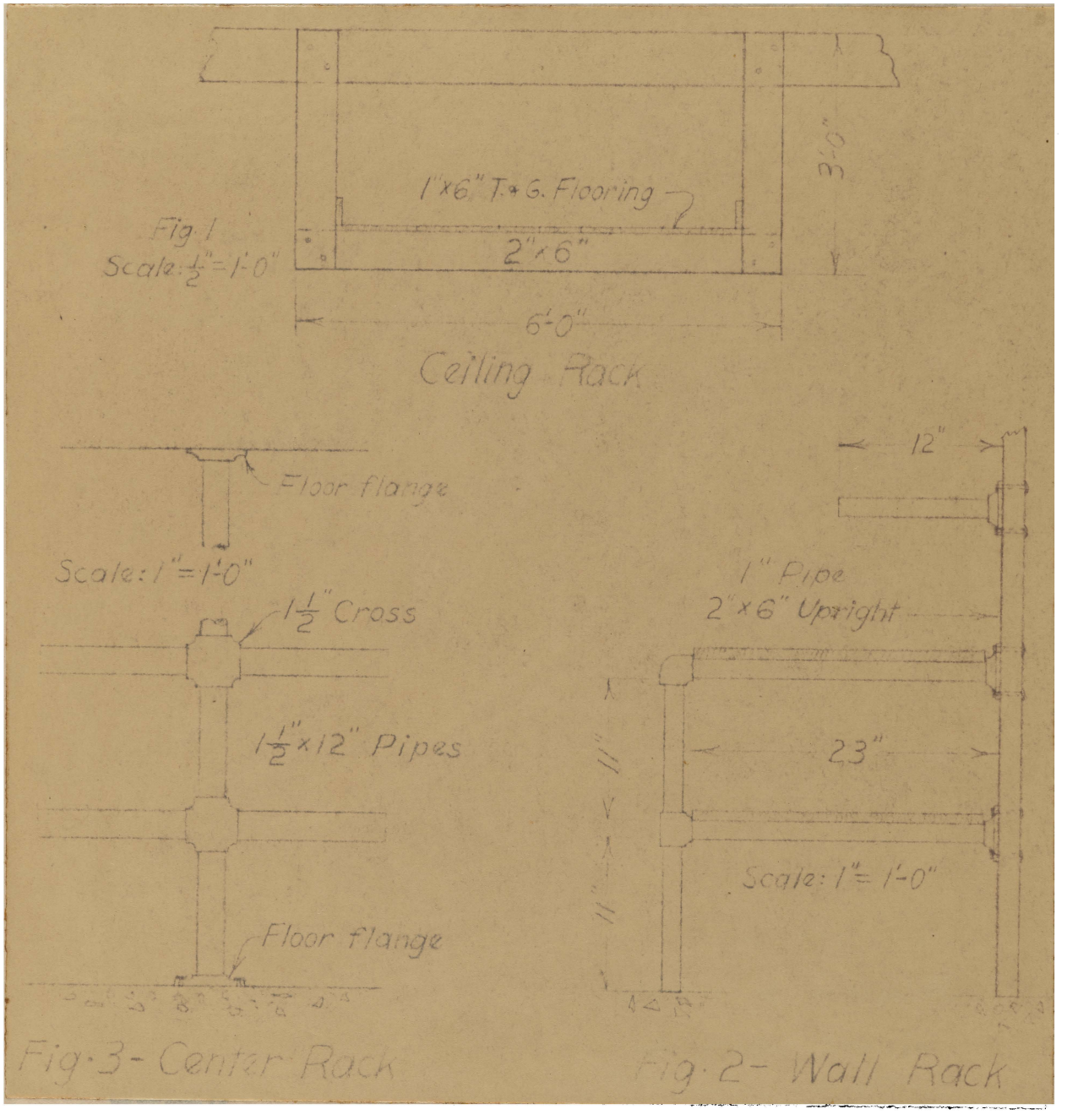
1. Assemble as shown in fig. 3. The dimensions will be determined by the height of the ceiling and the number and the size of the racks required. Racks should be placed close enough together so the lumber will not sag between them.

Questions:

1. How may a small working space in the shop be used to best advantage?
2. Name three advantages resulting from proper storage of lumber?

References:

1. Roehl, Louis, M., "Shop Management in Rural High Schools", Pages 58-59, Bruce Publishing Company, New York.


1"x6" T.+G. Flooring
2"x6"
3'-0"
6'-0"
Fig 1
Scale: ½"=1'-0"
Ceiling Rack
Floor flange
Scale: 1"=1'-0"
1½" Cross
1½"x12" Pipes
Floor flange
12"
1" Pipe
2"x6" Upright
23"
Scale: 1"=1'-0"
Fig·3- Center Rack
Fig·2- Wall Rack

Making a Loading Chute

A portable, substantial unloading chute will be useful on every farm where stock is raised. One should be made that will be strong enough for cattle as well as lighter stock.

Equipment and Materials: Saw, plane, rule, square, gage, T bevel, hammer, screw driver. Floor and supports should be made of oak, rest of lumber should be of some durable wood.

No. pcs.	Dimensions	Use
3	1 3/4" x 12" x 8'	floor
1	1 3/4" x 6" x 8'	floor
1	1 3/4" x 6" x 14'	foundation
3	7/8" x 9½" x 16'	siding
2	2" x 4" x 14'	uprights
2	2" x 4" x 10'	cross ties
2	7/8" x 2" x 14'	cleats

A quantity of 10 d, 16 d and 20 d common nails, and some ½" no. 9 flat head screws.

Procedure:

Operation 1 Laying out and Reducing Stock

1. Saw 2 pieces 1 3/4" x 6" x 7' for foundation (see drawing).
2. Saw off 4 pieces 2" x 4" x 4' for cross ties. Set T bevel to an angle on the square of 3" to 7" and plane three of the cross ties on one edge to this angle so they will fit up under floor (see drawing).
3. Saw 2 pieces 2" x 4" x 5'7" for front uprights, two pieces 2" x 4" x 4' x 5" for middle uprights, two pieces 2" x 4" x 3' 3" for

rear uprights. Saw all these pieces at one end using the angle mentioned in step 2.

4. Six pieces 7/8" x 9½" x 7'8" are needed for siding. Measure to correct length and by using the given angle set the T bevel to end pieces and mark the angles. Remove the stock with the saw.

5. Mark and saw three pieces 1 3/4 " x 12" x 7' 8" and one piece 1 3/4" x 6" x 7' 8" for the floor. Using the T bevel, mark the given angle at each end of piece, and remove the stock. The slope on one end is just opposite from the other end (see drawing).

6. Saw nine pieces 7/8" x 2" x 3' for cleats.

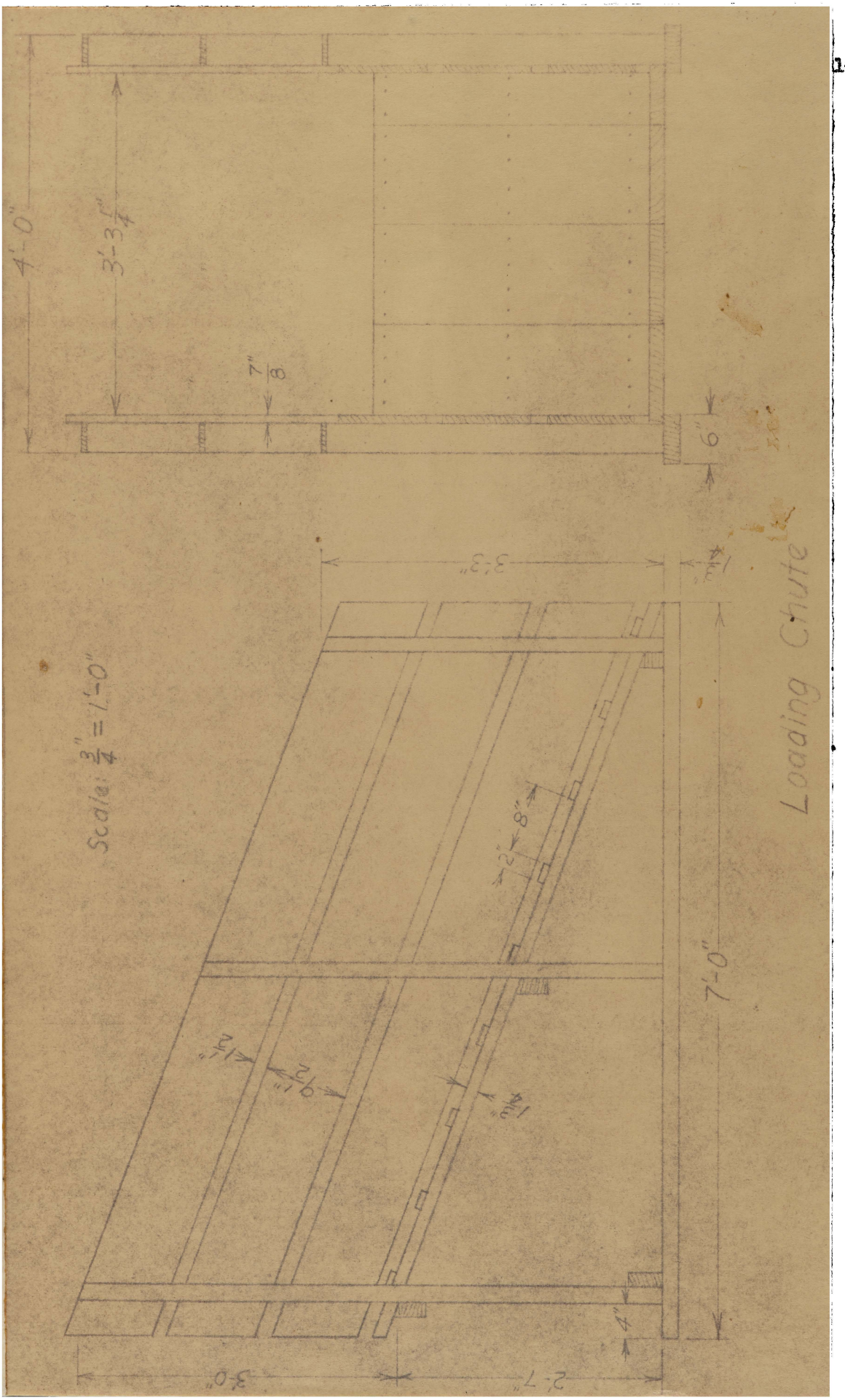
Operation 11 Assembling Stock

1. Nail a beveled cross tie, to the rear uprights at the lower end with the bevel in position shown in drawing. Likewise nail a cross tie on the front uprights 2' 7" from the lower end. Nail on crosspiece at the bottom of these same uprights as shown in drawing.

