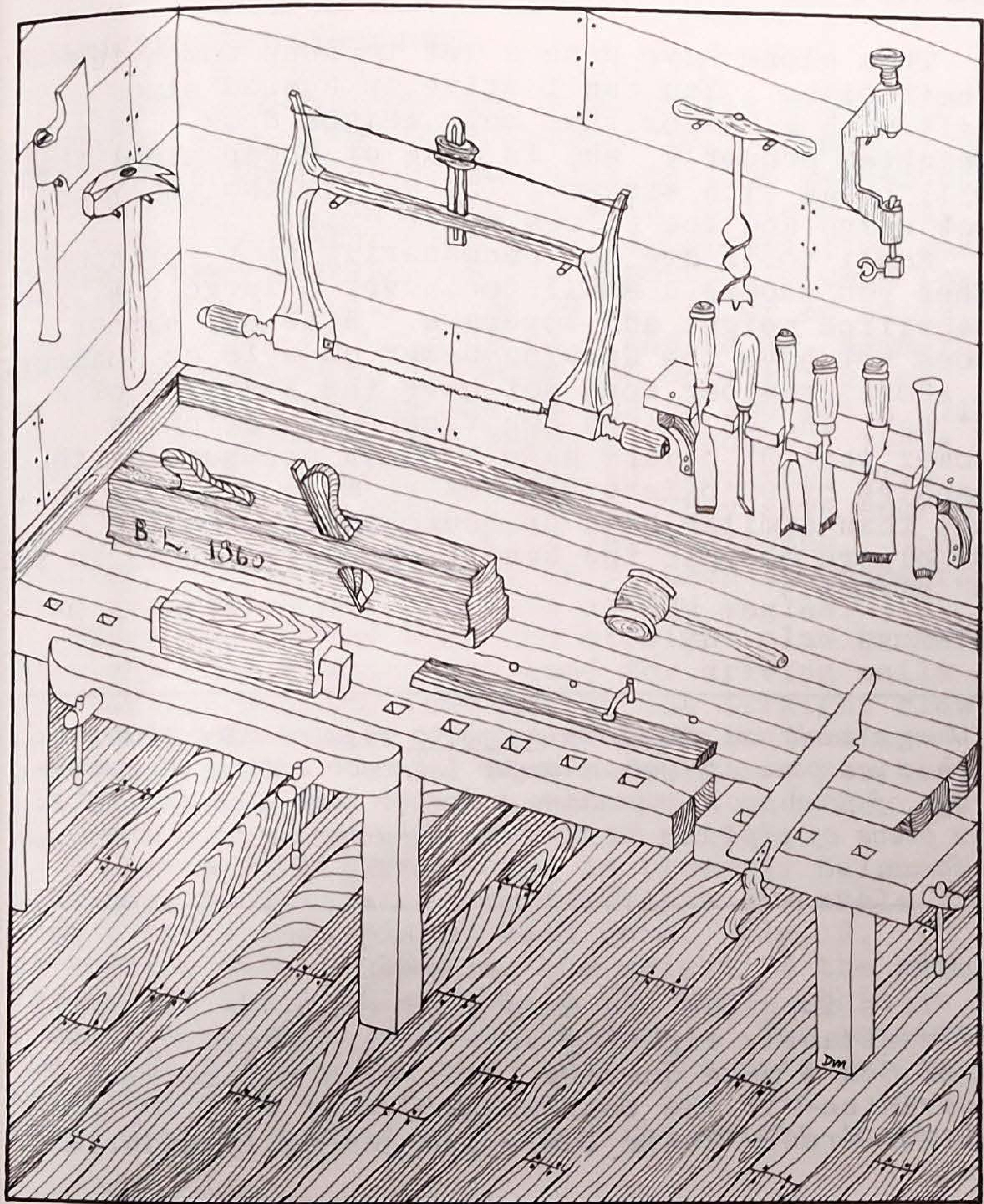
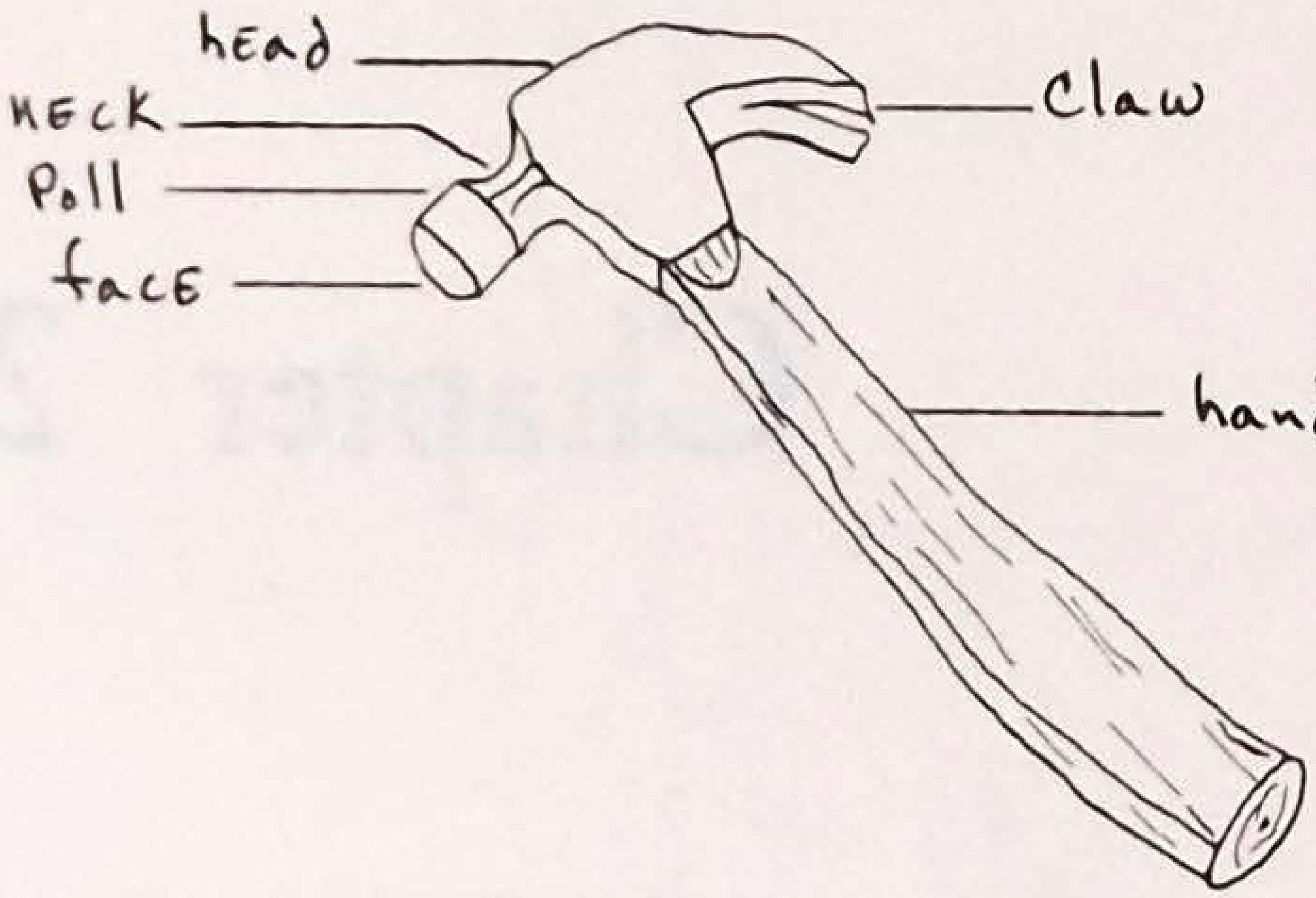
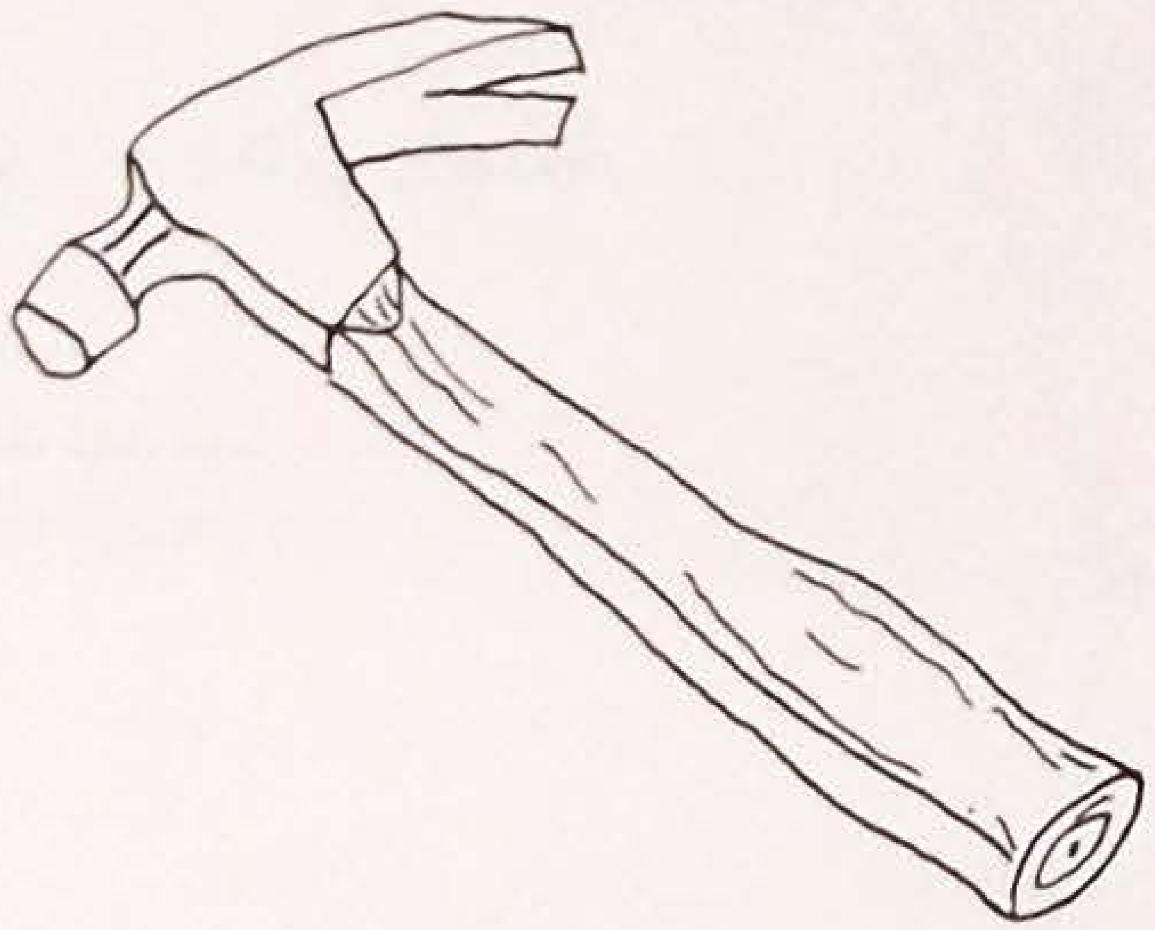


Chapter 2

Tools



Curved claw Hammer



Straight claw Hammer

Fig. 1 - Hammers

DO NOT GET TAKEN IN BY LADIES' TOOLS SETS

They alone have done a lot to keep women in their place. You can't drive in a good sized nail with a hammer that only weighs 8 oz., is not weighted properly, and is made of cheap steel that will break with stress. The saw is too small and not sharp and the pliers won't grip.

Small tools are not necessarily best for women. When you choose a small tool over a large one, you sacrifice weight and leverage. A 13 oz. hammer does not have the driving power of a 16 oz. hammer; a short crow bar does not have the leverage of a 3' bar; and 6" pliers don't have the gripping power that 9" pliers have. (Hand pressure on the handles of 9" pliers will exert more pressure on a nut than similar hand pressure on the handles of 6" pliers because the handle/lever is longer in the 9" pliers.)

> *When a task you are doing seems to require more strength than you possess, get a longer lever or extend the leverage of your tool by putting a longer handle on it. Often a piece of pipe can be slid over the handle to increase force.*

It's important to have good tools or you will be constantly fighting your work. Chain stores like Sears make quality tools with a life time guarantee--if the tool breaks, they will replace it for free. Their tools are generally a dollar or two cheaper than the name brand tool companies.

HAMMERS AND HAMMERING

Lighter hammers are not necessarily easier to use--they are often more frustrating. The heavier the hammer the farther the nail will be driven with each stroke. For 16d nails (said "sixteen penny") you should have at least a 16 oz. hammer (the most common hammer size). 13 oz. hammers are used for finish work-- mainly to drive 4d, 6d or 8d nails. There are also 20 oz., 22 oz., and 28 oz. hammers which are used when you know the only thing you will be doing is pounding in 16d or 20d nails all day, as in erecting the frame of a house. These heavier hammers aren't harder to use; they take practice like any other hammer. They save energy by pounding in the nail with fewer strokes. The greater weight in the head helps keep the hammer from deflecting off the nail at odd angles.

There are curved claw and straight claw hammers. Straight claw hammers are good for driving nails but not for pulling them out as the straight claw sacrifices leverage. They are used in framing and rough work. Curved claw hammers are the best all around hammer. They hammer well and the curved claw is designed for nail pulling.