2. Place the 2" x 6" foundation pieces on the floor and toe nail the front and rear uprights to these, placing them in 4" from the end. These may be braced temporarily if necessary.

3. After being sure that the uprights are vertical by using a level, place one of the pieces of flooring in place and put a nail in each end. Do the same at the other side.

4. Toe nail the middle uprights to foundation piece 3' back of front uprights;then hold cross tie up to flooring and nail (see drawing).


4'-0"
3'-3 1/4"
7/8"
6"
3 3/4"
1/4"
3'-3"
Scale: 3/4" = 1'-0"
Loading Chute
8"
2"
7'-0"
1 3/4"
1 1/2"
1 3/4"
4"
2'-7"
3'-0"

5. Nail in the two remaining pieces of flooring.

6. Nail on the siding, leaving 1½" between each piece as shown in drawing.

7. Place the cleats on the floor 8" apart and fasten them on with the flat head screws.

Questions:

1. Why should chute be made so that it can be moved easily?

2. Of what value are the cleats on the floor of the chute?

References:

1. Blackburn, Samuel A., "Problems in Farm Woodwork", Page 90, The Manual Arts Press, Peoria, Illinois.

Constructing a Mixing Box.

A mixing box is a very easily constructed box used in mixing concrete, or morter, and slaking lime. It is not necessary to build it perfectly water tight; however, it should be tight enough not to lose any of the water or wet concrete. The second time the box is used the dried concrete will have filled the small leaks in the box. For general use the tongue and grooved lumber is not considered necessary, but it is preferable. A mixing box may be made stationary or portable according to the size desired. The one considered here is a small portable type to be used for small jobs on the farm.

Equipment and Materials: Hammer, saw, draw knife or plane, jig saw, square. Either hard or soft straight well seasoned lumber.

No. pcs.	Dimensions	Use
5	1" x 10" x 7' 8"	bottom
2	1" x 15" x 4'	ends
2	1" x 10" x 10'	sides
3	1" x 4" x 4' 2"	cross pieces

One pound of 10 d wire nails.

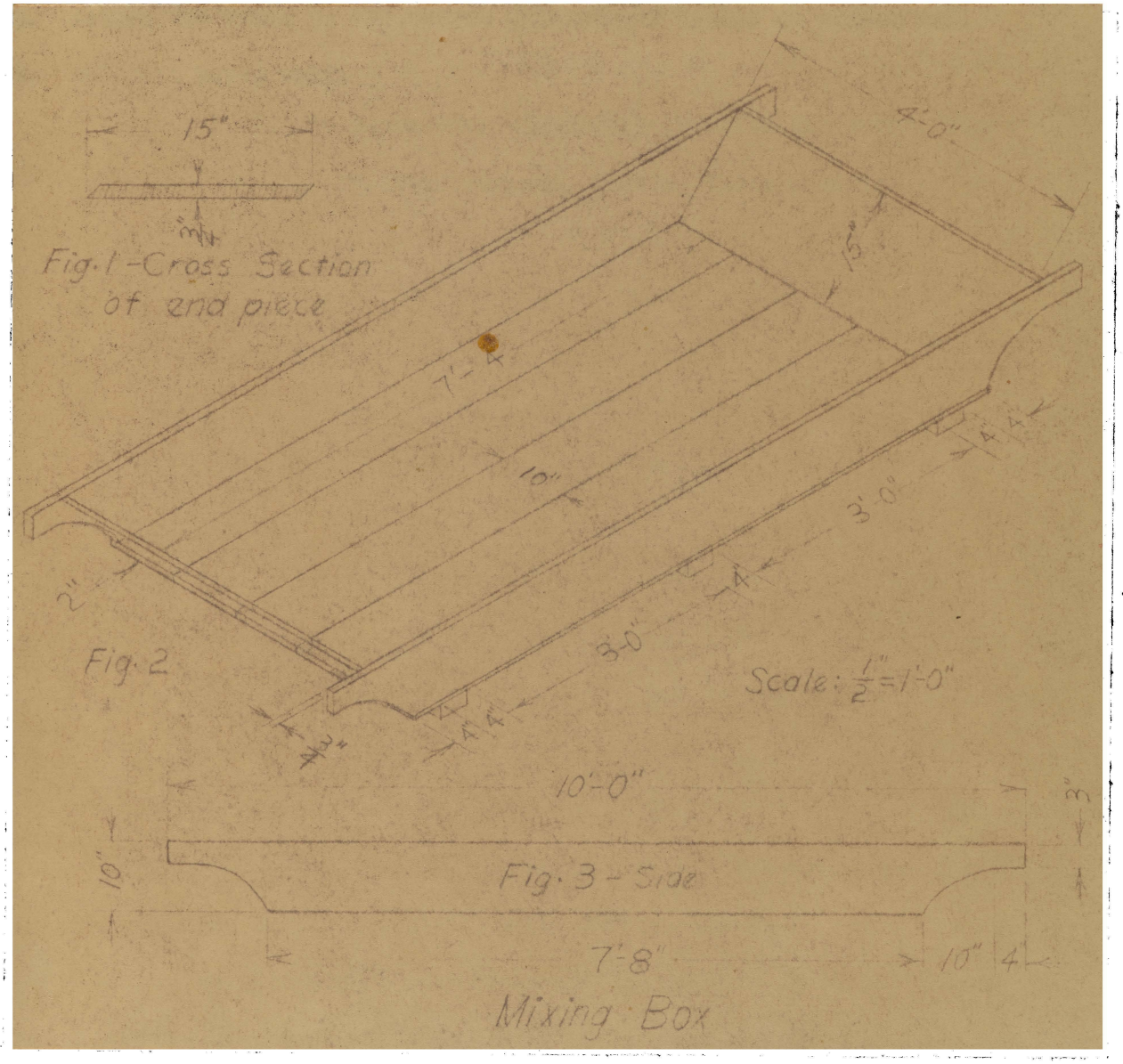
Procedure:

Operation I Preparing Material

1. Reduce lumber to dimensions as indicated in bill of materials.
2. Remove a portion of each end of the side pieces to form handles, either by hand saw or jig saw. Dress the handles with a draw knife or plane (fig. 3).
3. Bevel each edge on opposite side of both end pieces at a forty-five degree angle (fig. 1).

Operation II Assembling Parts

1. Fasten the ends between the side pieces sloping outward at an angle of forty-five degrees. Make sure that the boards join together tightly. Use the dimensions as shown in fig. 2.
2. Fasten the bottom boards to the crosspieces. Place them as closely together as possible. If the width exceeds more than 4' 2" remove the remainder of the stock with a plane or drew knife (fig. 2).



3. Attach the frame to the bottom indenting 2 inches on either end.

4. Nail all parts well.

Questions:

1. Why is it best to cut the handles in a semicircular fashion?

2. Why not attach the bottom boards the short way instead of the long way?

3. Why are the ends slanting? Is it necessary for both ends to be slanting?

References:

1. Struck, F. T., "Construction and Repair Work for the Farm", Pages 268-269, Houghton Mifflin Company, Boston, Massachusetts.

Making a Tool Carrier

This tool carrier is very handy for carrying the most used tools where needed on the farm.

Equipment and Materials: T bevel, brace, 1" bit, rule, wood chisel, hammer, plane, saw. Use pine wood.

No. pcs.	Dimensions	Use
1	$\frac{1}{2}$" x 8" x 2' 7"	bottom
1	3/4" x 8" x 2' x 11"	handle partition
1	$\frac{1}{2}$" x 6" x 8' 4"	sides and ends
6 d common nails		

Procedure:

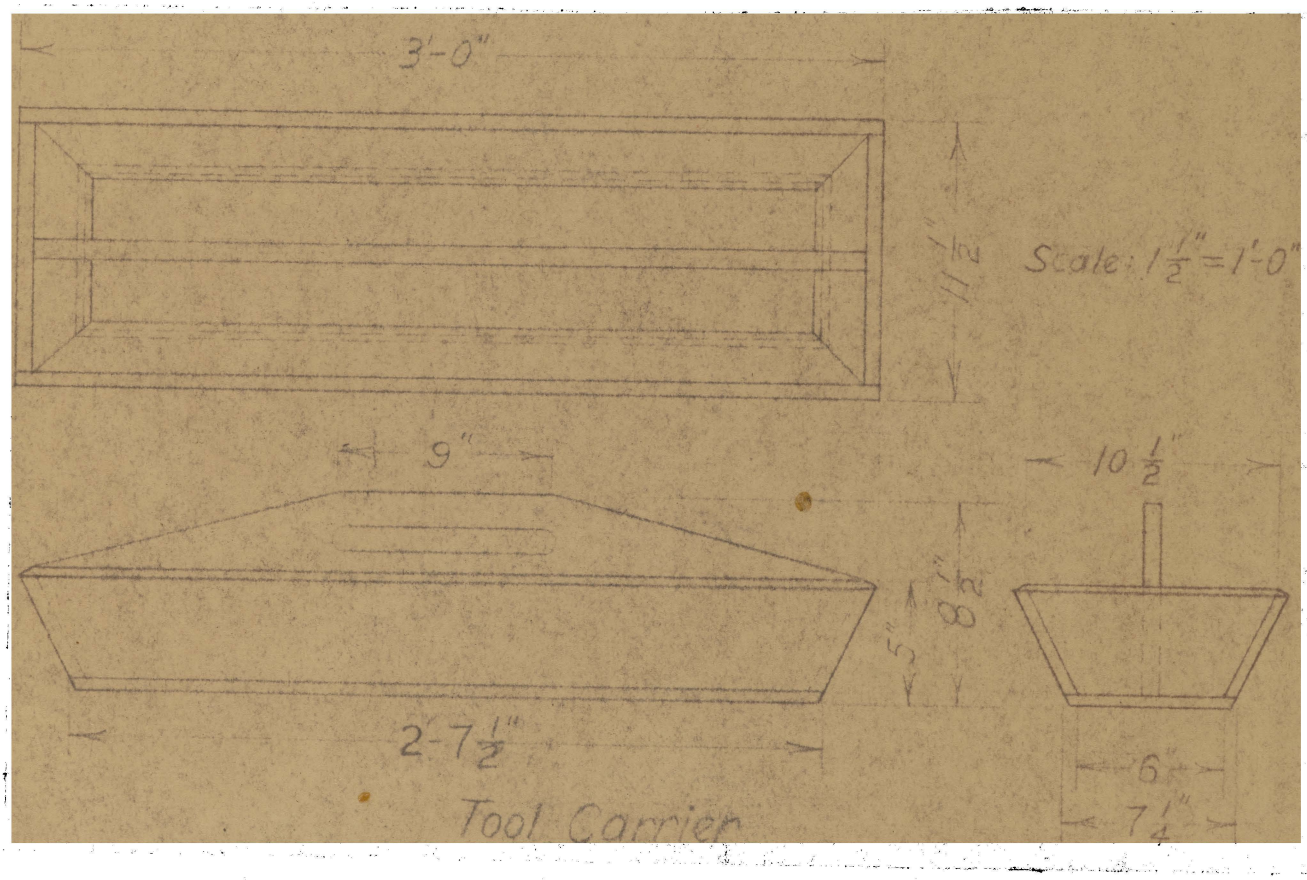
Operation 1 Laying Out and Reducing Stock

1. By using the square, set T bevel at an angle of 5" to 2$\frac{1}{2}$". This angle is to be used in making all joints.
2. Make the bottom piece 2' 6" long plus the length added by beveling the ends.
3. Plane side boards to 5$\frac{1}{2}$" width and bevel the edges. Make the side boards 3' in length at the upper edge. Draw lines from these longest points at an angle with the T bevel and saw to obtain the correct angle.
4. Make the upper edge of end pieces 10$\frac{1}{2}$" long, and draw a line from these longest points at an angle with the T bevel. Saw the end pieces following the line made with T square.
5. The longest inside measurment of the carrier is 2' 11" long. Lay off this length at a point 4$\frac{1}{2}$" from the lower edge of the handle partition. Mark the slant with T bevel, and saw. Make opening in handle 9" long and 1$\frac{1}{2}$" from upper edge; Bore out the wood with 1"

bit and finish with chisel. Then taper the partition as shown in drawing.

Operation 11 Nailing Pieces Together

1. Nail side pieces on to end pieces, letting sides lap evenly over ends of end pieces.
2. Center the handle partition inside of end pieces and nail.



Questions:

1. Why is the same angle used in making all joints?
2. What is the advantage in using this angle instead of a right angle?
3. Why should opening in handle be made 9" long?

References:

1. Blackburn, Samuel A., "Problems in Farm Woodwork", Page 10, The Manual Arts Press, Peoria, Illinois.

Constructing a Saw Jointer

The saw jointer is a very handy tool to have around when saws are being fitted. It is used to hold the file in jointing the saw. This tool is easily constructed and every farm shop should possess one. It is made so that the file that is placed in it will be at right angles to the blade of the saw to be jointed. An expert saw fitter probably would not need a jointer. He would simply hold the file with his hands, but for beginners it is advisable to use a jointer in order to do a good job.

Equipment and Materials: Cross-cut saw, rip saw, square, plane, brace and bit, screw driver. Two pieces 13/16" x 1¼" x 4½" hardwood or close grained softwood, two 1¼" No. 10 flat head bright screws, 5" single-cut mill file.

Procedure:

1. Reduce the two pieces to dimensions indicated in bill of materials.
2. Measure up 7/8" on each end of piece, thus locating the center points. Measure out 3/8" from inside lower edge for other side of bevel.
3. Remove stock to lines as shown in fig. 1.
4. With a ¼" radius lay off and remove stock from top edges (fig. 1).
5. Use a saw and cut the grooves for the file about the same width as the file (fig. 1). Care must be taken to make sure that the file will lie at right angles to the saw-kerf through which the saw blade is passed in jointing.
6. With the plane remove a little stock from the inside edge of the two pieces just above the file grooves (fig. 1). The two halves of the jointer are made so that they touch at the top only. Plane more just above the groove and gradually less toward the top.
7. Drill holes for screws ¾" from each edge.

8. Place the file in the grooves and fasten the two pieces together with the two No. 10 screws.
9. Cut the saw kerf with a rip saw where the two pieces meet (fig. 1).
10. If it becomes necessary to make the kerf larger, loosen the screws, remove the file and plane a small portion from each side.
11. It is necessary that the saw kerf be large enough for the saw to pass through when screws are tightened, because the file is held in place by the compression exerted by the screws.

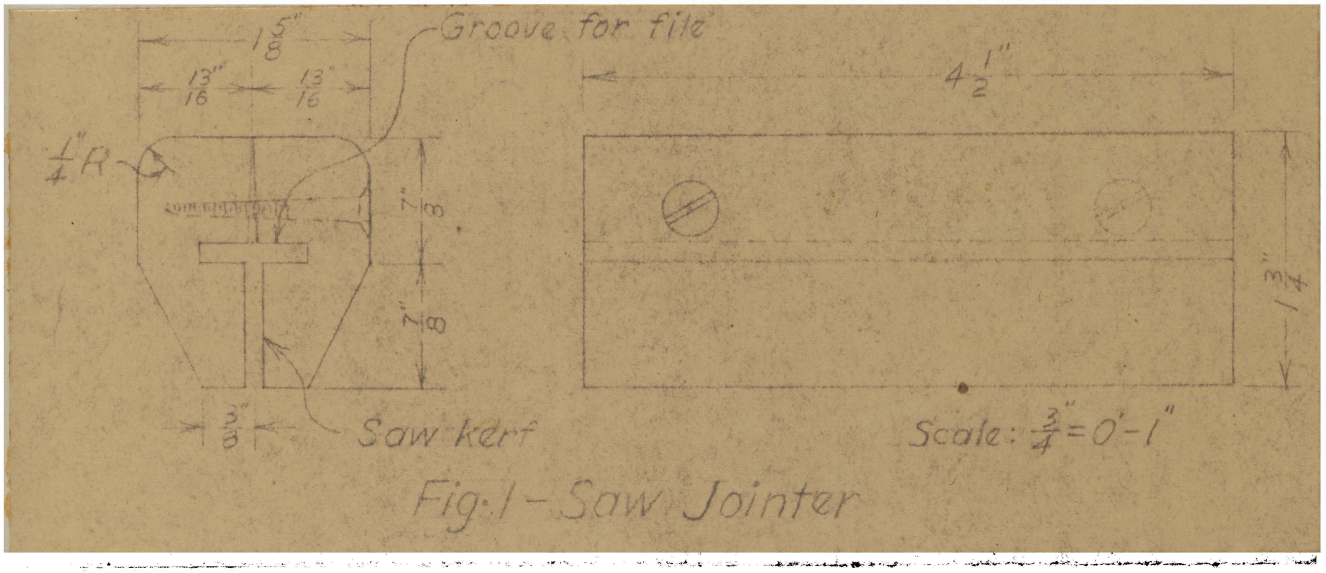


Fig. 1 - Saw Jointer

Questions:

1. Explain the use of a jointer.
2. Why is it necessary that the file lie at right angles to the kerf?
3. How large should the saw kerf be?

References:

1. Struck, F. T., "Construction and Repair Work for the Farm", Pages 306-308, Houghton Mifflin Company, Boston, Massachusetts.

Constructing a Hog Hurdle

One of the most convenient articles of equipment for the hog farm, is a hurdle, which is useful in driving and handling hogs and in protecting both hogs and herdsman in handling ferocious animals. Some of them are made to restrict animals to certain feeding areas. The hurdle is managed easily with one hand.

There are several designs of hurdles as shown in fig. 1 and 2. However, the bill of materials is only given for the type shown, in fig. 1.

Equipment and Materials: Hammer, saw, drawing knife, plane. Light lumber such as pine or poplar is best to use for this purpose.

No. pcs.	Dimensions	Use
4	½" x 2 3/4" x 4'	rails
2	½" x 3 3/4" x 2'	uprights
2	½" x 2 3/4" x 2' 8"	diagonals
1	½" x 2 3/4" x 15"	handle

Procedure:

1. Reduce all pieces to dimensions indicated in bill of materials.
2. Nail the rails on to the uprights spacing them as shown in fig.1.
3. Fasten the diagonals in place slanting them as shown in fig. 1.
4. Saw off the bottom ends of the diagonals even with the bottom rail.
5. Measure up 6" from the top rail, mark and saw off the tops of the diagonals parallel with the rails (fig. 1).
6. Place the handle in position, flush with the diagonals and lay off dimensions.
7. Cut ends of the handle to desired shape and remove 3/4" of stock

from the lower edge between the diagonals.

8. Fasten the handle in place with nails.

The type shown in fig. 2 is a very convenient hurdle made from the half rim of an old buggy wheel. This hurdle can easily be constructed by following the drawing closely.