A curved claw hammer that is properly balanced will come to rest at approximately a 45° angle with a table when placed head down. Fig. 2. If it topples over backwards, the weight of the hammer is more in the handle than in the head, (this is true of most steel handled hammers). The greater the angle formed with the table, the more weight is centered in the front part of the head. An easy to wield hammer will have its weight in the

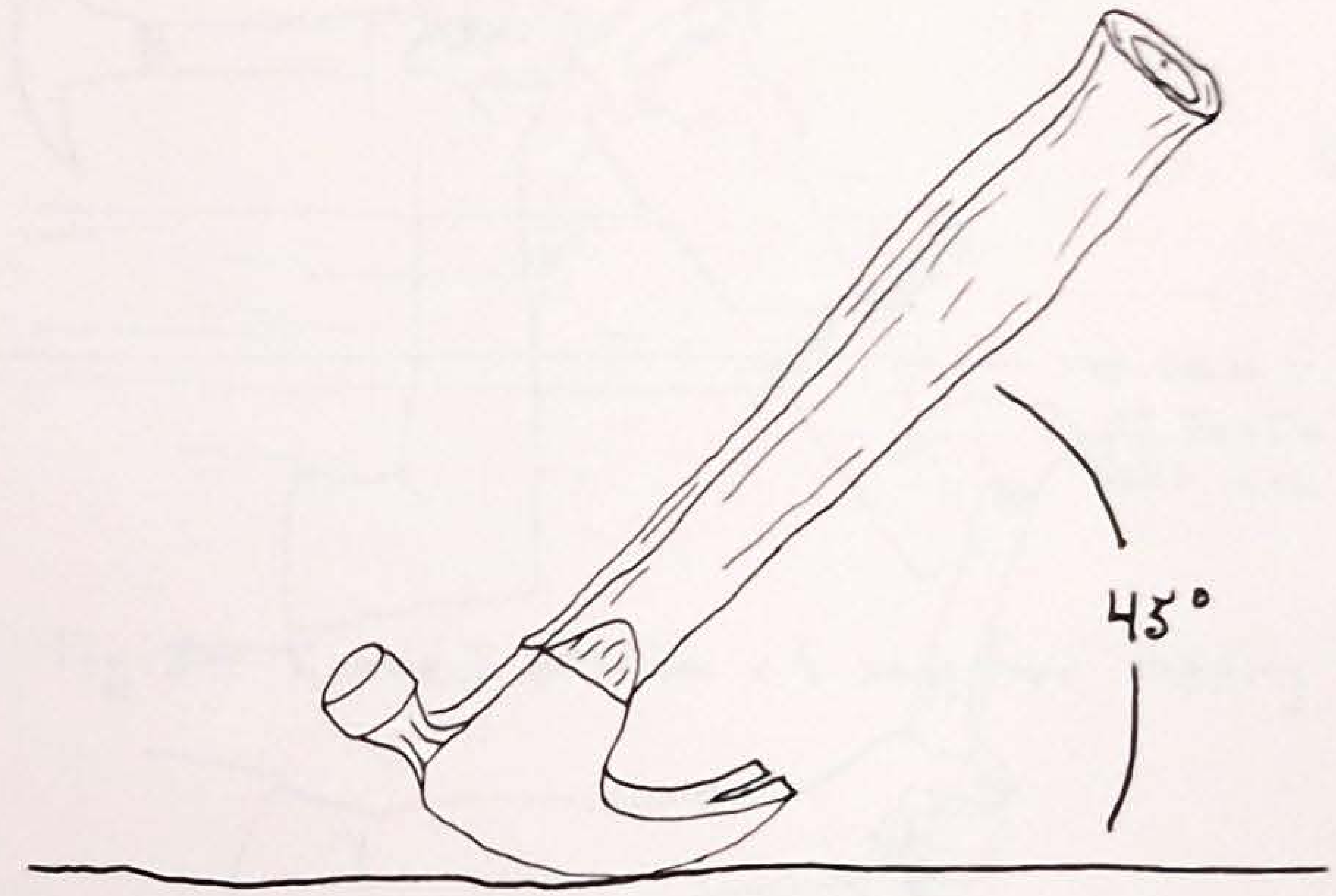


Fig. 2 - A correctly weighted hammer

Curved claw hammer
Straight claw hammer

head.

Hammering

To be able to hammer well takes practice and a good hammer. Your arm should be loose and relaxed. The stroke is a full arm motion with a wrist snap at the end. The wrist snap begins 6"-8" above the nail and is one reason why your arm should be relaxed. A lot of power is lost in stiff arm hammering. Fig. 3.

The hammer face should be parallel to the nail head upon impact. If the face contacts the nail head at an angle, the nail will bend and a great deal of power will be lost because the force of the blow is wasted in horizontal directions. When the face of the hammer contacts the nail head squarely, all the force of the blow is used efficiently to push the nail down into the wood.

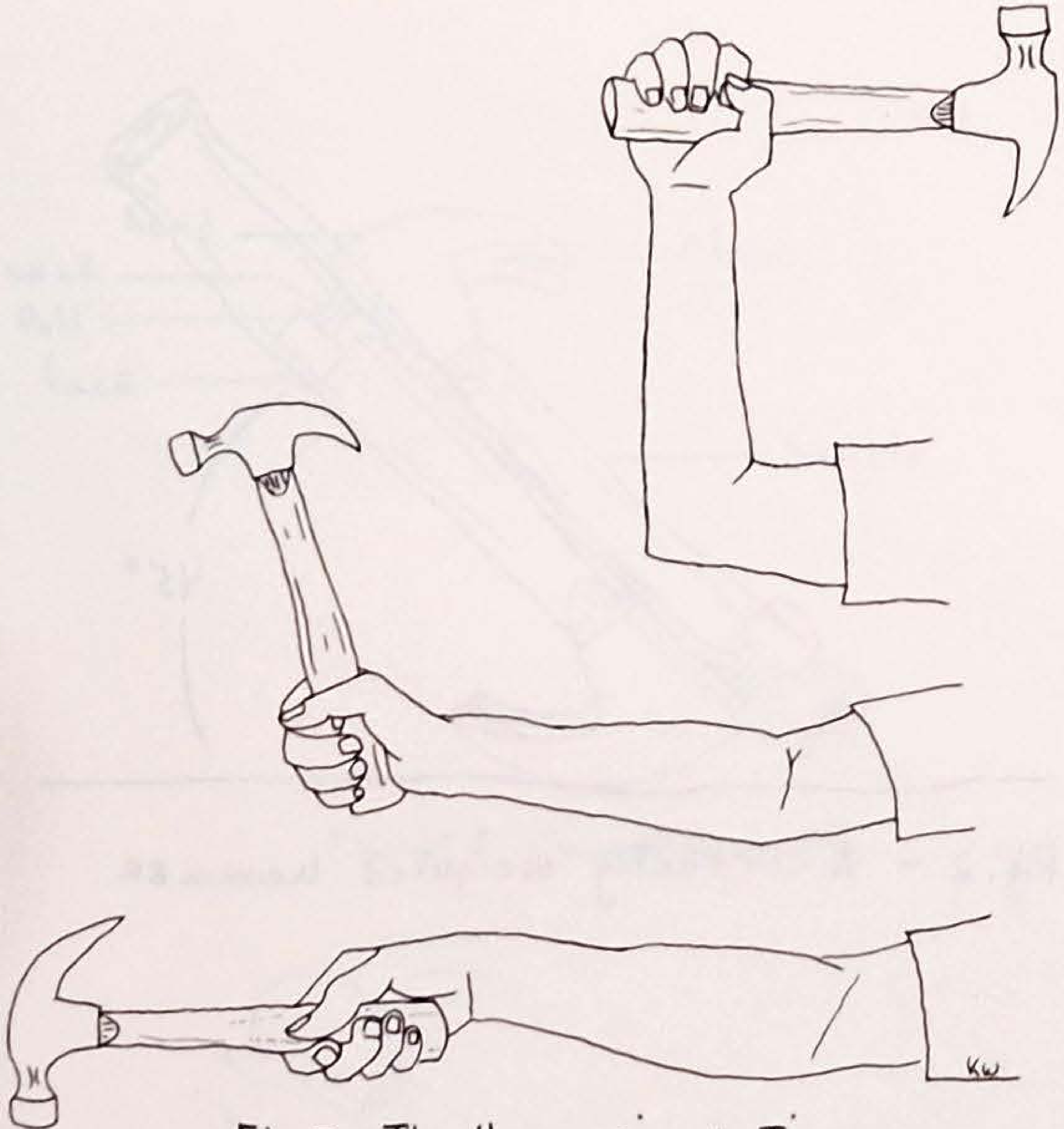


Fig. 3 - The Hammering Motion

Rip saw
Crosscut saw

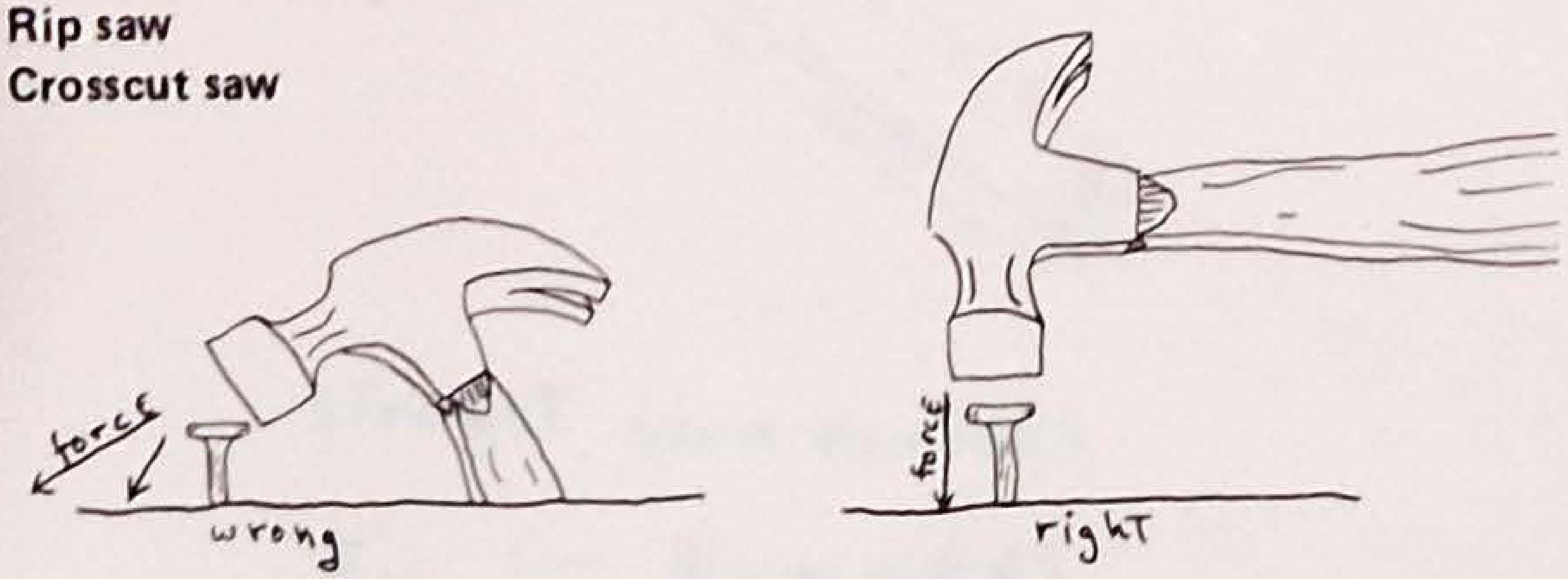


Fig 4. - Correct hammer face contact with nail head

HAND SAWS AND HANDSAWING

There are two main kinds of hand saws: rip saws and crosscut saws. Rip saws aren't very common any more because of the widespread use of power tools. They have 5½ teeth per inch and are designed to cut with, parallel to, the grain. Fig. 5.

Crosscut saws basically look like rip saws do except that they vary from 12 teeth per inch (fine) to 8 teeth per inch (rough cut). The teeth of a crosscut saw are designed to be most efficient while cutting across the grain. It can be used to rip but is slower than a rip saw.

An 8 or 10 point crosscut saw (this is the way saws are described; it means approximately 8 or 10 teeth per inch) is a good all around saw to have. When you pick one out, sight down the blade from the handle and make sure the blade is straight with no bends or kinks. A saw that is gotten new from the store will not necessarily be sharp. You will probably have to take it to a saw sharpener to have it sharpened.

Set

All saws (power and hand) have what is known as set. The set of a saw is the amount that the teeth are deflected out of line. One tooth is bent to one side and the next tooth to the other side and so on down the saw blade.

Kerf

The saw must have a certain amount of set so that the path the saw cuts (the kerf) is wider than the main part of the blade is thick. If the kerf were the same dimension as the blade, the saw would stick and bind as it passed through the wood.

The teeth have two purposes: to cut wood and to rake out of the kerf the sawdust made by the cut. If the sawdust were left in the kerf, it would build up and bind the blade. For this reason it is important to take long strokes when sawing using almost the whole length of the blade.