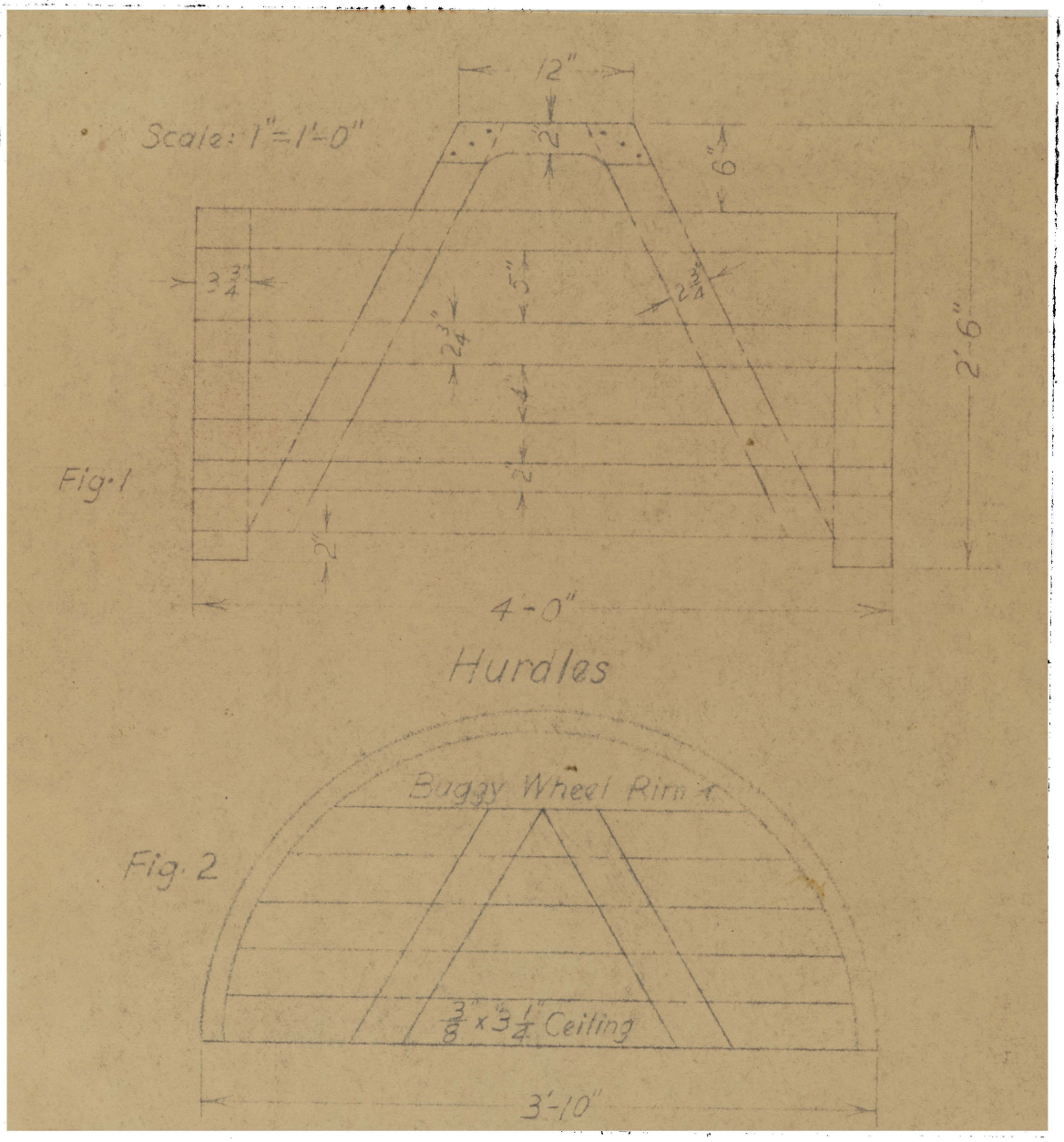


Fig. 1

Hurdles

Fig. 2

Questions:

1. Why is light lumber used?
2. Why do you always see hog hurdles around a show ring?
3. Where should the hurdle be kept around the farm?

References:

1. Struck, F. T., "Construction and Repair Work on the Farm", Pages 184-186, Houghton Mifflin Company, Boston, Massachusetts.
2. Russell, E. Z., Buckley, S. S., "Hog Lot Equipment", Pages 17-18, Farmer's Bulletin Number 1490, United States Department of Agriculture, Washington, D. C.

Constructing a Barn Door Stop

This stop is very valuable when a door is used extensively. It is convenient and is easily constructed. This stop will hold the door at any desired position and will allow a person to hold both hands on any object that is being carried. There is no danger of stock staying out in the cold because the wind blew the door shut. Attach the stop to the inside of the door if it opens outward and vice-versa.

Equipment and Materials: Saw, hammer, screw driver, brace and bits, block plane, any hardwood.

Number Pieces	Dimensions
2	1" x 1½" x 2½"
1	1" x 1¼" x 8"
1	½" x ¾" x 8"
1	1" x 1" x 28"

1 piece of flat iron ¼" x 1" x 6",

1 bolt ¼" x 3½", 8 ½" wood screws,

4 2" wood screws, 3 1½" wood screws.

Procedure:

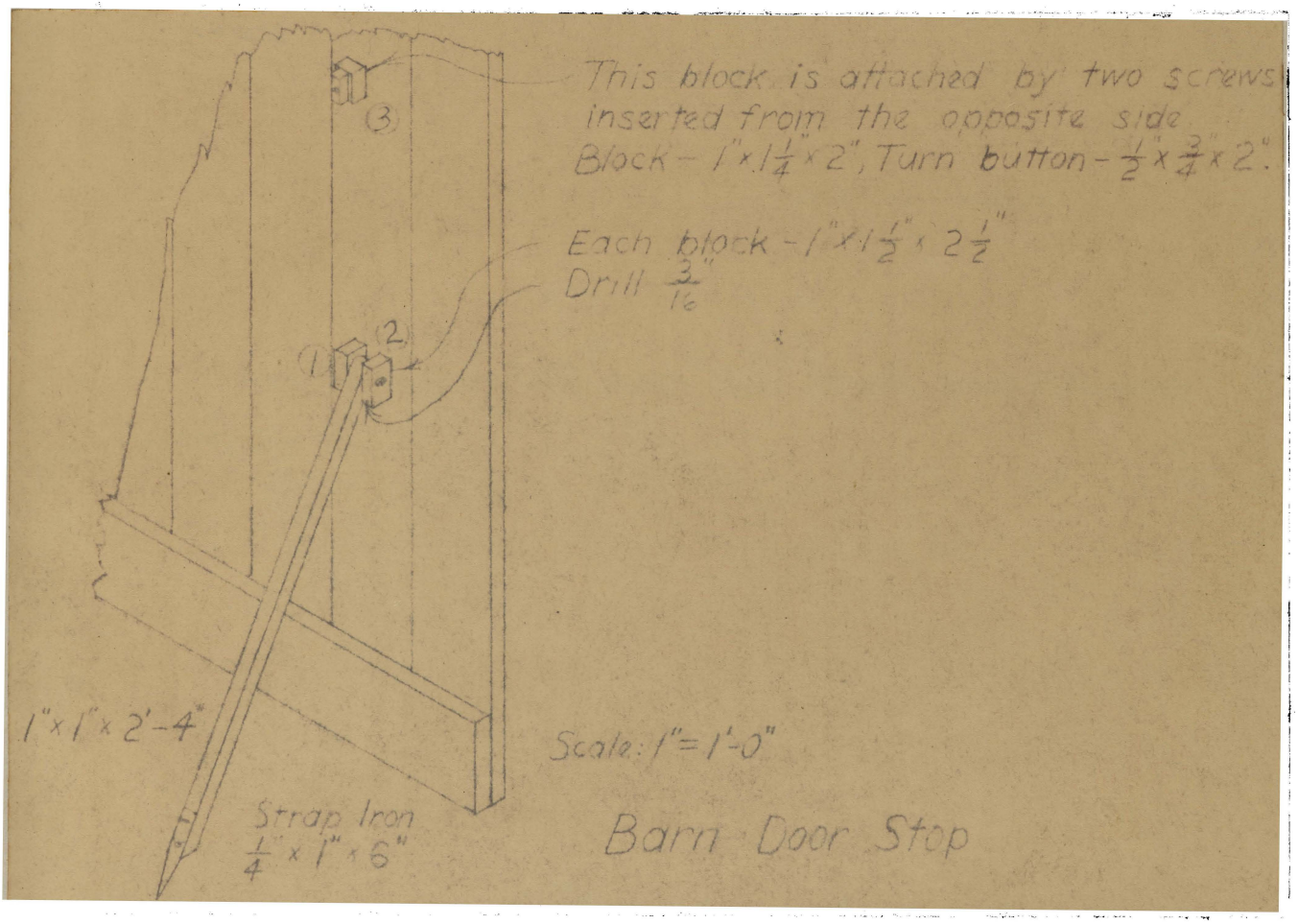
Operation 1 Preparing the Material

1. Forge or cut one end of the piece of flat iron to a sharp point, (see drawing).
2. Bore two quarter inch holes one inch from theend and one inch apart in the square end of the piece of flat iron.
3. Attach the piece of metal to the stop with wood screws.
4. Round the other end of the 1" x 1" x 28" stick and bore a ¼" hole in the center ½" from the end of the stick.
5. Bore two 3/16" holes in each of the blocks 1 and 2 shown in drawing. These holes should be ½" from the end.

6. Bore a $\frac{1}{4}$" hole in blocks 1 and 2 to attach the stick by. These holes should be in the center of the blocks (fig. 1).

Operation 11 Attaching the Door Stop

1. Attach the stop to the door so that the stop will make an angle of about 60° with the horizontal when the door is open.
2. Fasten blocks 1 and 2 securely to the door with 2" wood screws.
3. Match the holes in the blocks with the hole in the end of the stick and attach them with the $\frac{1}{4}$" x $3\frac{1}{2}$" bolt.
4. When the stop is not in use, simply raise it and keep it in place with the turn button.



Operation 111 Preparing and Attaching Turn Button

1. Reduce the two pieces to proper dimensions.
2. Raise the stick and mark position for the turn button. The block and button should be so placed that when the stick is swung up, the button may be turned to hold it in place.
3. Attach block No. 3 with two 1¼" wood screws from the opposite side of the door (fig. 1).
4. Attach the turn button to block No. 3 with a wood screw. This should be made tight enough so that the button will stay at the place desired.

Questions:

1. Why is the metal attached to the door stop?
2. Why should the No. 3 block and the edge of the door prop be on the same line?
3. Why were holes bored all the way through block 1 and 2 before screws were inserted?

References:

1. Roehl, Louis M., "Farmer's Shop Book", Pages 187-189, Bruce Publishing Company, New York.

Constructing a Screen for Gravel or Sand

A screen for cleaning sand of foreign material and separating fine sand from coarse sand is a very convenient and necessary in concrete work where a very smooth finish is desired. It can also be used for other purposes about the farm such as sifting dirt for hot beds, etc.

Equipment and Materials: Saw, hammer, brace, small bit.

No. pcs.	Dimensions	Use
2	1" x 2" x 4' 6"	legs
2	1" x 4" x 5'	sides
1	1" x 4" x 2' 6"	top
1	1" x 4" x 2' 8"	bottom
1	1" x 2" x 2' 10"	brace

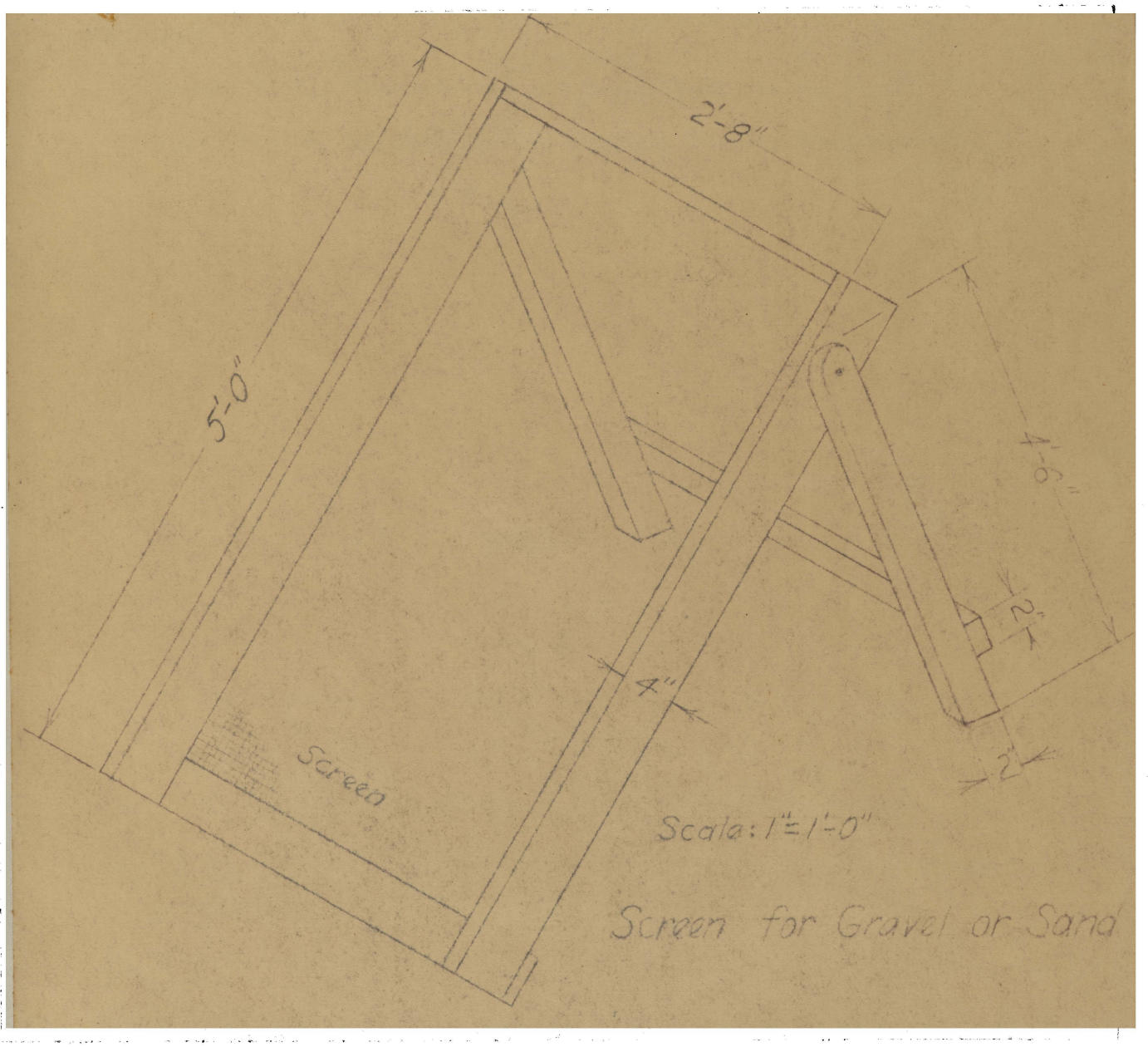
½ lb. 3/4" staples, 2 dozen 8 d finishing nails, 2 small bolts or two large nails, 1 piece of wire mesh 3' 6" x 5' of desired mesh size.

Procedure:

1. Reduce lumber to dimensions as indicated in the bill of materials.
2. Fasten the frame together with the shorter of the cross pieces at the top end between the side pieces (fig. 1).
3. Fasten the screen mesh on the bottom of the frame with staples.
4. Fasten the longer cross piece on the bottom end of the frame over the wire mesh. Fasten the screen to this cross piece with staples (fig. 1).

5. Bore holes in legs and frame with a very small bit either for a large nail or bolt. If nails are used clinch them, and if bolts are used place washers and nuts on them (fig. 1).

6. Attach the braceto the legs about one foot from the lower ends (fig. 1).



Questions:

1. Why is the screen placed on top of the bottom cross piece?
2. Why is the coarse sand separated from fine sand when a smooth finish is desired?
3. Mention several uses of this screen other than for screening sand?

References:

1. Struck, F. T., "Construction and Repair Work for the Farm", Pages 271-272, Houghton Mifflin Company, Boston, Massachusetts.

Constructing a Fruit Ladder

This ladder comes to a point at the top and is very useful about the orchard at pruning and fruit picking time, because it can be readily placed between the branches of trees.

Equipment and Materials: Hammer, saw, square, plane, draw knife, brace, bits, wood chisel, screw driver. Use ash or yellow pine.

No. pcs.	Dimensions	Use
2	2" x 4" x 14'	uprights
1	2" x 2½" x 2' 4"	top piece
1	7/8" x 2½" x 3' 4"	cross piece
2	7/8" x 2½" x 8'	cross piece
1	7/8" x 2" x 3'	top cross piece

Procedure:

Operation 1 Preparing the Material

1. Taper one of the 14' pieces to 2½" at the upper end. Using the other one as a straight edge, mark and taper the other piece likewise (fig. 2).
2. Mark off 12" on the top piece, and from this point lay out and taper so that the upper end of stock will be 1" thick x 2" wide (fig. 1).
3. Place the two upright pieces on floor 3'6" apart at bottom. Plane off the inside of the upper ends so that they will fit snugly against the top piece (fig. 1).
4. Place the first rung 14" from bottom of upright pieces and mark its position.

5. Spacing the rungs each 14" apart mark and cut out grooves for each 3/8" deep and as wide as rungs.

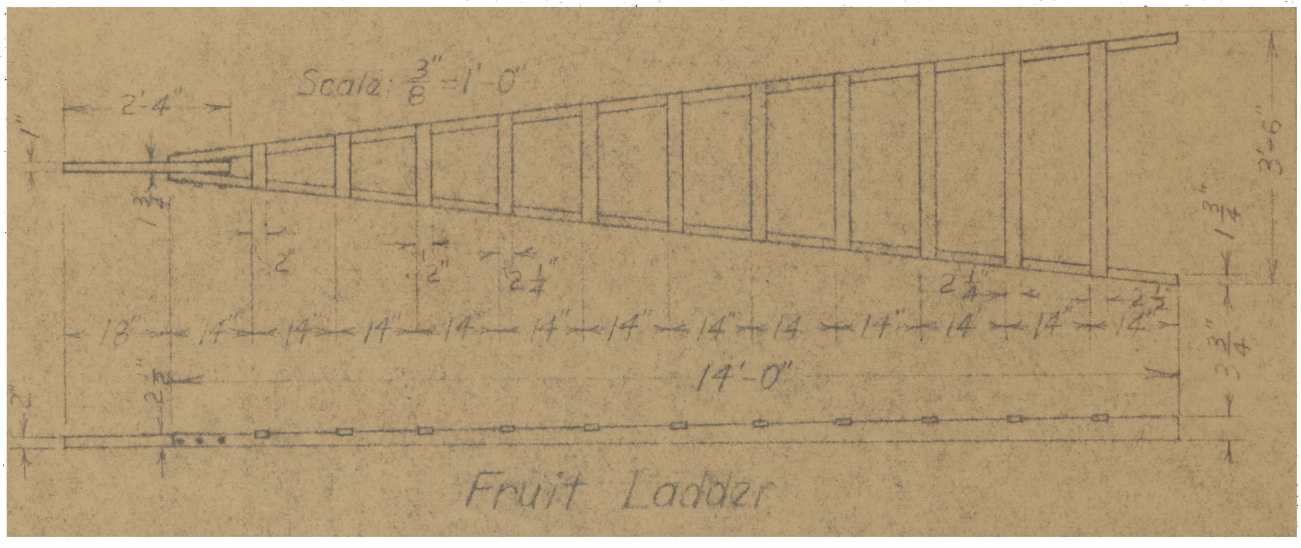
6. Place top in position and bore three 1/4" holes through ends as shown in (fig. 1).

7. Cut rungs on crosspieces to length.

Operation 11 Attaching the Prepared Material

1. Bolt the top in position with the 3 bolts as shown in fig. 1.

2. Fasten a crosspiece with two screws at each end.



Questions:

1. List several reasons why the fruit ladder is constructed as it is?

2. Why are the crosspieces near the bottom wider than those near the top?

3. In order to construct a good ladder what are some of the most important things to keep in mind?

References:

1. Roehl, Louis, M., "Farmer's Shop Book", Pages 200-205, Bruce Publishing Company, NewYork

2. Struck, F. T., "Construction and Repait Work for the Farm", Pages 65-68, Houghton Mifflin Company, Boston, Massachusetts.

Constructing a Base for Oilstones

Oilstones are very easily broken and if they are to be carried around in tool boxes they should be protected. For stones that are kept in the shop, it is wise to place them in a base or half-box. This base may be permanently fastened to a work bench or table. The base is constructed to fit the oilstone, therefore the dimensions may vary.

Equipment and Materials: 1 piece of white pine, or other soft, close grained wood, 1 1/8" x 5½" x 9½". Try-square, saw, wood chisel, plane, sandpaper. A small quantity of boiled linseed oil.