Back saw–See Joining: Butt Joints

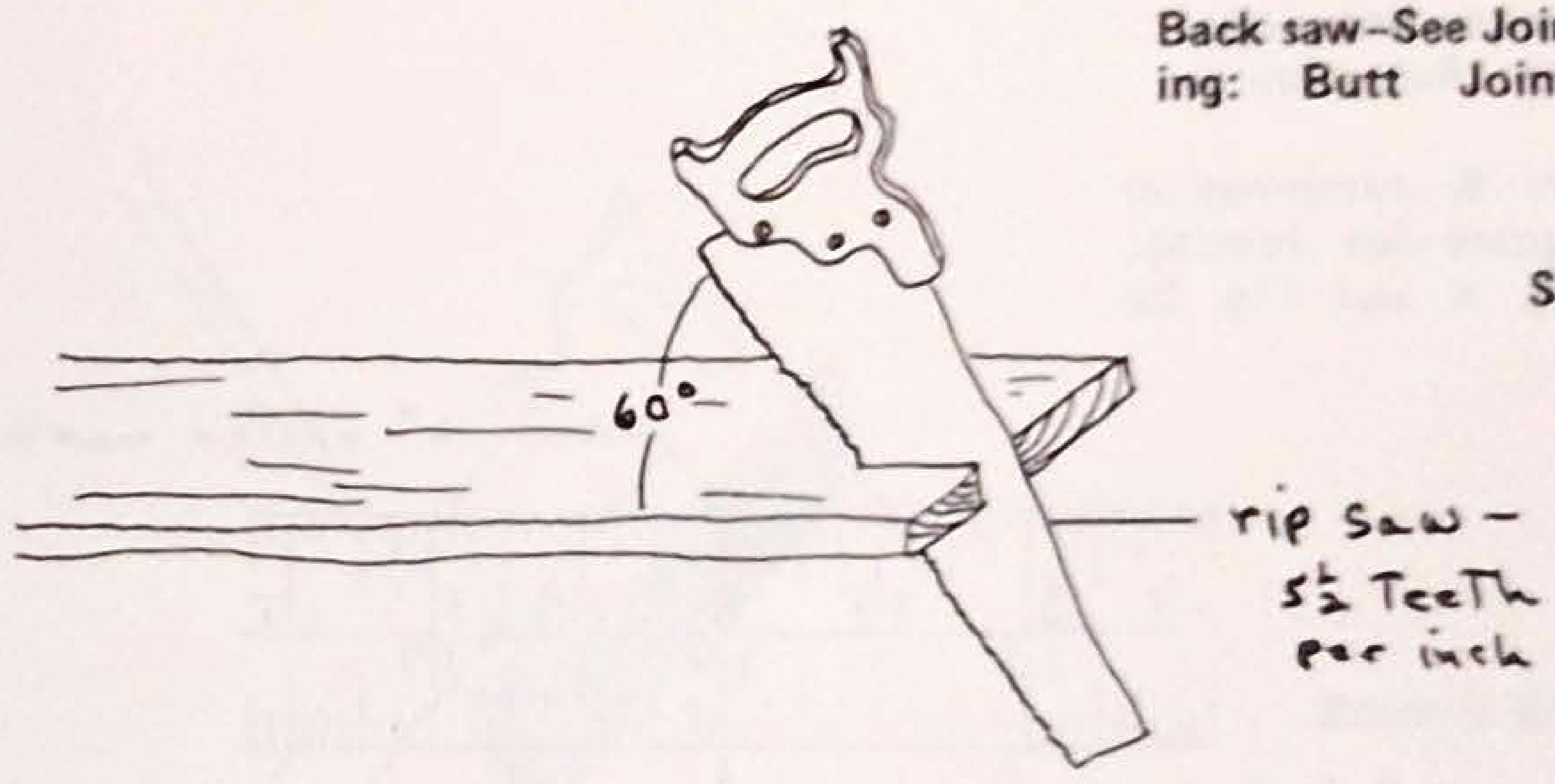


Fig. 5 – Correct position of saw for ripping

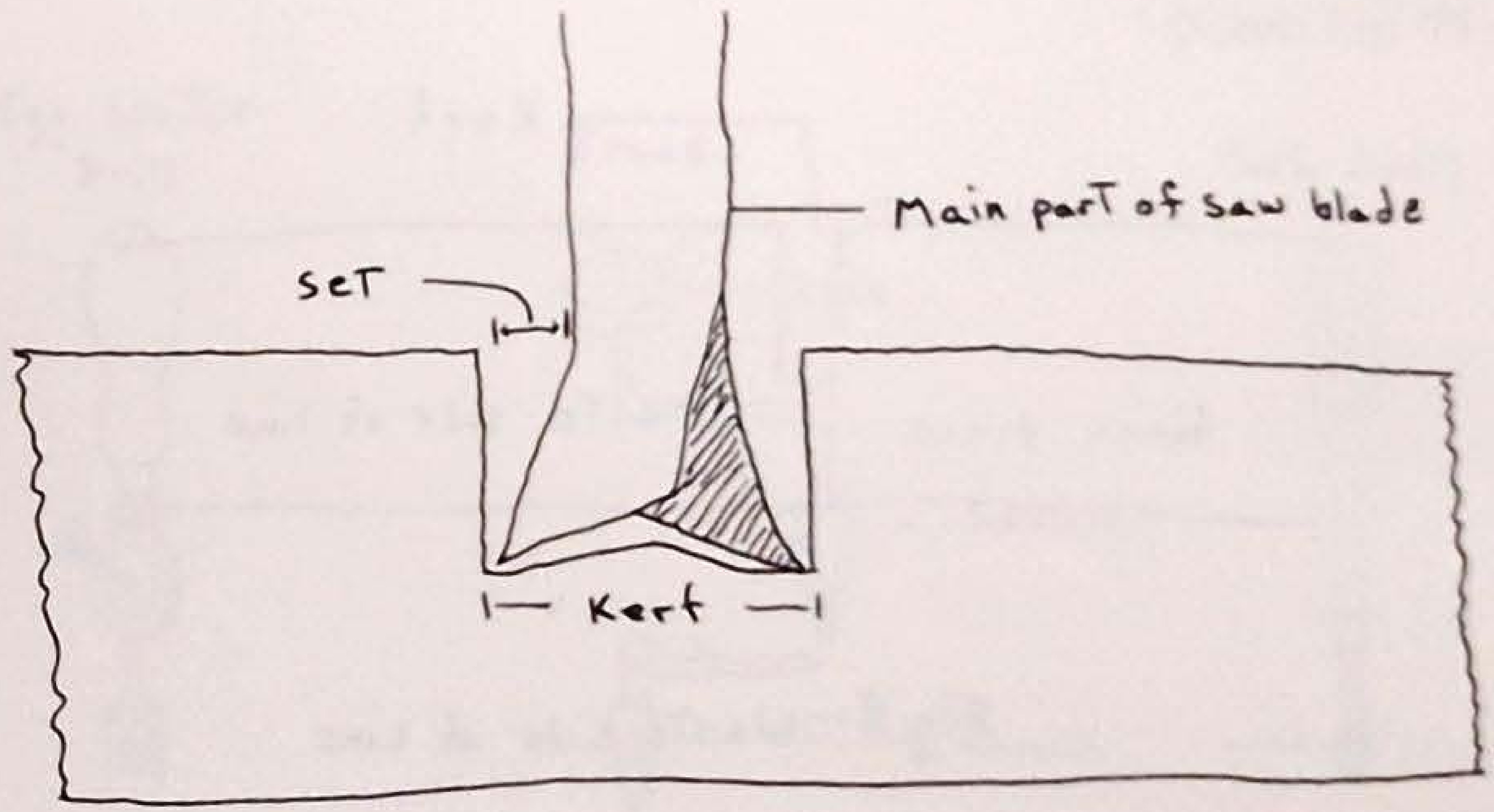


Fig. 6 – The Saw Kerf

Measuring

A crosscut saw is used to cut a piece of wood to length. Measure the correct distance with a tape measure and make a mark. A crow's foot is the most precise way of marking. The point of the crow's foot is pointing to the exact measurement you want. There is no guessing after you take the tape away as to which part of the mark is correct. Straight lines are inaccurate and there is inherent error in the thickness of the line. Fig. 7.

Square-See Joining: Butt Joints

Try & combination Square--See Joining: Fig. 4 and Fig. 26

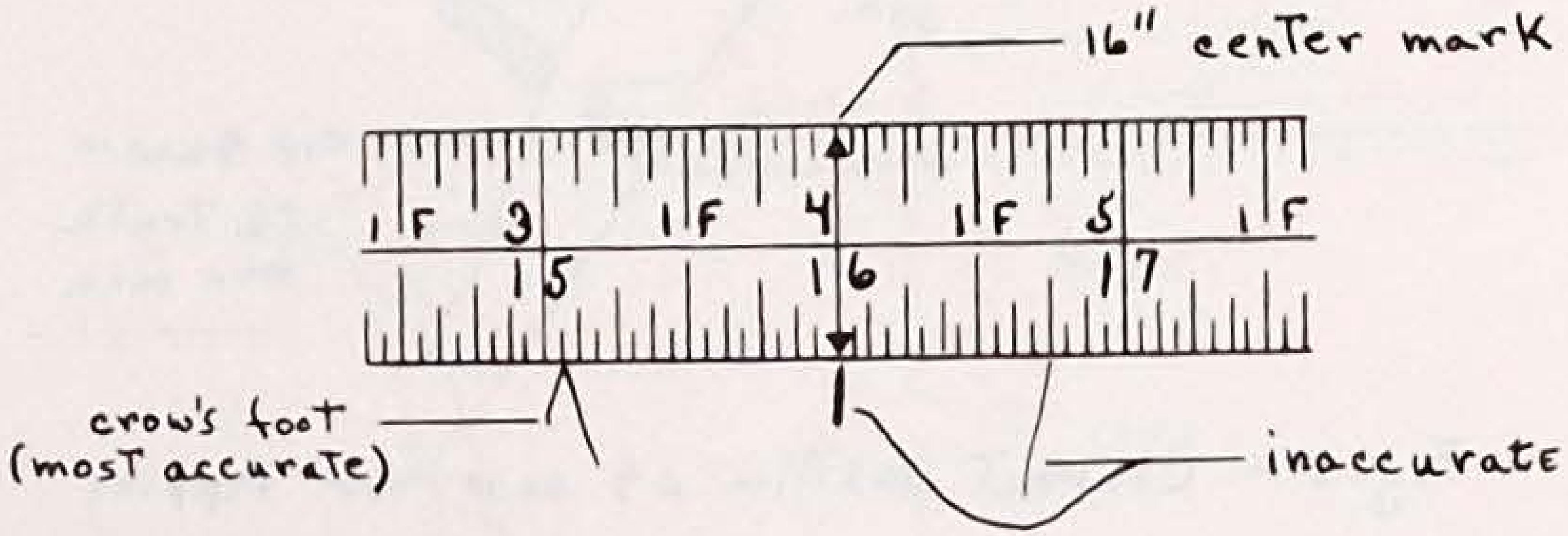


Fig. 7 - Correct marking during measuring

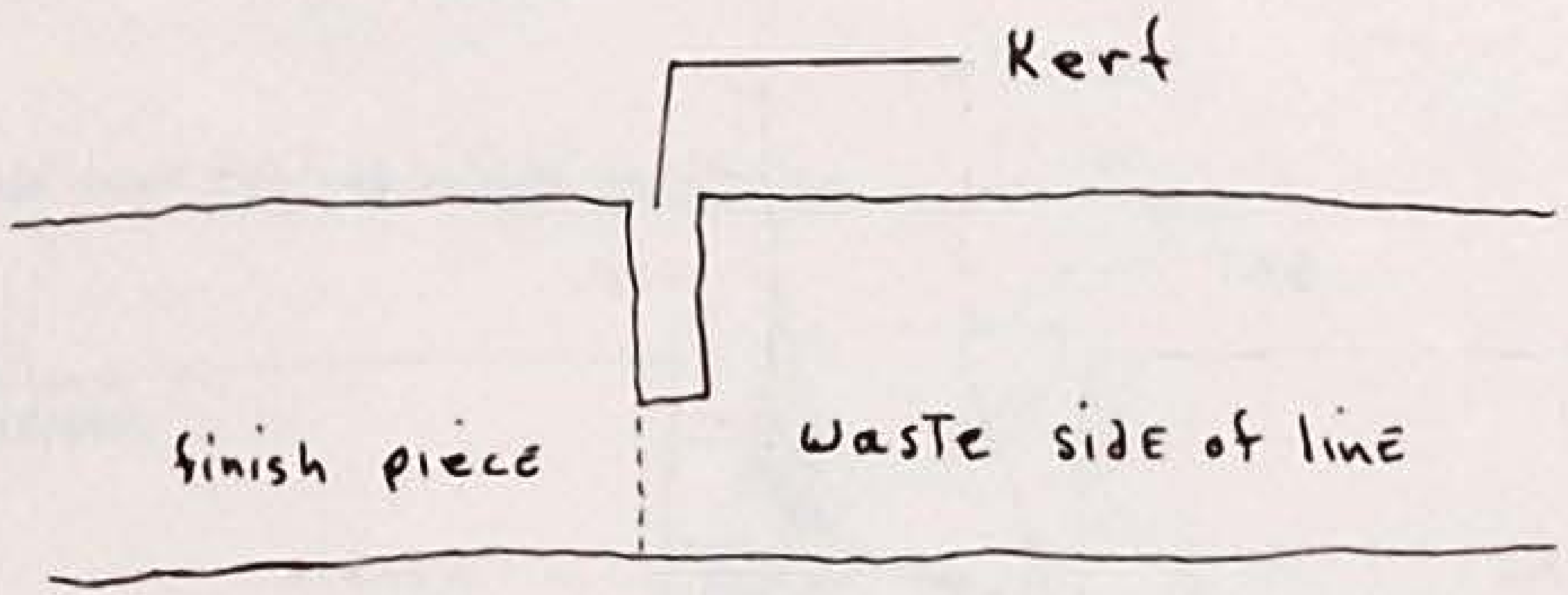


Fig. 8 - Waste side of Line

Laying Out The Cut

To make a line square across the board where you want to cut it, take a try square or combination square, hold the body tight against the edge of the board, lay the blade over the crow's foot so that your pencil mark will intersect the point of the crow's foot perfectly, and draw a line square across the board by running the pencil along the blade of the square. Fig. 8.

The cut should be made on the opposite side of the line from the piece you want to keep-- this is called the waste side of the line.

Starting The Cut

Holding the saw in one hand, place it on the wood on the waste side of the line. The other hand grips the finish part of the board near the line and the thumb of the non-sawing hand guides the blade. The thumb is kept above the board so there is no danger of sawing into it if the saw slips. To start the cut draw the saw towards you several times, guiding it with the thumb of the non-sawing hand until you have a 1/4"-1/2" kerf in the board. When the cut is started, move the non-sawing hand away from the cut and continue with long, even strokes holding the saw at a 45^{o} angle with the board. Don't apply too much pressure; use only enough to make the saw cut smoothly.

If the saw is not cutting smoothly but is catching and taking a lot of strength to move, then there is any of three things wrong. 1. The saw may be dull. 2. Something may be binding the saw blade. Make sure that the waste side of the board is hanging freely in the air. Sometimes when a co-worker offers to support it to keep it from falling, she may raise it too high, thereby causing the sides of the kerf to pinch the blade. 3. Also when the finish end of the board isn't being held steady enough, it can slide around causing the saw to drag along the sides of the kerf.

HAND DRILLS AND DRILLING

There are three types of hand drills: brace and bit, eggbeater drill and push drill. Fig. 10.

Using A Brace

Braces come in different sizes from 8-14 inches. An 8 or 10 inch brace is a good standard size. Braces take only bits with a square tang (the part of the shank that fits into the chuck of the brace). The bits are what do the drilling and the most common type to use with a brace is an auger bit. Fig. 11. Auger bits come in sizes from 1/4"-1" and adjustable expansive bits can be obtained that drill holes from 7/8"-3".

The feed screw of the bit determines how fast the bit goes into the wood. The feed screws vary in threads per inch. Bits are available in three speeds: fast, medium or slow boring. The fast boring bits have few threads per inch on their feed screw, while slow boring bits have many threads per inch on the feed screw.

The chuck of the brace has within it two or three jaws that tighten around the tang of the auger bit as the outer chuck shell is turned.

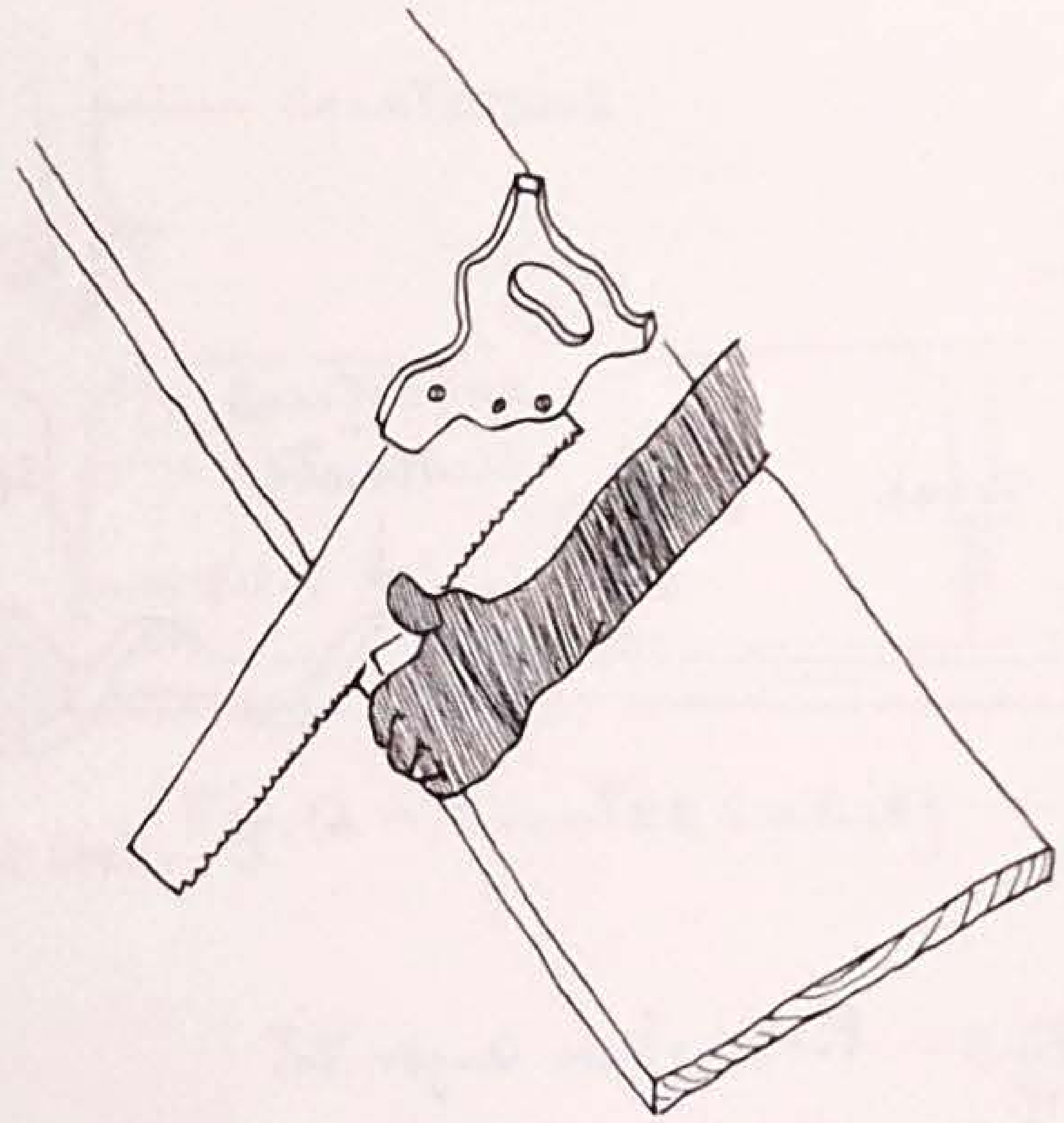


Fig. 9 – Starting the Cut

Brace & Bit

Tang

Chuck

Auger bit

Expansive Bits--See Doors: Fig. 11

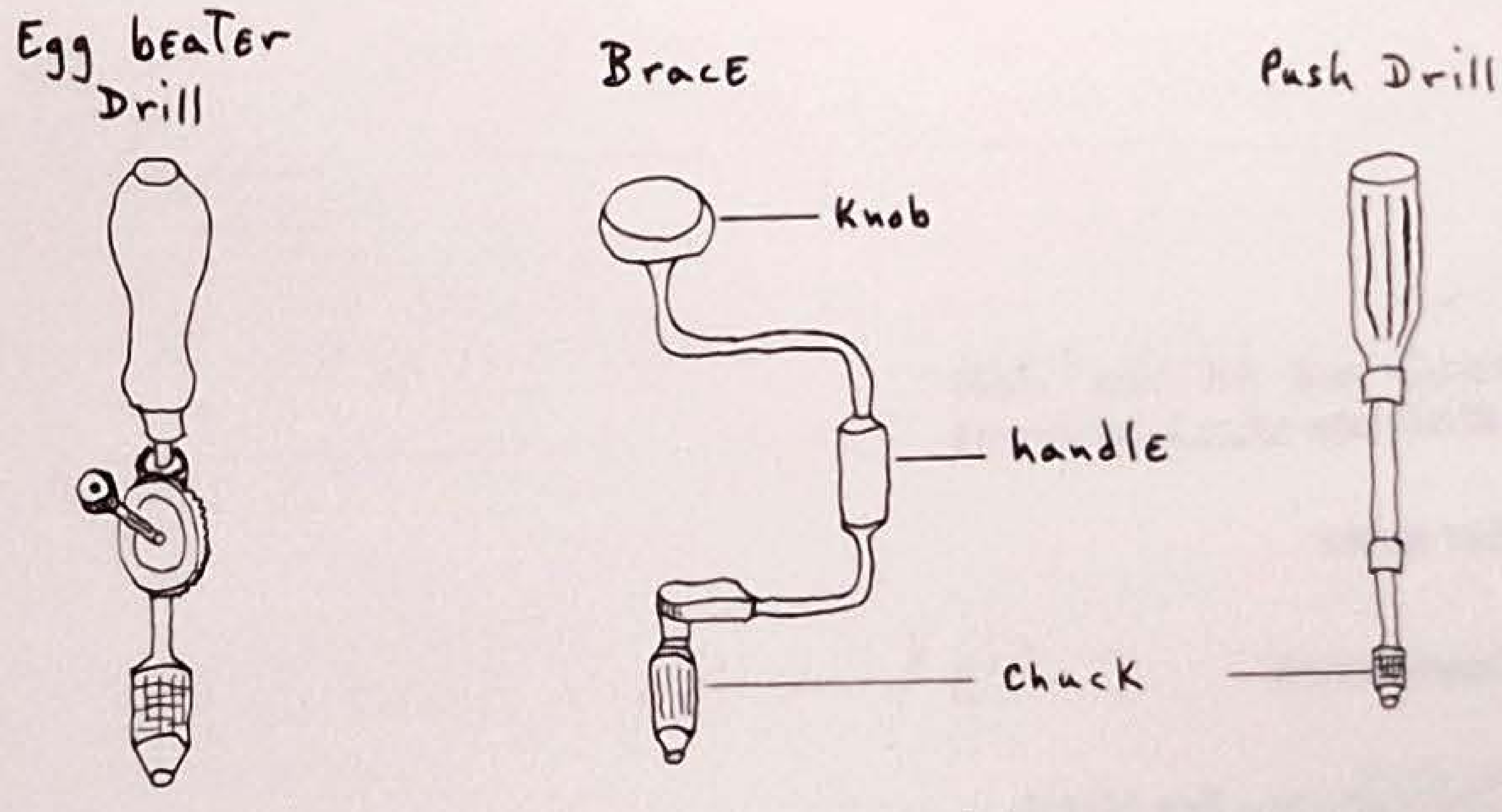


Fig. 10 – Three Drills

Layout--See Joining: Dowel Joints

Scratch awl

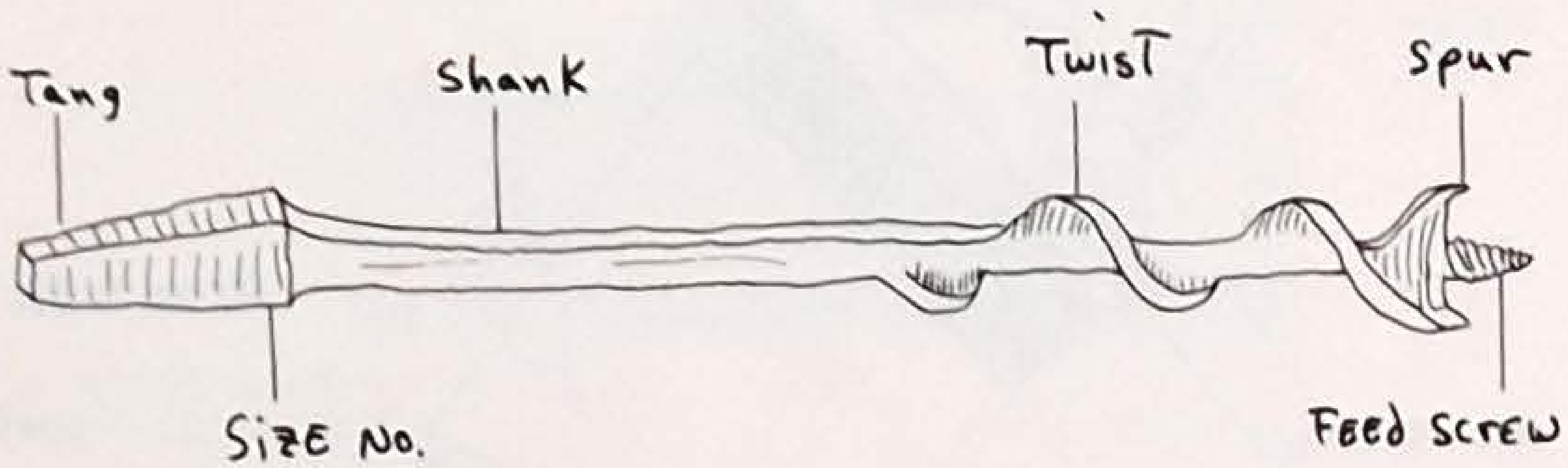


Fig. 11 - Parts of an auger bit

Ratchet

Set screw

Countersink

Countersink-- See Metal Fasteners & Glues: Figs 11 & 12

Laying Out The Hole

The center of each hole to be drilled should be indented with a nail or scratch awl before the hole is drilled. The feed screw of the bit is inserted into the punch mark at the center of the drill hole layout. The brace and bit are held upright while drilling so that the bit goes into the wood as perpendicularly as possible. When drilling, the palm of one hand is placed over the head of the brace while the other hand turns the handle. If more pressure is needed, bend over the work resting your sternum (breastbone) on the back of the hand that is holding the knob of the brace.

Some braces are equipped with ratchet action for drilling in tight places where a full swing of the handle is impossible. Ratchet is a mechanism that allows forceful turning in one direction only. When the handle is turned in the other direction the bit is not backed out.

If a blind hole of a certain depth (a hole that doesn't go completely through the wood) is to be drilled, then a marker must be put on the bit to show when the bit has drilled through the wood to the specified depth. Any kind of tape can be wrapped around the bit merely as a marker or if wrapped thick enough it can stop the bit from going further into the hole. Patented bit gauges are available that attach to the bit by means of a set screw and prevent the bit from drilling deeper than its location on the bit. Fig. 12.

Countersink bits are made for any type of drill. They are used, after the hole for the screw has been bored, to hollow cut a conical space so that the head of a flat or oval headed screw can fit flush with the wood surface. If the screw head is countersunk below the surface, a dowel or some putty can be applied over it to hide the screw completely. Usually when a dowel is used to cover a screw head, a drill bit the size of the dowel is used instead of a countersink. In this case the countersink hole is drilled first (1/4"-3/8" deep), the shank hole next, and finally the hole the size of the root diameter.

Preventing Splintering

When drilling through plywood or veneer wood with an auger bit, score the veneer completely through with the spur of the bit by turning the handle forward one half turn and then backwards one half turn--repeating until the bit has cut completely through the veneer. This will prevent the veneer from splintering.

Any kind of wood will split out on the back side as the bit comes through. A back up piece of scrap can be clamped to the backside of the board being drilled to prevent splintering. If this isn't possible, the hole can be bored from each side. The hole in the front side is drilled just deep enough for the feed screw to peek out through the other side of the wood. The wood is turned over and the hole is finished using the feed screw hole in the back side of the wood as a guide for the bit. This method of drilling from each side should be used when using a hole saw bit to cut the hole for the door knob and hardware in a door.

Push Drills And Egg Beater Drills

The egg beater and push drill both take straight shank drill bits which do not have a feed screw to determine the speed at which the bit is fed into