Procedure:

1. Reduce the base to dimensions indicated in bill of materials.
2. Use the try-square and lay off a rectangle 2" x 8" at equal distances from the sides and ends of the base block (fig. 1).
3. With a good sharp chisel remove the stock within the rectangle to a uniform depth of ½" (fig. 1).
4. With a plane or draw knife remove the stock from upper edges of base, thus forming a ¼" chamfer as shown in drawings.
5. Sandpaper edges and corners to make them smooth.
6. Finish by giving it several coats of boiled linseed oil.

Questions:

1. Of what value is the base for oilstones?
2. Why is it advisable to give the same base several coats of boiled linseed oil?

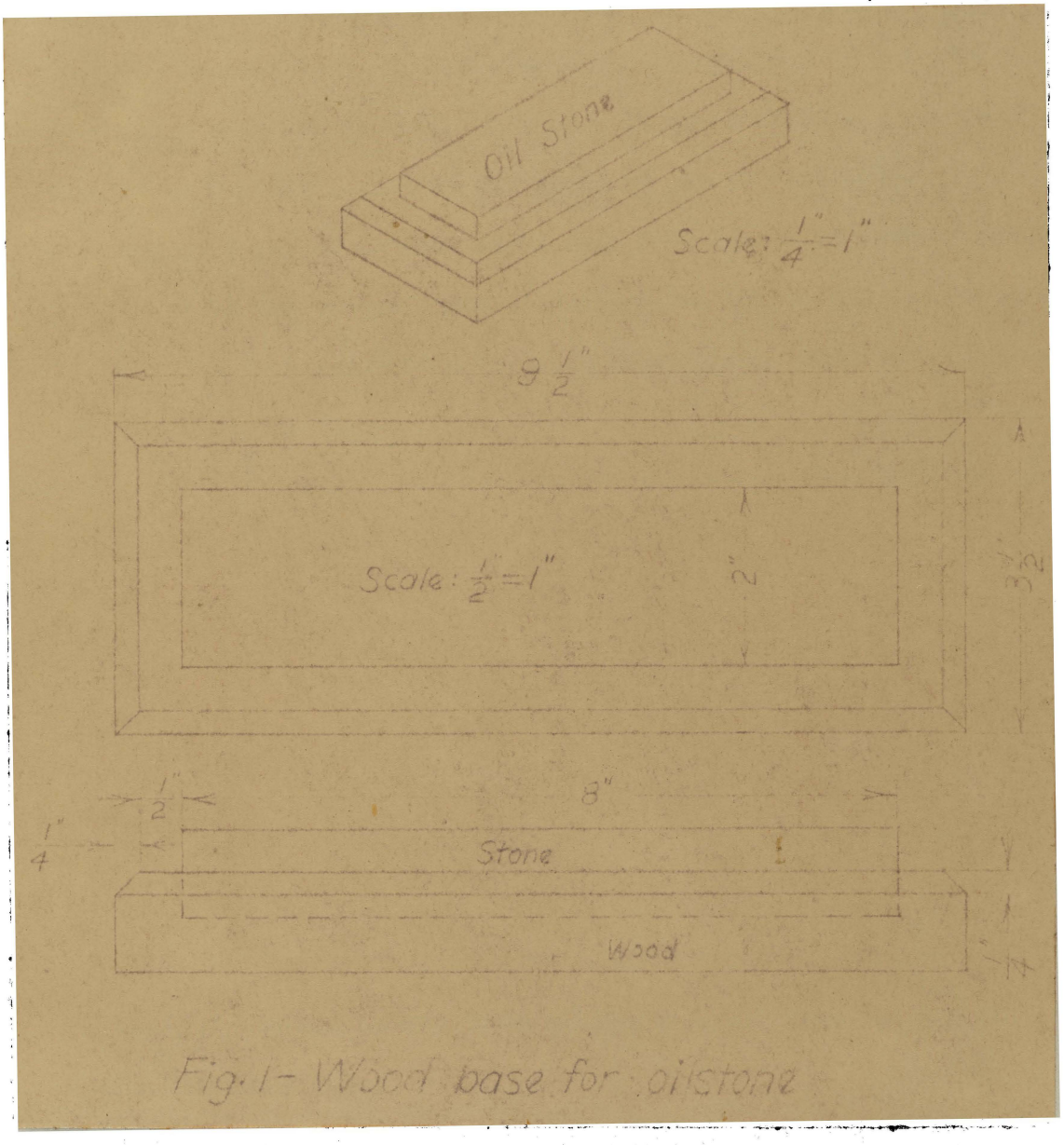


Fig. 1 - Wood base for oilstone

References:

1. Struck, F. T., "Construction and Repair Work for the Farm", Pages 297-298, Houghton Mifflin Company, Boston, Massachusetts.

Making a Harness Hook

The harness hook is constructed for the purpose of hanging up harness when not in use. This hook is substantial and can be adapted to various positions and kinds of lumber available. There are various types of harness hooks made from pieces of fork or broom handles which are trimmed down at one end and driven into a piece of timber. The type shown here is built directly on posts or studdings that stand in the barn.

Equipment and Materials: Saw, hammer, screwdriver, plane, wood chisel. White pine, or other soft wood.

No. pcs.	Dimensions	Use
1	1 3/4 " x 3 3/4" 20"	back
2	3/4" x 2½" x 10"	horizonal ties
1	3/4" x 3½" x 18"	diagonal strut

15- 1¼ " flat head screws, and 4 - 3" common screws.

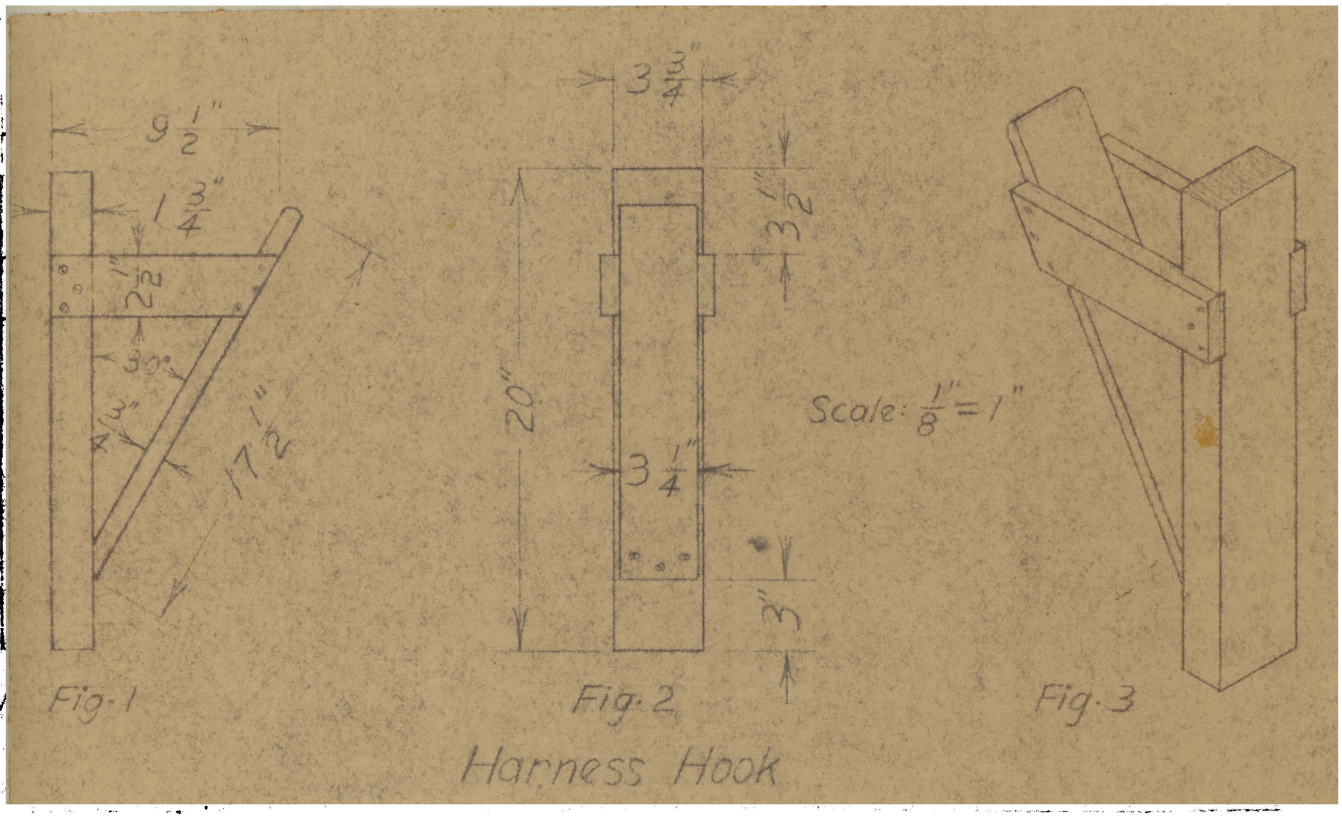
Procedure:

1. Reduce all lumber to dimensions indicated on drawings.
2. Cut a ¾" mortise on each side of the back 5½" from the top for the horizonal ties.
3. Bevel off the lower end of the diagonal strut at a 45° angle. Round off the upper end (fig. 1).
4. Attach the diagonal about 3 " from the bottom of the back with three 1¼" No. 10 screws.
5. Round off the outside edges of the horizonal ties.
6. Attach the horizonal ties to the back and diagonal with No. 10 screws (fig. 1).

7. Cut the horizonal ties flush with front of the diagonal strut (fig. 1).

8. Finish with several coats of linseed oil.

9. Attach the hook to the wall with 3" common screws (fig. 2).



Questions:

1. Why round off the outside edges of the horizonal ties?

2. What are some other types of harness hooks?

3. Give advantages and disadvantages of the type hook explained here, as compared with other types.

References:

1. Roehl, Louis, M., "Farmer's Shop Book, Page 191, Bruce Publishing Company, New York.

2. Struck, F. T., "Construction and Repair Work for the Farm", Pages 228-230, Houghton Mifflin Company, Boston, Massachusetts.

Making a Seed Corn Tree

Equipment and Materials: Plane, wood chisel, saw, square, tin snips, hammer, brace and bit. Any type of well seasoned lumber.