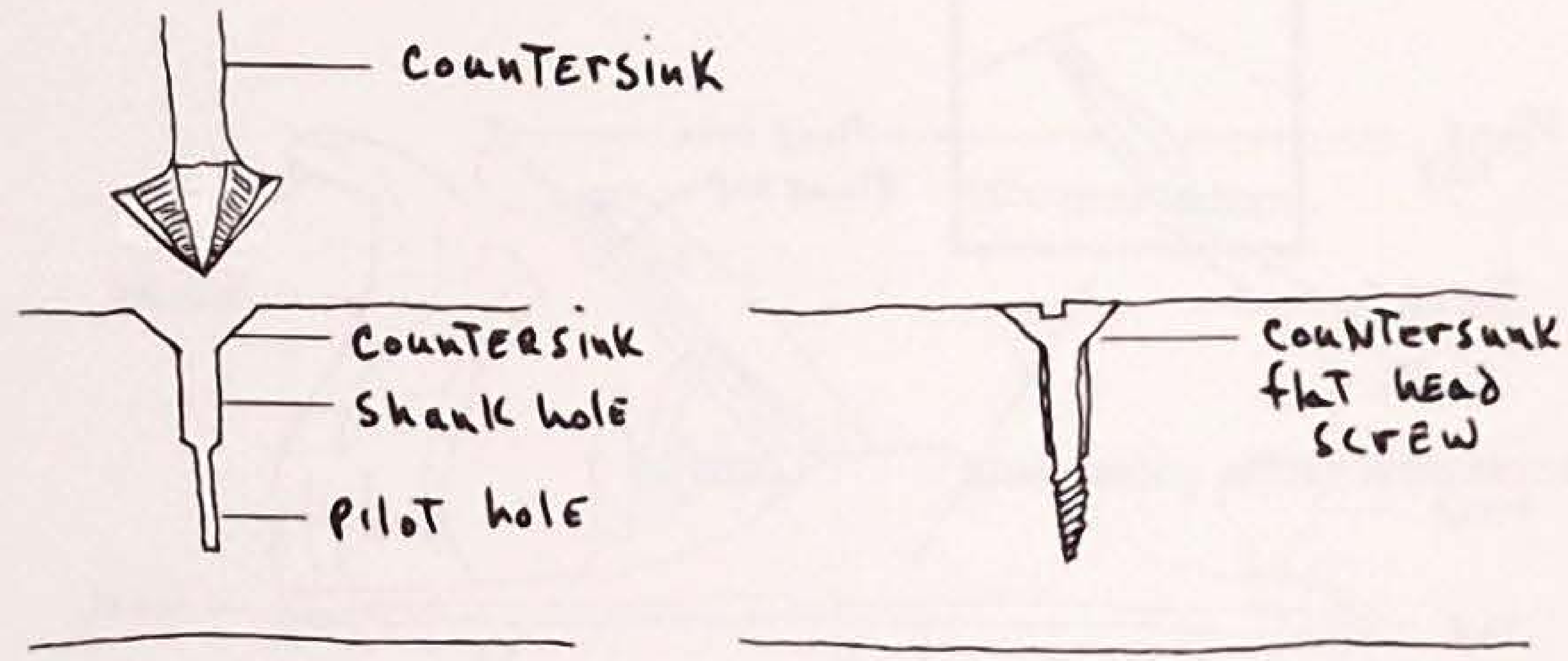


Fig. 12 - CounTersinking

Veneer

Hole saw bit--See Doors: Installing Locks and Strikes

Push drill

Egg beater drill

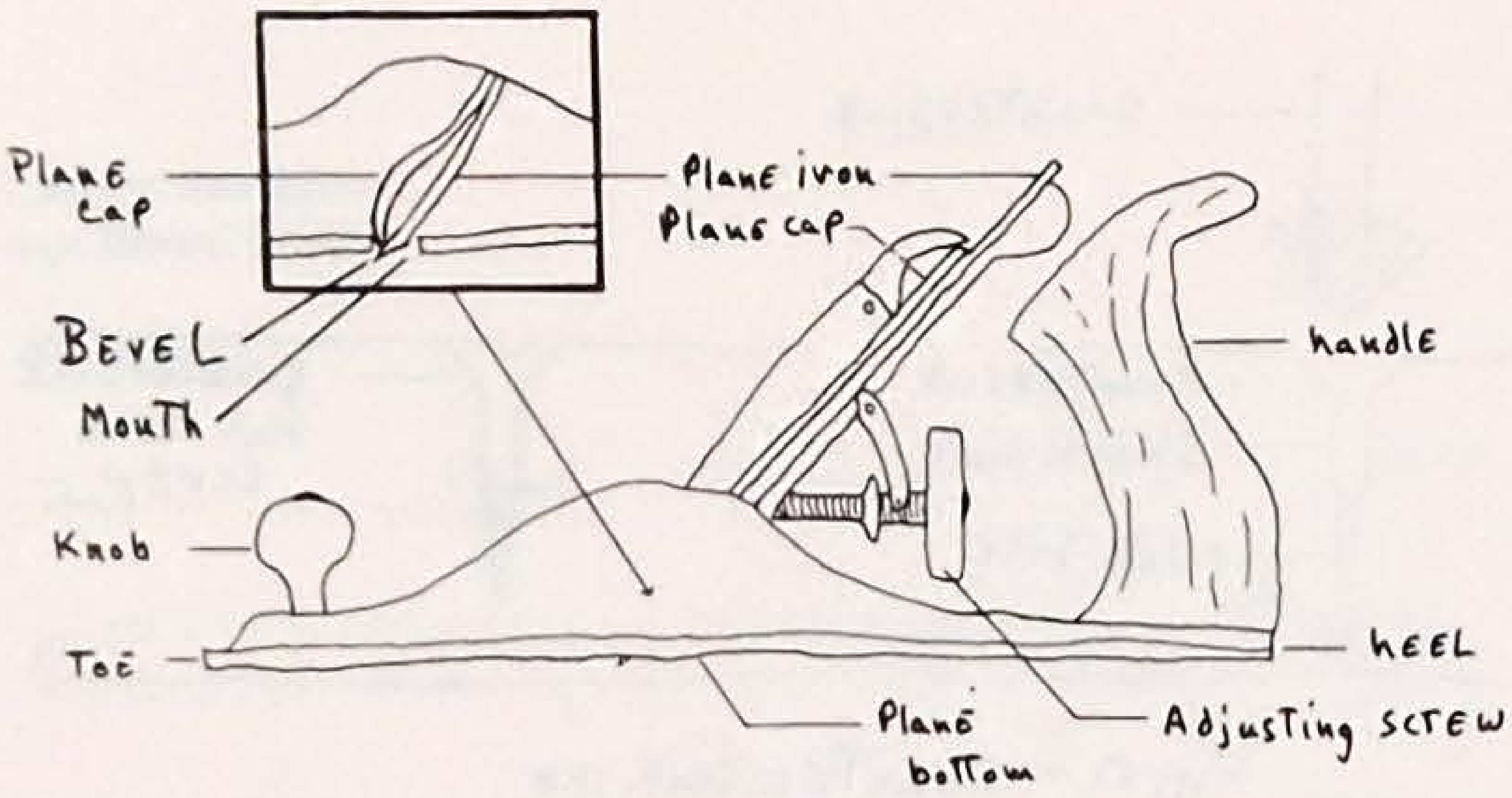


Fig. 13 - The Parts of a Plane

Rabbet plane

Rabbet plane-See Joining: Dado and Rabbet Joints

Block plane & end grain planing--See Joining: Butt Joints

the wood. Instead the pressure put on the drill determines the feed. The bits are rather blunt on the end so it is especially important to start the holes with an awl or a nail lest the bit slip and mar the wood surface.

The egg beater drill has a chuck like a brace which must be tightened around the bit. The push drill takes special bits which have notches that snap into the chuck. The egg beater drill must be operated with two hands; the push drill needs only one. Both drills are used for drilling small holes ¼" and smaller and are especially good for drilling holes for nails and screws.

PLANES AND PLANING

There are many different planes and planing operations. There are fillister planes for making ornate trim, router planes for smoothing the bottoms of dados, and rabbet planes for smoothing rabbet joints. These are the fancier planes that are used in cabinetmaking and joining. The planes that are commonly used in carpentry are the block plane and the jack plane.

Planing an edge until it is absolutely straight is a job for the jack plane--a 14" plane with a 2" cutter. The block plane can be used to help smooth an edge or a surface but the results will not be perfect because the length of the block plane is only 6" and will follow the crooked contour of the edge to some degree.

To plane the edge of a board or door, clamp it in a vise if you have one or hold it securely if you don't. When planing, the plane is moved along the wood with the grain. You may have to run the plane in both directions along the edge to determine which way the grain is going. If it is planing with the grain, the plane will slide smoothly taking even shavings. If it is planing against the grain, the plane will get caught in the grain and dig in too deeply taking rough shavings. To plane the other edge, turn the board end over end and plane in the same direction--this should place the grain in the right direction.

Adjust the depth of cut by turning the adjusting screw until the plane takes only a fine shaving (feathery light) when moved along the edge of the board. It is very important that the plane iron be sharp. If it is not, planing will be next to impossible. Take the plane iron out and sharpen it on a whetstone. Put some oil or water on the stone and place the plane iron bevel down on the whetstone. While holding the plane iron at an angle with the stone so that the bevel is flat against the surface of the stone, move the iron in small circles until the edge begins to get sharp. Do not sharpen the flat side of the plane iron. Chisels are sharpened in this same way--on their beveled side. After these tools have been sharpened in this way, burrs that form on the edge during sharpening can be honed off by placing the flat side of the tool flat against the whetstone and moving it in small circles.

Start the cut from the end of the board with only the front part of the plane under the knob contacting the wood. Hold one hand on the knob and the other on the handle and push the plane onto the edge keeping most of the pressure on the knob until the rest of the plane is also supported by the edge. Smoothly change to even pressure along the length of the plane and at the end of the cut finish with more pressure on the plane handle as the plane leaves the edge. Use a try

Sharpening with a whetstone

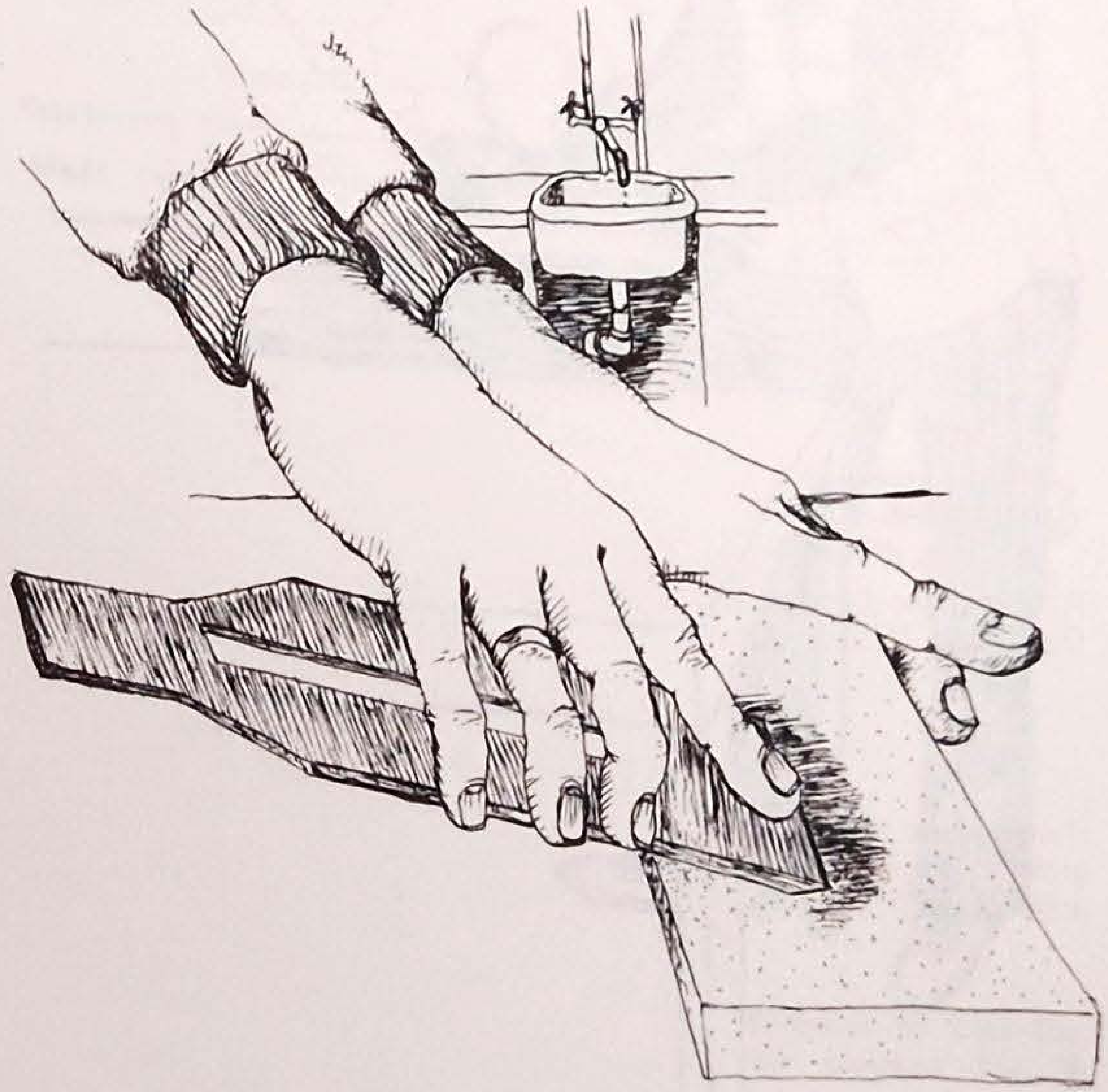


Fig. 14 - Sharpening with a whetstone

Checking squareness--
See Joining: Fig. 4

Fig. 15 - Using a PlanE

square to check the squareness of the edge as you plane.

POWER SAWS

Power saws are scary to use the first couple of times, but if you learn how to use them properly and respect their power, they won't hurt you. Always keep the telescoping blade guard working smoothly, never change the blade while the saw is plugged in and don't stand in water or let the cord of any electric tool lay in water while you are using it--if there is a break in the cord, the water will conduct the electricity and you will get a shock.

Changing Blades

To change the blade, unplug the saw, slide open the blade guard and push the teeth of the blade into a scrap piece of wood that is long enough for you to stand or kneel on to hold it steady. The wood will hold the blade stationary while you loosen the bolt at the center of the blade. Make sure you put the new blade on with the rotation going in the right direction. The rotation is marked on the guard of the saw and on most blades with arrows indicating the direction the blade should be turning. The arrows on the saw guard and on the blade should be pointing in the same direction when the blade is put on correctly. If there is no arrow on the blade, remember circular saw blades should always have the tips of the teeth pointing toward the front of the saw because the saw's rotation is counterclockwise as you look at the blade--the teeth first contact the under-side of the board being cut. Fig. 16.

Circular saws have adjustments for depth of cut so that you can cut anything from ¼" plywood to a 2x4. These saws also can cut at different angles up to 45°. There is a knob and a bevel scale that adjust the saw for angle cutting. These knobs are located at different places on different saws so fiddle around with the knobs and wing-nuts on the saw you are going to use until you know how to adjust it. The depth adjustment is set correctly when approximately ¼" of the blade protrudes beneath the wood as you are sawing.

Operation

After measuring the board and marking a line square across it with the try square (or combination square), hold the power saw so that the table is flat on the board--the blade should not be touching the board. Start the saw by pulling the trigger (and simultaneously pressing the safety catch button if there is one) while the blade is still away from the wood. When the blade is turning at full speed, line it up with the mark and move the saw evenly through the wood. There are sights on most saws, but they are usually inaccurate. I find it better to watch the blade as I saw to make sure it is following the line. If the saw is started with the blade in contact with the wood, the blade will either catch in the wood and not begin turning or it will rip and mar the wood. The cut should be made so that the kerf is on the waste side of the line.

While sawing there is a certain small amount that the saw can be maneuvered left and right along the line, but if the blade is turned too much, the sides of the kerf will pinch the blade

Bevel

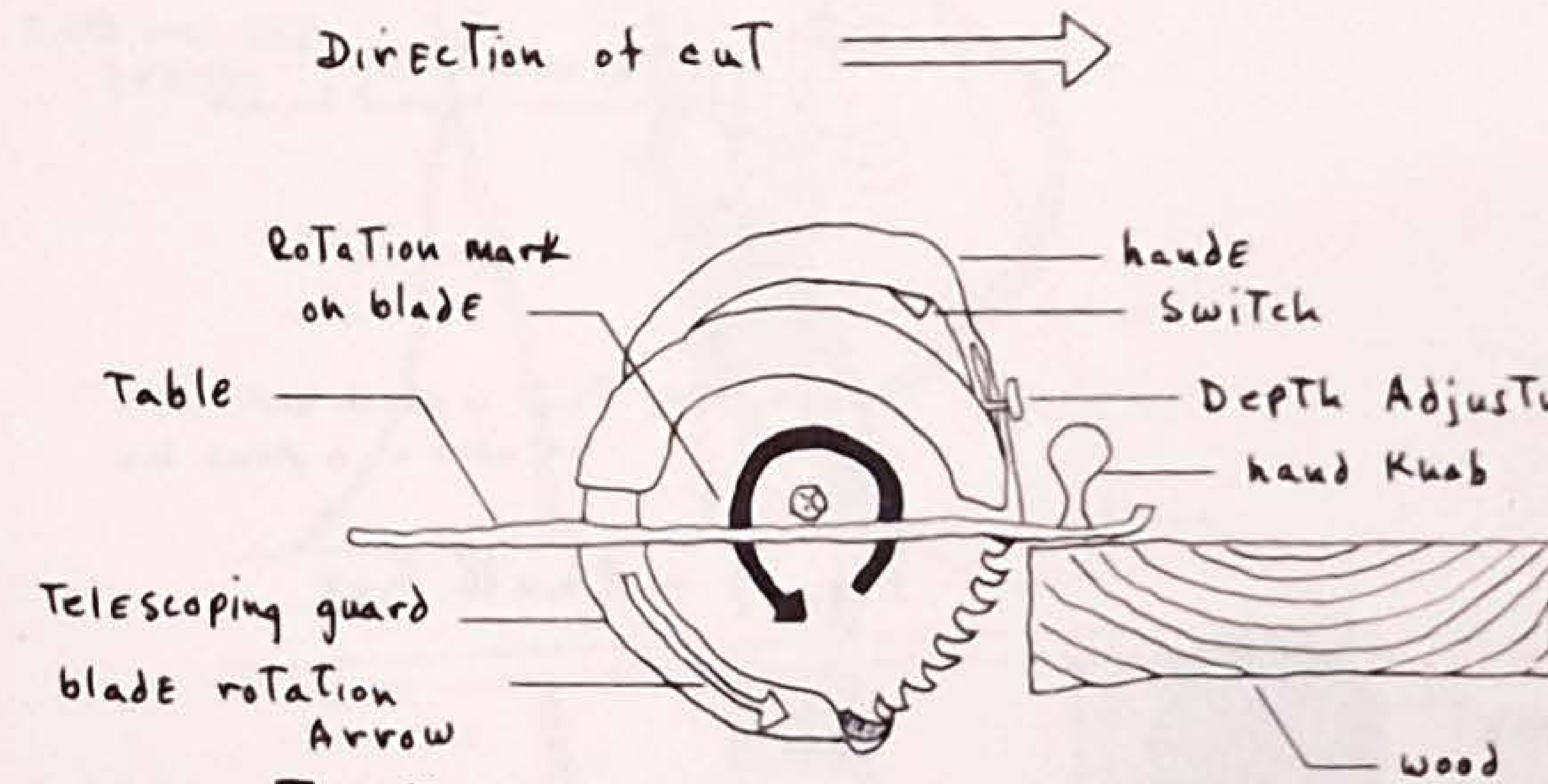


Fig. 16 - Correct Position for beginning a saw cut

Combination & try square–See Joining: Figs. 4 & 26

Wasteside of Line–See this chapter: Fig. 8

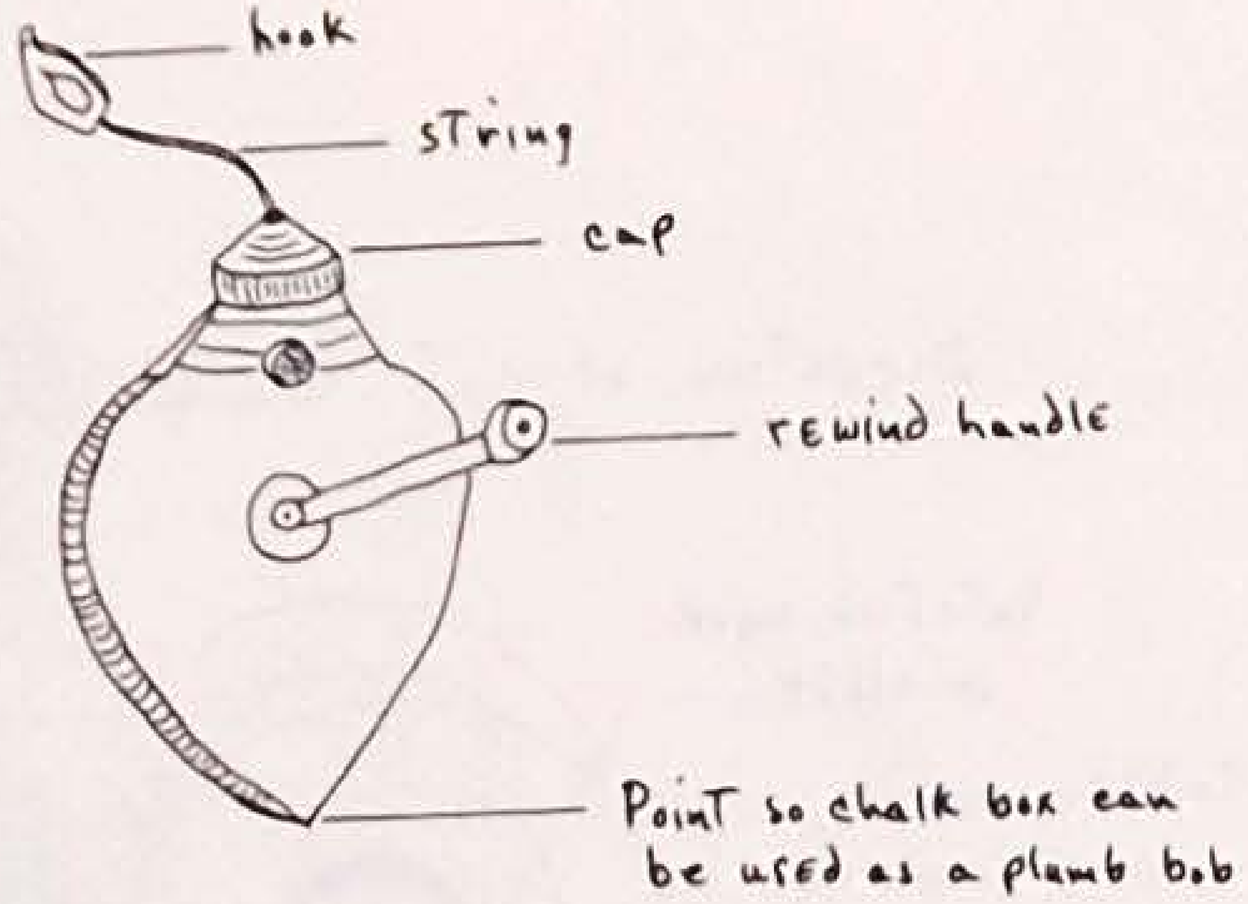


Fig. 17 - Chalk box

Chalk box

Fig. 18 - Snapping a Chalk Line

and the saw will bind and become impossible to push forward. You will be fighting your work. A saw operates in the space it has cut out for itself--the kerf. If you want to change the direction of the cut, then you must let the saw cut out another space to operate in. If you are cutting and the saw has gotten off the line too far to maneuver it within the kerf, back it up a little (with the blade still turning) and start forward again, this time cutting closer to the line.

CHALK LINE

A chalk box is a tool that evolved from a piece of string that was rubbed on colored cake chalk and then snapped on surfaces between two marks to make long straight lines. Nowadays the line is wound by a reel into a container filled with powdered chalk and is called a chalk line or box. It is useful for making straight lines on any kind of surface and is essential in marking sheet material for cutting. To use it with sheets such as plywood first measure along each edge the specified length and make a mark. Stretch a chalk line between the two marks and while holding the ends securely (this is sometimes a two person job) lift the middle of the string 3"-6" straight up above the wood and let it go. As the line snaps against the plywood it will leave a colored line across the entire sheet. Chalk lines usually come with a hook on the end of the string so that the tool can be used by only one person. The hook is placed over the edge of the sheet at one mark and you hold the other end of the string over the other mark and snap the line with your free hand. Fig. 18.

THE HIGH SPEED ELECTRIC DRILL

Electric drills are the cheapest power tool one can buy. An adequately made drill with only one forward speed can cost under $10. However, there are drills with forward and reverse and even fancier ones that have variable speeds so that when you press the trigger a little, the drill goes slowly and when it is pressed harder, it goes faster. Most drills have only one speed and a trigger which is a less complicated on/off switch. Having reverse is useful if you want to put a screwdriver bit in the drill and use it as a screwdriver--with reverse you can remove screws. The best drill for use as a screwdriver is the variable speed drill because it allows you to start the screw slowly. The on/off drills will usually strip out the head of the screw.

There is a tool that looks like an electric drill with a long nose called a screw gun. It usually has only an on/off switch and has limited uses in wood. It is made more for screwing into metal or, for example, screwing sheetrock to studs.

The best kind of drill to get, if you're a carpenter, that does a lot of varied work, is a 3/8" chuck, variable speed drill with a top rpm of around 2,000. A 1/4" chuck is satisfactory, but there are a lot of bits that won't fit into it. The chuck of the drill is the part that holds the bit. A 1/4" chuck means that only bits with shanks that measure up to 1/4" in diameter will fit into that drill. A 3/8" chuck holds shanks up to 3/8". There are also 1/2" chucks, but these are in heavy duty drills.

Two kinds of bits are most commonly used in electric drills: the high speed bit and the paddle bit. Paddle bits can only drill into wood. High

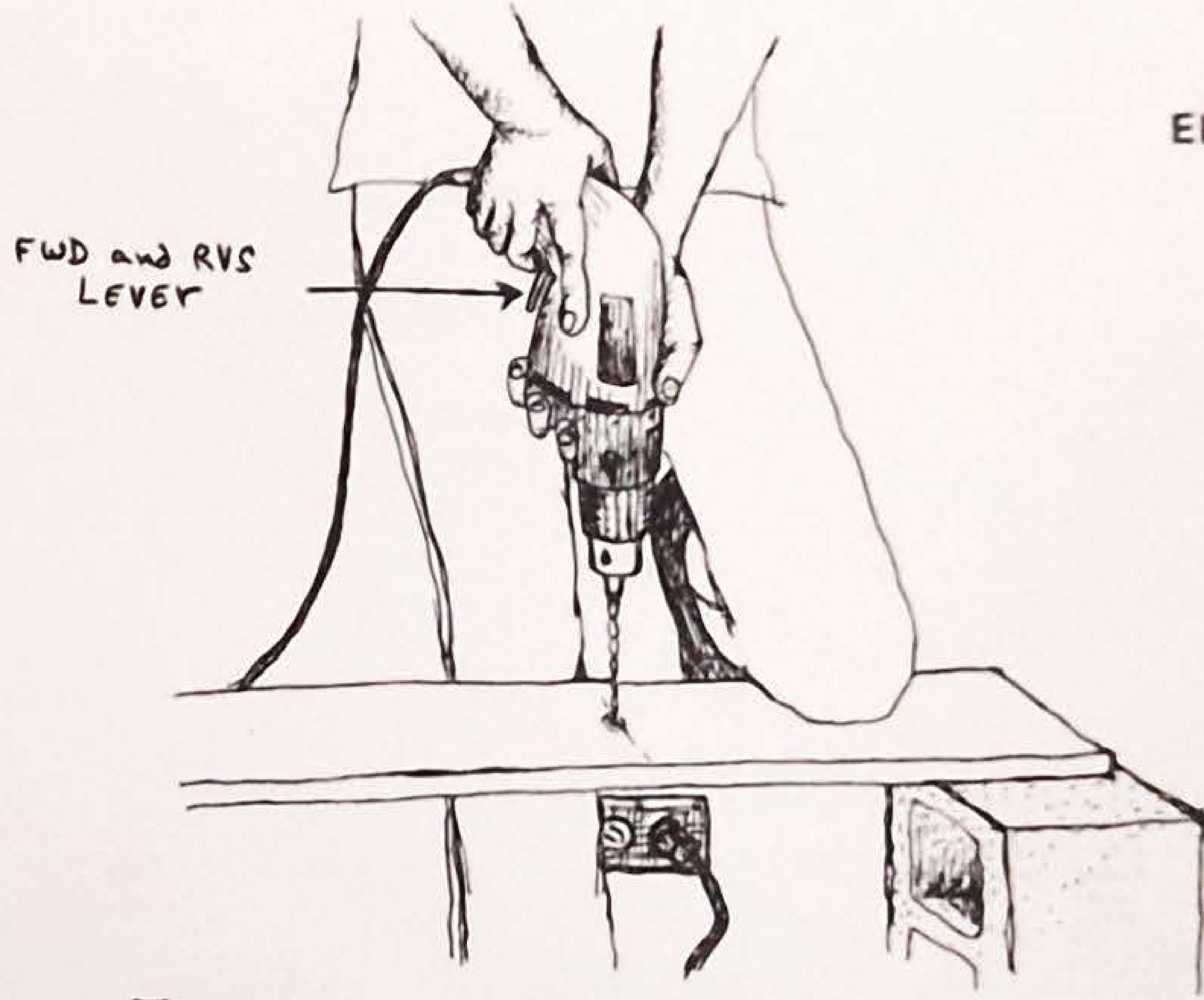


Fig. 19 - An Electric Drill with hands in Correct position

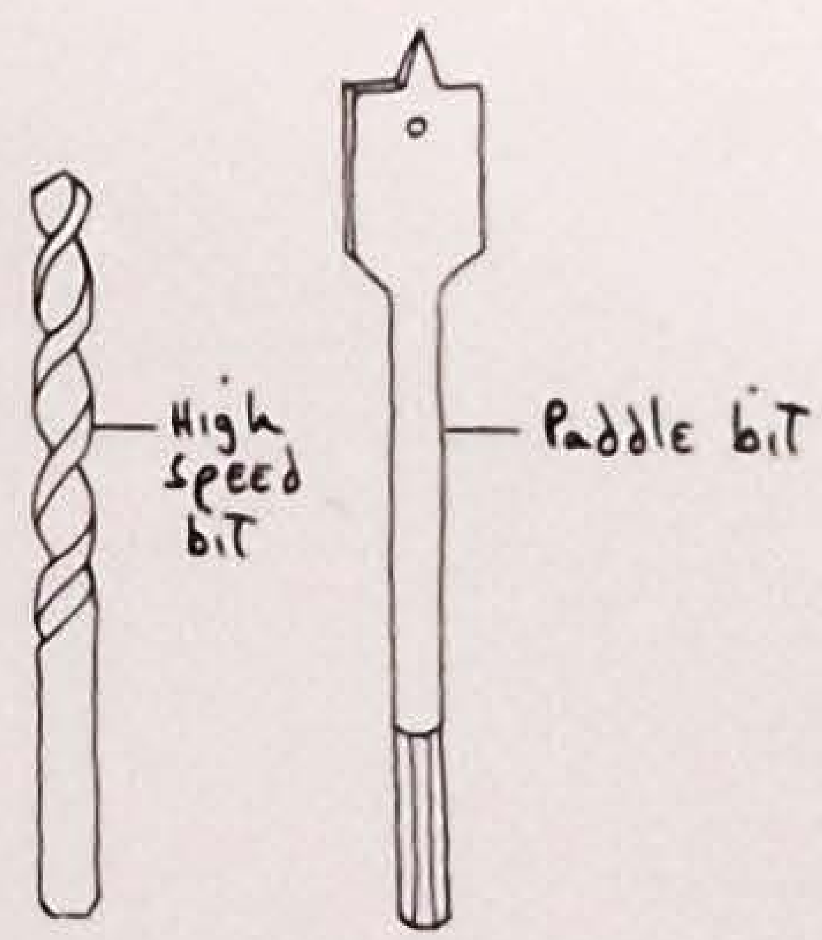


Fig. 20 - Bits for High Speed Drills

Electric drill

Screw gun

RPM
Chuck

Paddle bit
High speed bit

speed bits drill into either wood or metal. A drill with an rpm of 1000 is fine for drilling into wood, but for drilling into metal the rpm should be above 2000.