No. pcs.	Dimensions	Use
1	4" x 4" x 6'	tree
2	2" x 6" x 18"	feet
4	1" x 2" x 7"	braces

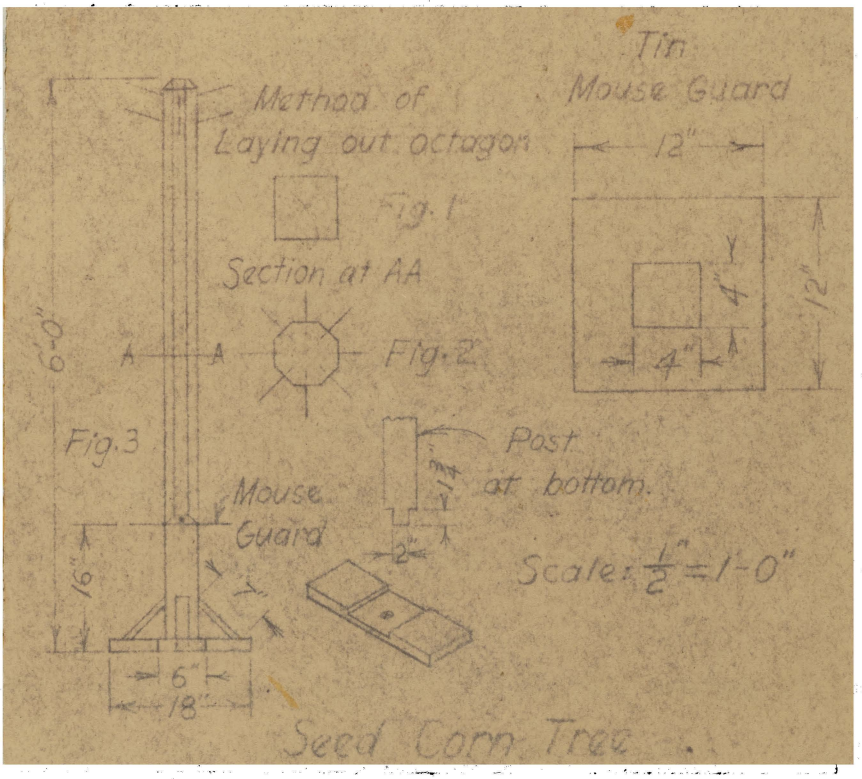
One piece of tin 12" x 12", some 10 d finishing nails.

Procedure:

1. Mark out an octagon at the upper end of the tree and chamfer on each corner 14" from the lower end of the tree. Remove stock for chamfer with plane and chisel (figs. 1 and 2).
2. Cut the top of the tree as shown in fig. 3.
3. Reduce the stock on the bottom of the tree to the dimensions shown in drawing.
4. Splice the foot members together and bore a 2" hole through the center for the bottom of the tree.
5. Brace the post with four braces (fig. 3).
6. Cut a hole 4" x 4" in the tin mouse guard and place it on the tree 16" from the bottom with strips.
7. Place 10 d finishing nails about 3" apart in a staggered position as shown in fig. 3.

Questions:

1. What is the importance of a mouse guard?
2. Would there be any advantage of using common nails with the heads removed for the ear supports?



References:

1. Roehl, Louis, M., "Agricultural Woodworking", Pages 66-67, Bruce Publishing Company, New York.

Hanging a Wooden Gate

Equipment and Materials: Hammer, brace and bit, hatchet, two heavy screw strap hinges and necessary washers and bolts, two heavy hooks with staples, a wooden gate and posts properly set.

Procedure:

Operation 1 Preparing the Post

1. Have the post well braced and firmly set in the ground. The best method of setting a gate post is to use concrete or by mixing rocks with the dirt and tramping this firmly.
2. With a hatchet smooth the side of the post to which the gate is to be hung.
3. Place the gate in its approximate position between the posts and mark the position for the screws to go into the post. The bottom screw should be set out slightly farther than the top screw.
4. Bore the holes in the post for each screw using a bit slightly smaller than the screws.
5. Take one of the strap hinges and screw the lugs into the post. The distance that these should go into the post can be adjusted after the gate has been hung.

Operation 11 Preparing the Gate

1. Attach one of the strap hinges to the top board of the gate, being sure to use washers on the end of bolt next to the wood.
2. Place the gate in its proper position between the posts. Slip the top hinge over the top screw and raise the free end of the gate by placing blocks under the gate.

5. Bore the holes for the bottom hinge and attach the hinge with heavy bolts.

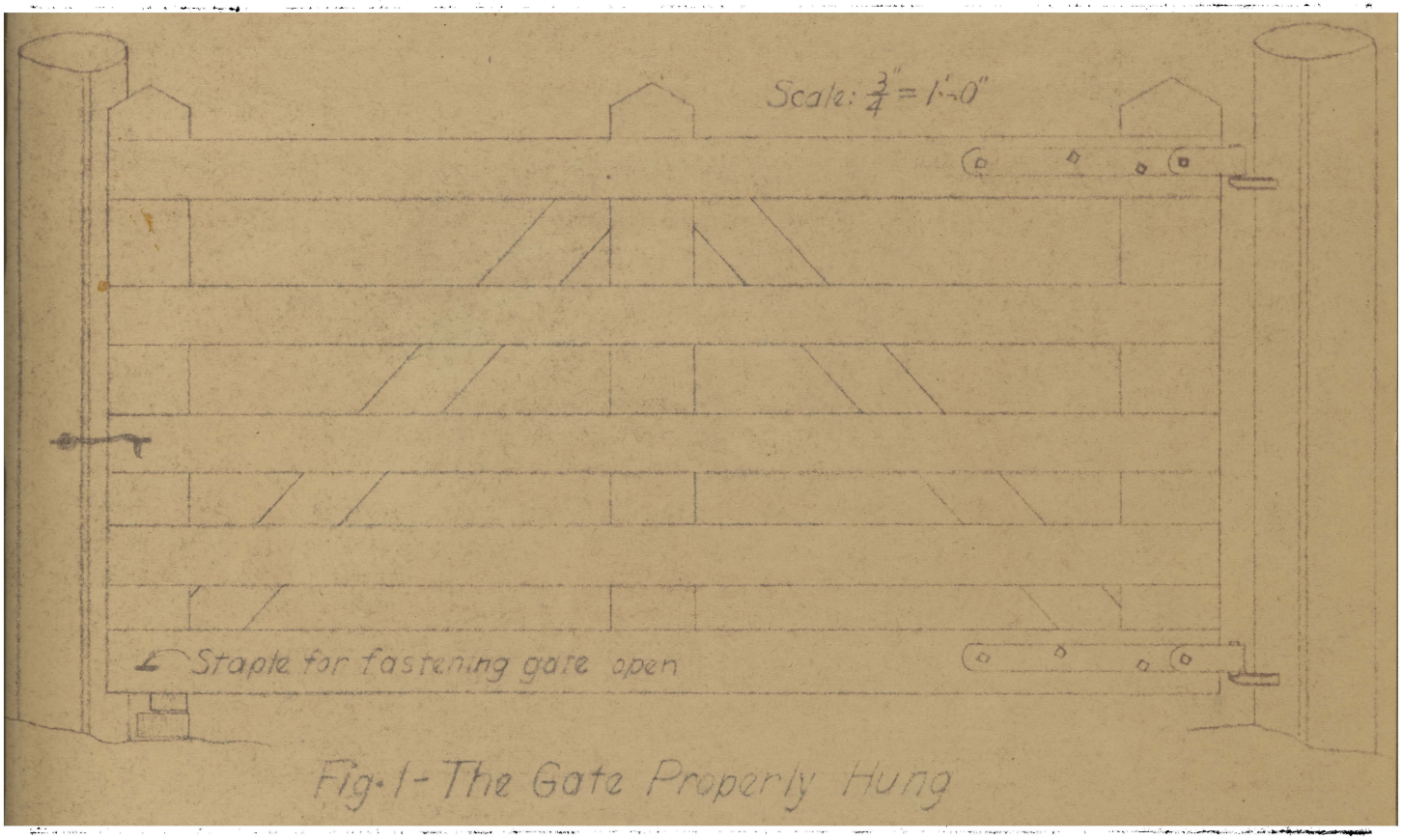


Fig. 1 - The Gate Properly Hung

Operation 111 Hanging and Adjusting the Gate

1. Block up the free end of the gate and the hinges can easily be slipped over the screws.
2. If the gate drags the ground when opened, screw the top screw in farther.
3. Allow the free end of the gate to close against the other gate post or against a 2" x 4" nailed to this post.
4. Attach a gate hook to the gate post so that the gate can be fastened when closed.

5. Drive a small stake into the ground opposite the post to which the gate is attached and about ten feet from this post.
6. Attach a hook to this stake and a staple in the gate at the point where it hits this stake.

Questions:

1. Should the gate swing toward or from the post when swinging free?
2. What other means may be employed in keeping a gate in position?

Making a Home Made Farm Anvil

Every farm shop should have some kind of an anvil. The one described here is made from a piece of railroad rail mounted on a wooden frame. It is very easily constructed and serves its purpose well.

Equipment and Materials: Steel drill, hammer, saw, square, plane, brace, and bit, any kind of hard wood can be used.

No. pcs.	Dimensions	Use
2	7/8" x 8" x 24"	cross pieces
2	13/4" x 10" x 32"	uprights
2	7/8" x 8" x 28"	feet
2	7/8" x 10" x 10"	bottom

One piece of railroad rail 30" long, one 3" bolt, one metal peg, some 10 d common nails.

Procedure:

Operation 1 Preparing the Rail

1. Bore or drill a hole at one end of the rail to accommodate the metal peg. This hole should be bored 1" from the end and ¾" from the outside edge.
2. With the drill, bore holes of various sizes along the edge of the rail for punching. These may be placed near the center or on the protruding end. (See drawing).
3. Make countersunk depressions with the frill for riveting.

Operation 1 Making the Frame

1. Reduce the lumber to dimensions shown in drawing.
2. Cut the openings at the top of the upright members to receive the rail. The dimensions for these openings are determined by the size of the rail used.
3. Cut the 1¼" chanfer from the top edge of the upright as shown in

in drawing.