Pilot Holes

Pilot hole

When drilling into hard wood, metal or finish material, make an indentation with a punch or a nail over the center mark of the hole to be drilled. This will keep the drill from slipping when it starts. If a sizeable hole must be drilled in metal (5/16" or more), first drill a smaller pilot hole (1/8"-1/4") and then drill into that with the bigger bit. It will take forever if you try to drill all that metal out with the large bit; the bit will overheat and become dull.

Drilling Safely

It is important to have a firm grip on an electric drill. Some bits have a tendency--especially when drilling through metal or in wood with a paddle bit--to catch and stop abruptly. When this happens, the drill will whirl around the bit and if you don't have a good hold on the drill, it will jerk and hurt your hand. Hold the drill with both hands: one on the handle and the other on the casing below the chuck. The bit will catch only if it's out of line with the hole so keeping the drill straight and drilling smoothly are good preventative measures.

CHISELS AND CHISELING

The use of a chisel is explained in Joints: Dado and in Doors: Hinge pockets.

LEVELS, LEVELING AND PLUMBING

The use of levels and plumb bobs is explained in Walls: Plumb and Plumbing.

NAIL SET

Nail sets and their use are explained in Walls: Paneling.

WATER LEVEL

The principles behind water levels, how to make them and how to use them are explained in Concrete: Water Levels.

SCRIBES AND SCRIBING

A scribe, which looks somewhat like a compass, and how to use it are explained in Stairs: Scribing.

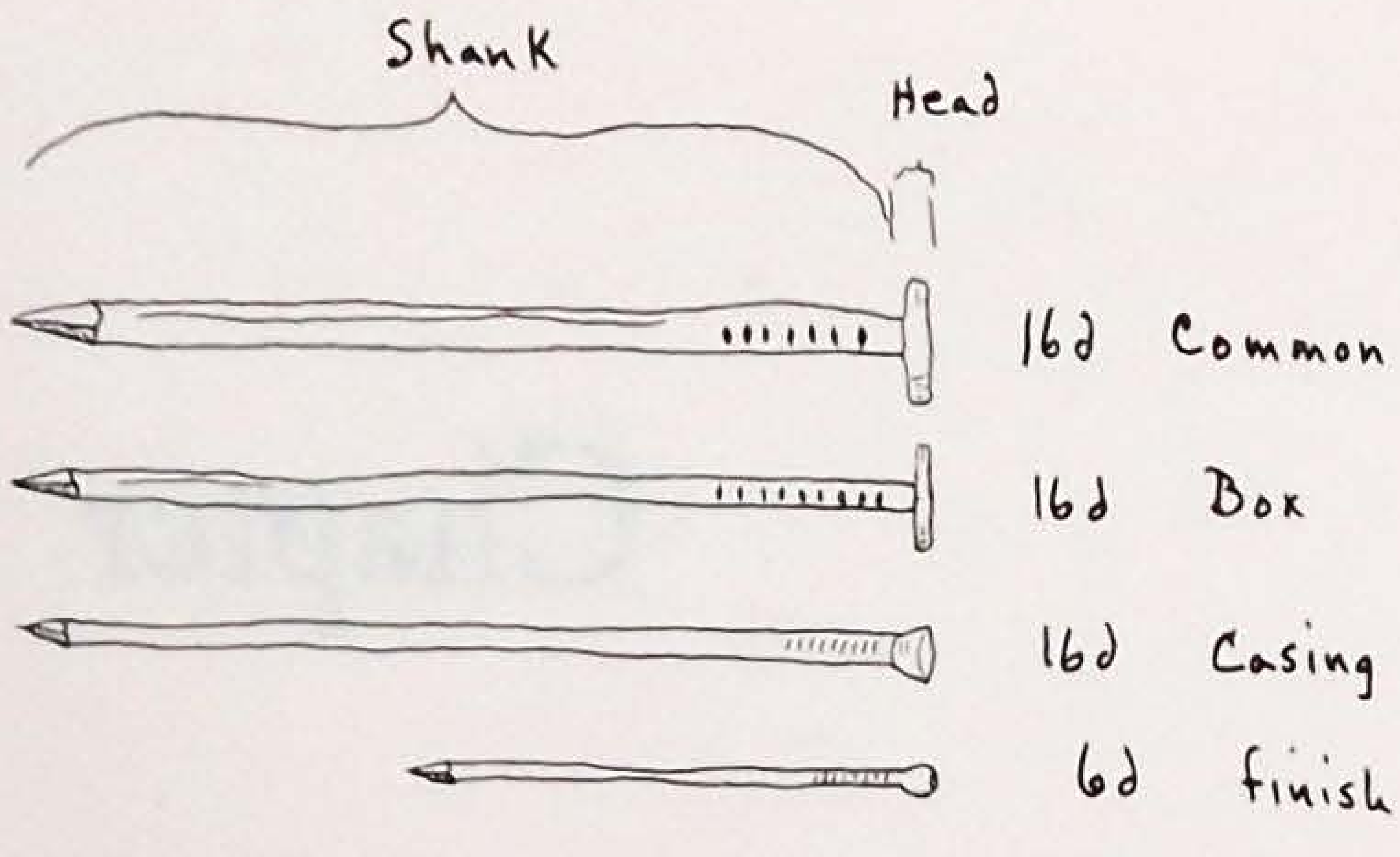


Fig. 1 — Four Types of Nails

Gauge

Finish Nails

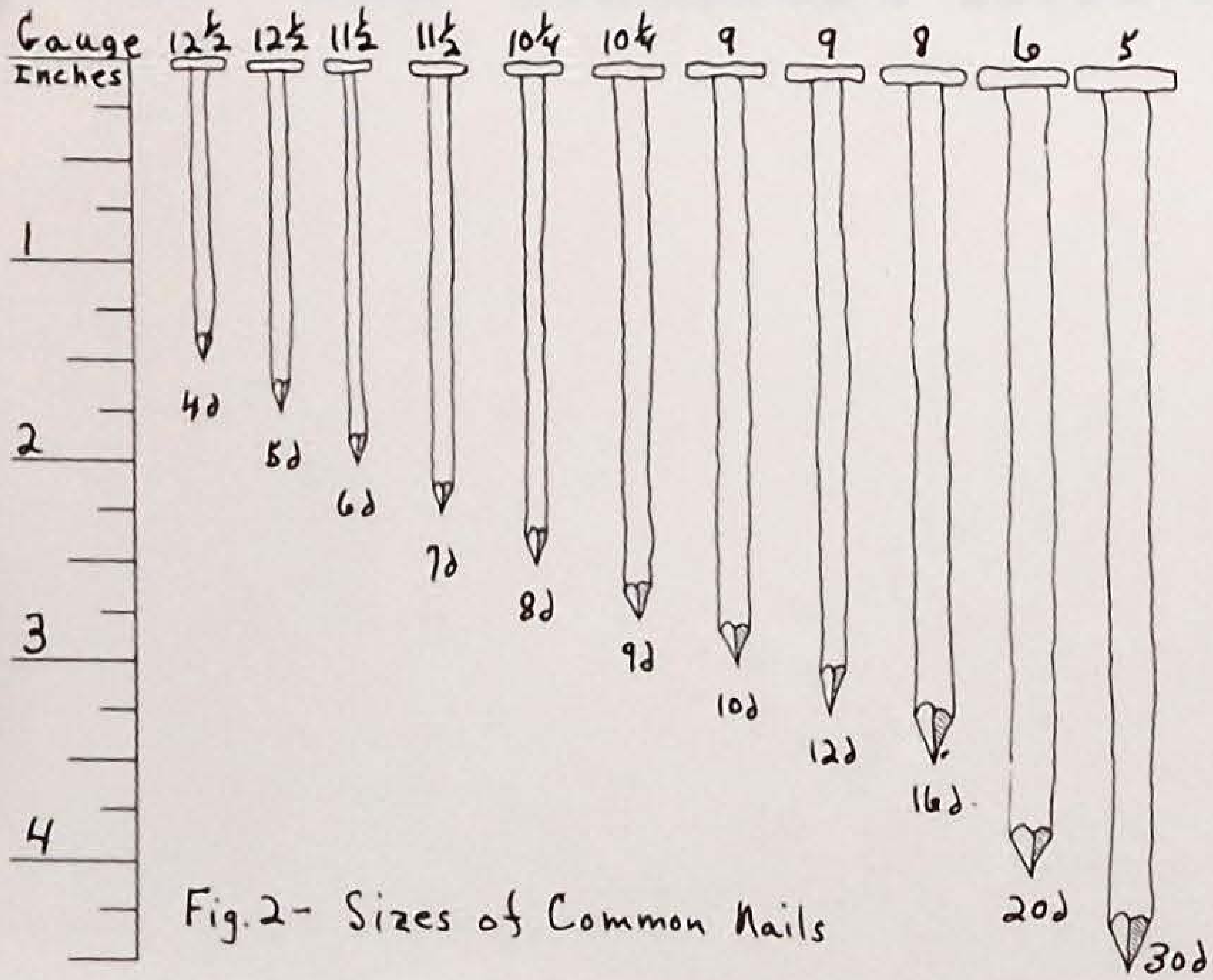


Fig. 2 - Sizes of Common Nails

NAILS

There are four basic types of nails: common, box, casing, and finish.

Common nails are used in rough carpentry work and framing houses. They have a thicker shank than other nails and are generally heavier because of the extra strength required of them.

Box nails get their name from their original use in boxes and crates. Their shanks are of a lighter gauge steel than common nails and they are not as strong. Gauge is a number assigned to nails and wire that reflects the thickness of the shank. A low number such as 9 is the gauge of a 10d nail. A high number like 12½ is the gauge of a 4d nail. The lower the gauge number, the thicker the wire or nail. Box nails are used when strength is not a major consideration and where there is a possibility of the wood splitting from a thicker shanked nail.

Casing nails are the same weight and gauge as box nails but they have a conical head. They are used in finish work: door and window casings and interior and exterior trim.

Finish nails have the smallest shank and head of any nail. They are used in interior finish carpentry and a variety of small construction work.

Penny

Nails are described by a number, followed by a small letter "d". The "d" is the abbreviation of a nail size unit called the penny. The "d" is pronounced "penny" when speaking. As the penny number gets larger, the nail thickness and length get larger also. Fig. 2.

Shank

Nails can either have plain, helically ringed, annularly ringed, or cement or rosin coated shanks. Plain shanked nails are held in the wood by friction. Helically ringed nails turn as they are driven. The grooves in the nail compress the wood fibers into threads that hold the nail almost as tightly as a screw. As annular ringed nails are driven into wood, the nail gets locked into the wood fibers. The shoulders of the rings are like barbs that go in easily but cannot be pulled out. Cement or rosin coated nails are covered by an adhesive film that acts as a lubricant when the nail is being driven, but results in a strong bond between nail and wood after the nail is in.

> *Coating or threading increases the holding power of a nail three or four times over that of a smooth shank nail.*