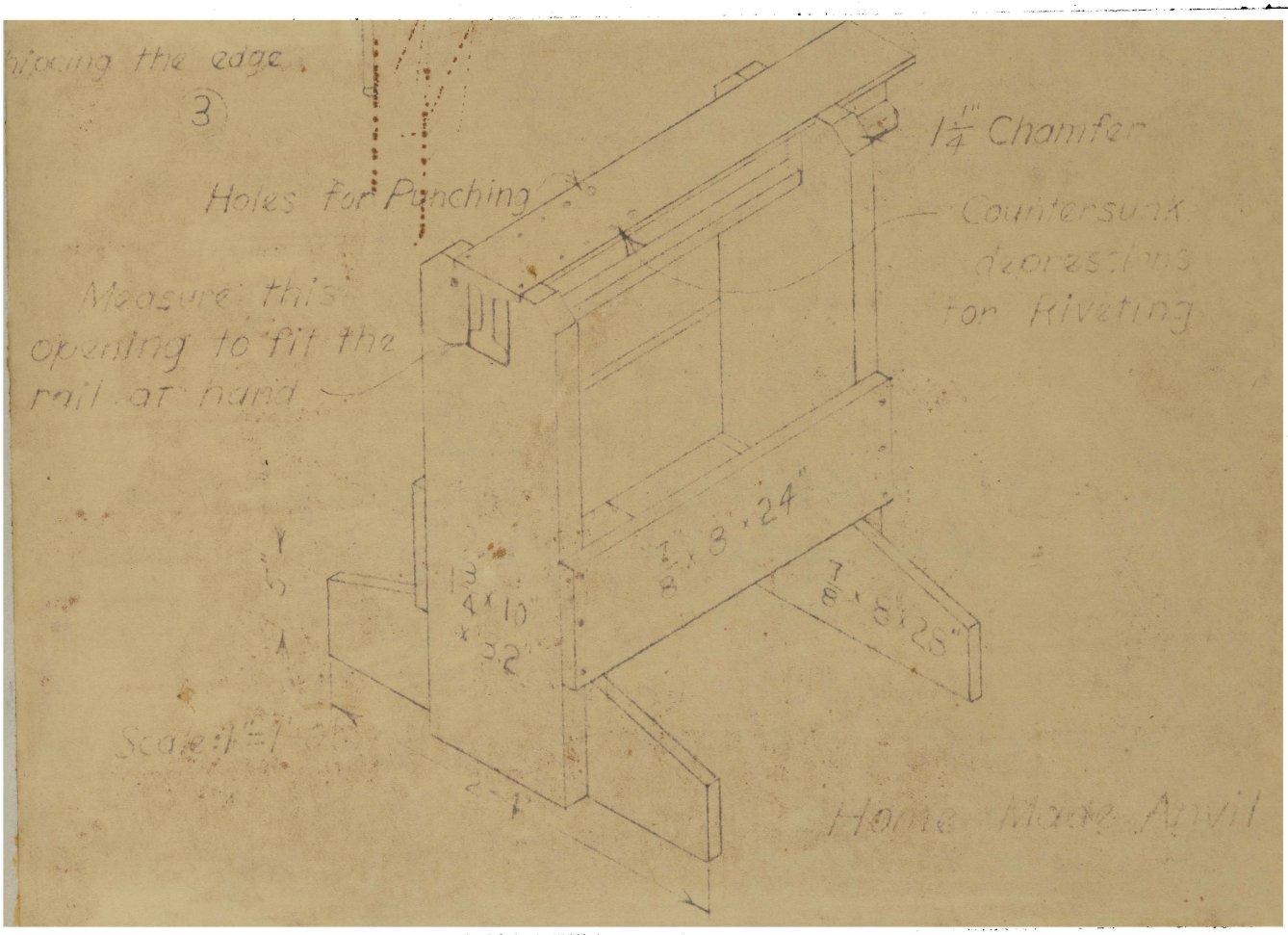
4. Taper the feet to 5" at each end as shown in drawing.

5. Assemble the frame, nailing securely with the 12 d common nails.

6. Place the rail in position.

7. Extend the hold made for the metal peg into the wood and drive the peg in place. This will keep the rail from slipping.

8. Bore a hole through the upright just below the metal peg and insert a bolt to keep the upright from splitting.



Questions:

1. Why should one end of the rail project over the end of the frame?
2. Why are the top corners of the upright pieces chamfered?
3. Why are countersunk depressions drilled in the surface of the rail?

References:

1. Roehl, Louis M., "Farmer's Shop Book", Pages 290-293, Bruce Publishing Company, New York.

Recommendations for Using Jobs

A farm shop job sheet is a guide for a vocational student and others to follow in preforming farm shop skills and farm shop jobs. It is an aid to the teacher in making the problem of supervision more simple and more effective. It cannot replace the supervision of the teacher. It cannot replace the demonstration of the skill. The job sheet is to recall the various steps to the mind of the student in their proper order along with the details they might not remember.

The student may use the sheet as a reference in planning his jobs. Before going into the shop, the learner should have a working plan. This plan should include a drawing with dimensions, bill of materials, tools used, and some definite idea as to the procedure.

The job sheet may be used as reference by the reacher when planning a lesson, and preforming a demonstration.

The student may use the sheet as a check on his finished product, and the instructor as a check on the quality of work done.

These job sheets can be used as a guide in making plans for other jobs which are not available.

Members of classes may take sheets home as an aid in preforming shop jobs on the farm.

This material should be made available to each Department of Vocational Agriculture in the state of Virginia in such a form that it can be used by the teacher and students.

Other jobs of similar nature, which have not been planned, should

be worked up and made available to teachers of Agriculture in Virginia.

The sheets should be properly stored in the shop files. The filing system should be such that the student as well as the teacher could easily locate each job.

Suggested List of Jobs

This list covers the jobs that have been completed in this study and others that can be worked up under, Tool Use and Care, Soldering, Harness Repair, Painting and Farm Appliances.

Tool Use and Care

1. Marking Farm Tools
2. Sharpening and Using Auger bits
3. Fitting the wedge
4. Use of files on metal
5. Fitting ensilage cutter blades
6. Sharpening a wood chisel
7. Sharpening a hand saw
8. Sharpening a draw knife
9. Sharpening a pruning saw
10. Sharpening a scythe
11. Sharpening a butcher knife
12. Using the cross cut hand saw
13. Using the brace and auger bits
14. Fitting a shovel handle
15. Cutting rafters
16. Use of the steel square
17. Using the marking gauge
18. Attaching an ax handle
19. Fitting a sledge handle and a hammer handle
20. Turning a grindstone; also cleaning
21. Using planes
22. Fitting and using the drill bit
23. Sharpening scissors
24. Fitting a screwdriver
25. Sharpening a hatchet or ax
26. Renewing the handle of a cross cut hand saw
27. Using the claw hammer
28. Use and care of the hacksaw
29. Replacing hoe handles
30. Cleaning and oiling tools
31. Repairing an ax handle
32. Fitting pitch fork handles
33. Sharpening and tempering a mattock
34. Drilling holes with the post drill
35. Sharpening plane bits
36. Sharpening the two man cross cut saw
37. Painting new woodwork on farm tools
38. Repainting farm tools
40. Sharpening circle saw
41. Fitting sledge hammer

42. Using the thumb gauge
43. Use and care of ripsaw
44. Sharpening a garden hoe
45. Making a garden tool rack
46. Fitting a rake handle
47. Care of garden tools
48. Use and care of the level
49. Use and care of a pipe and bolt threader
50. How to use a glass cutter
51. Use, care and selection of files
52. How to sharpen a pocket knife
53. Sharpening and using a cabinet scraper
54. How to select and use tin snips
55. Use of the countersink
56. Using and sharpening a gauge
57. Use and care of the drowshare
58. Use and care of the spokeshare
59. Use and care of the adze
60. Use and care of handscrews
61. Use and care of nail sets
62. Selecting and care of a grindstone
63. Selection and care of a whetstone
64. Using sandpaper
65. Use and care of inside and outside calipers
66. Use and care of pliers
67. Use and care of meter saw.

Soldering
1. Operating a blow torch
2. Fluxes and metals
3. Timing the soldering copper
4. Soldering galvanized iron
5. Running and soldering joints and seams
6. Mending small holes
7. Sweating on a patch
8. Repairing copper tubing and oil pipes
9. Soldering copper
10. Soldering cast iron
11. Soldering enamelware
12. Soldering zinc
13. Soldering lead pipe
14. Patching with rivets and solder
15. Soldering aluminum
16. Blow torch troubles.

Harness Repair
1. Knowing parts and fitting of harness
2. Cleaning and oiling harness
3. Making a waxed thread and threading
4. Making a riveted splice
5. Renewing hame clips and staples
6. Repairing trace ends
7. Attaching snaps and buckles
8. Making a stitched splice
9. Repairing a mid section of a trace

Painting

1. Mixing paints
2. Preparing surface for painting
3. Calculating quantity of paints
4. Selecting paint brushes
5. Priming and applying after priming
6. Filling
7. Shellacing
8. Varnishing
9. Waxing
10. Staining
11. Care of brushes
12. Calcimining
13. Whitewashing

Farm Appliances

1. Constructing a portable feed trough for lambs
2. Building creeps for lambs or pigs
3. Making a hog trough
4. Constructing a wood clamp
5. Constructing a drag sled
6. Making a singletree
7. Making a doubletree or two horse evener
8. Making a three horse evener
9. Making a milk stool
10. Constructing a saw jointer
11. Constructing a general purpose bench
12. Constructing a miter box
13. Making racks for lumber storage
14. Constructing a hog hurdle
15. Making a loading chute
16. Constructing a barn door stop
17. Making a tool carrier
19. Constructing a base for oil stove
20. Constructing a fruit ladder
21. Constructing a screen for gravel and sand
22. Making a harness hook
23. Constructing a movable hog house
24. Construction a hay and grain rack
25. Making a wheelbarrow
26. Constructing an open saw horse
27. Constructing a hog crate
28. Constructing a wagon jack
29. Making water stand for poultry
30. Constructing a chicken coop
31. Constructing a self feeder for hogs
32. Making a two man weigh carrier