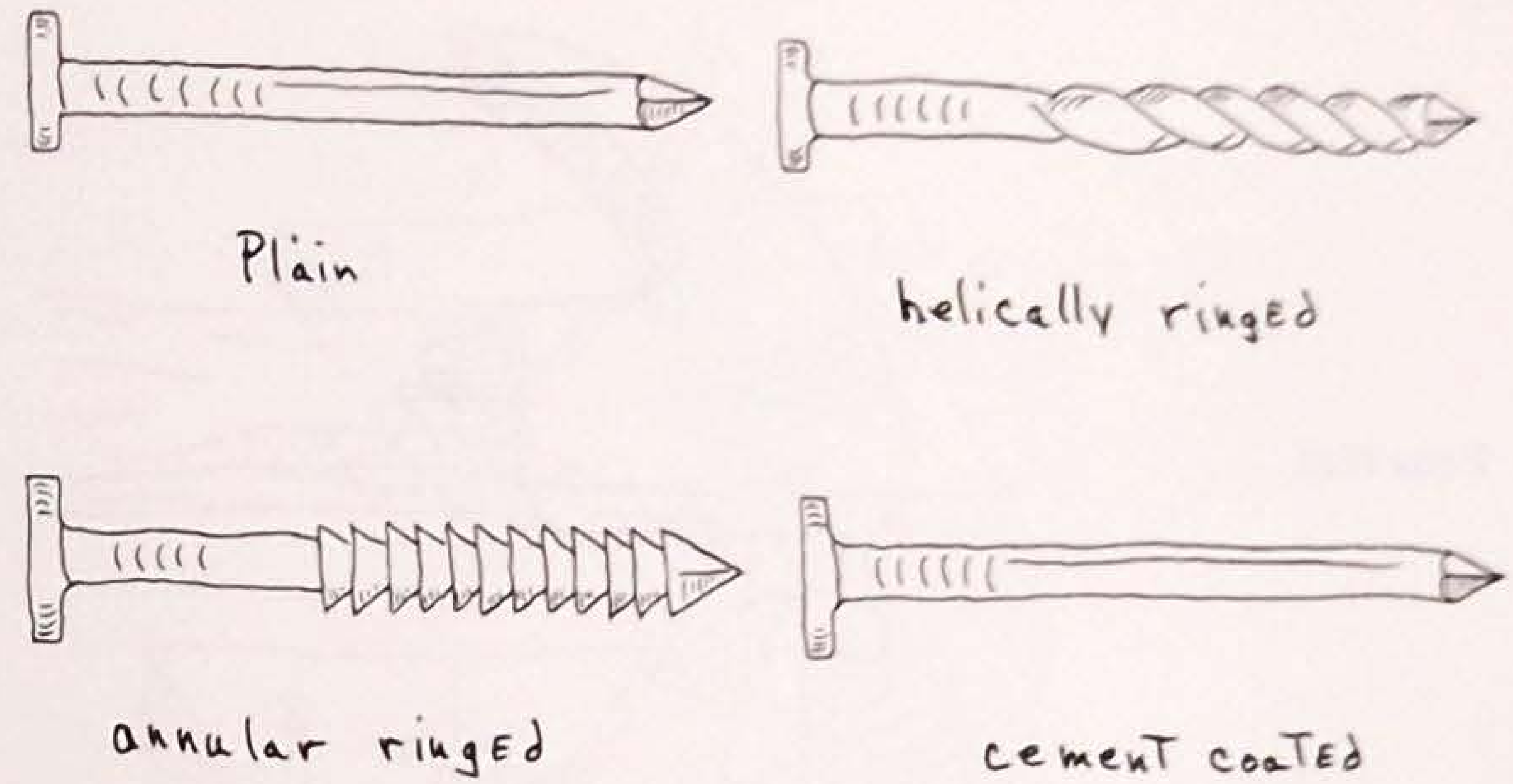
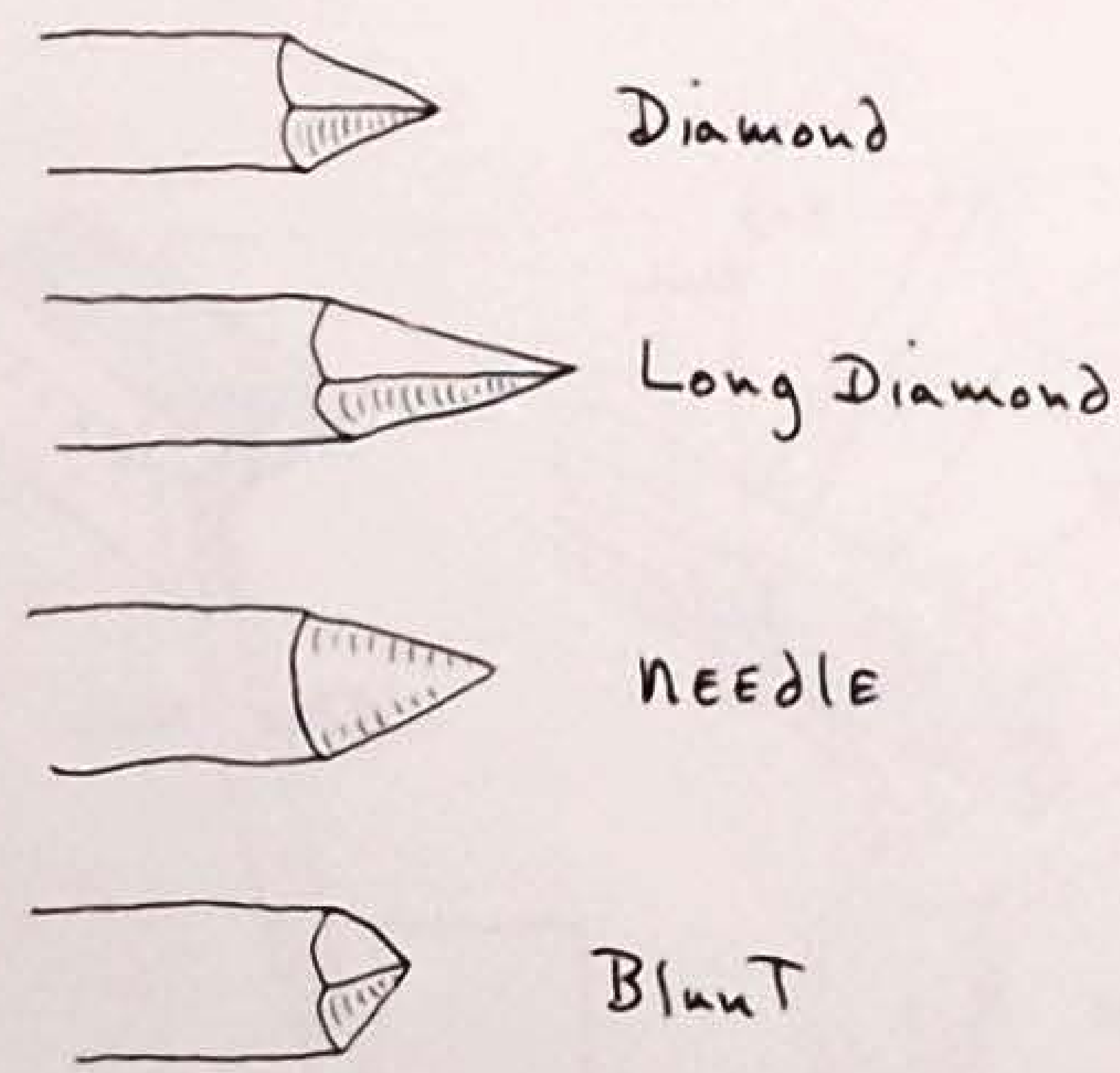


Fig. 3 - Four Types of Nail Shank

Point

Most nails have regular diamond points. The gradual taper of this point allows the nail to enter the less dense woods without splitting them. The long diamond and needle point allow the nail to be driven fast without too much effort and set easily. Nails with blunt points should be used in dense woods such as oak and the other hardwoods because a blunt point will not split the wood. Sharp points cause the wood fibers to spread and therefore to split, but blunt points pierce the fibers instead of spreading them. Sharp pointed nails can be blunted by resting their heads on a



Nail set--See Walls: Paneling

Preventing wood From splitting

Fig. 4 - Four Kinds of Nail Point

Face Nail

End Nail

Edge Nail
Toenail

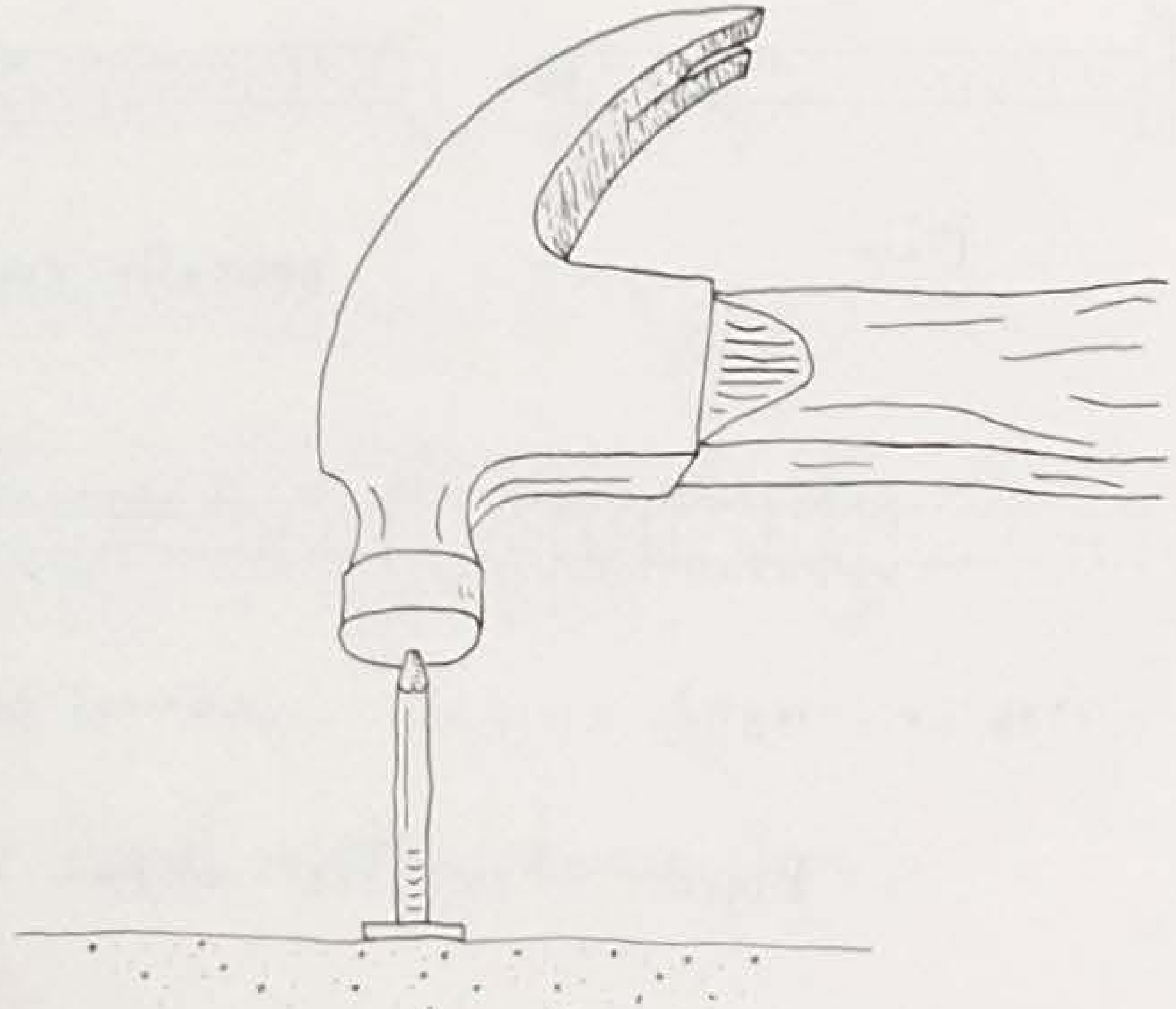


Fig. 5 - Blunting A Nail

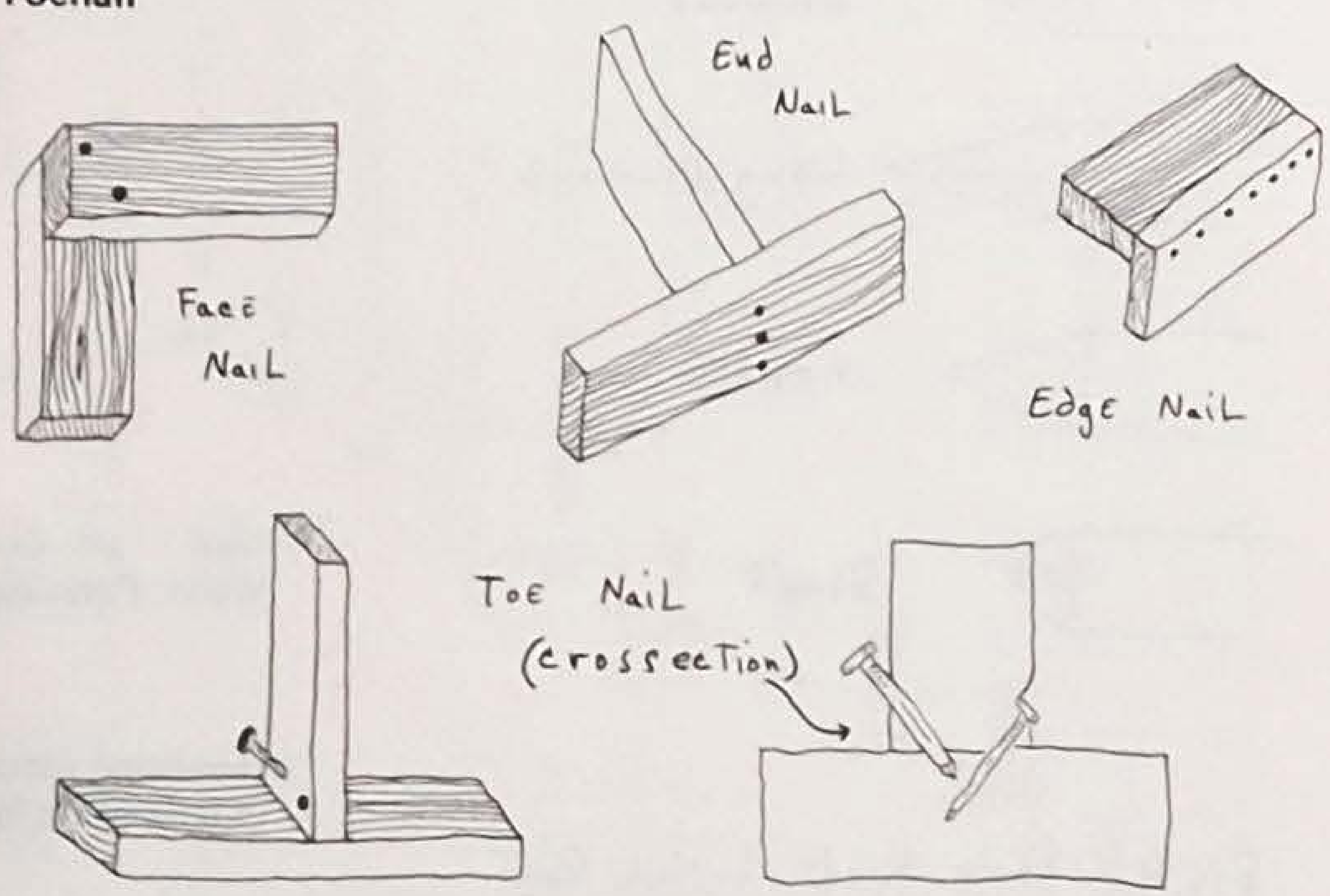


Fig 6. - The Four Ways of Nailing

firm surface and hitting the point with a hammer. This is a good habit to get into whenever there is danger of wood splitting. Fig. 5.

Face Nail/Toenail/End Nail/Edge Nail

Face Nail: Face nailing is when the width dimensions or faces of two boards are nailed together and the nail is fairly perpendicular to the surface of the wood. Do not nail less than 1/2" from the edge and stagger the nails in the wood as in Fig. 6. If the nails are driven into the same grain line, there is a good chance of the wood splitting.

End Nail: End nailing is when a nail is driven through the face of one board and into the end of another. Bottom and top plates are end nailed to the studs.

Edge Nail: When a nail is driven through the face of one board into the edge of another, it is edge nailing.

Toenail: Toenailing is when a nail is driven at an angle to both boards being fastened together. Studs are sometimes toenailed to the bottom plate. The board the toenail is started into has a tendency to move as the nail is hammered in because angular force is being applied. The board can be braced firmly with one of the nailer's feet or a smaller nail (6d or 8d) can be toenailed first to hold the board in place while the larger nail is toenailed.

Pulling Nails

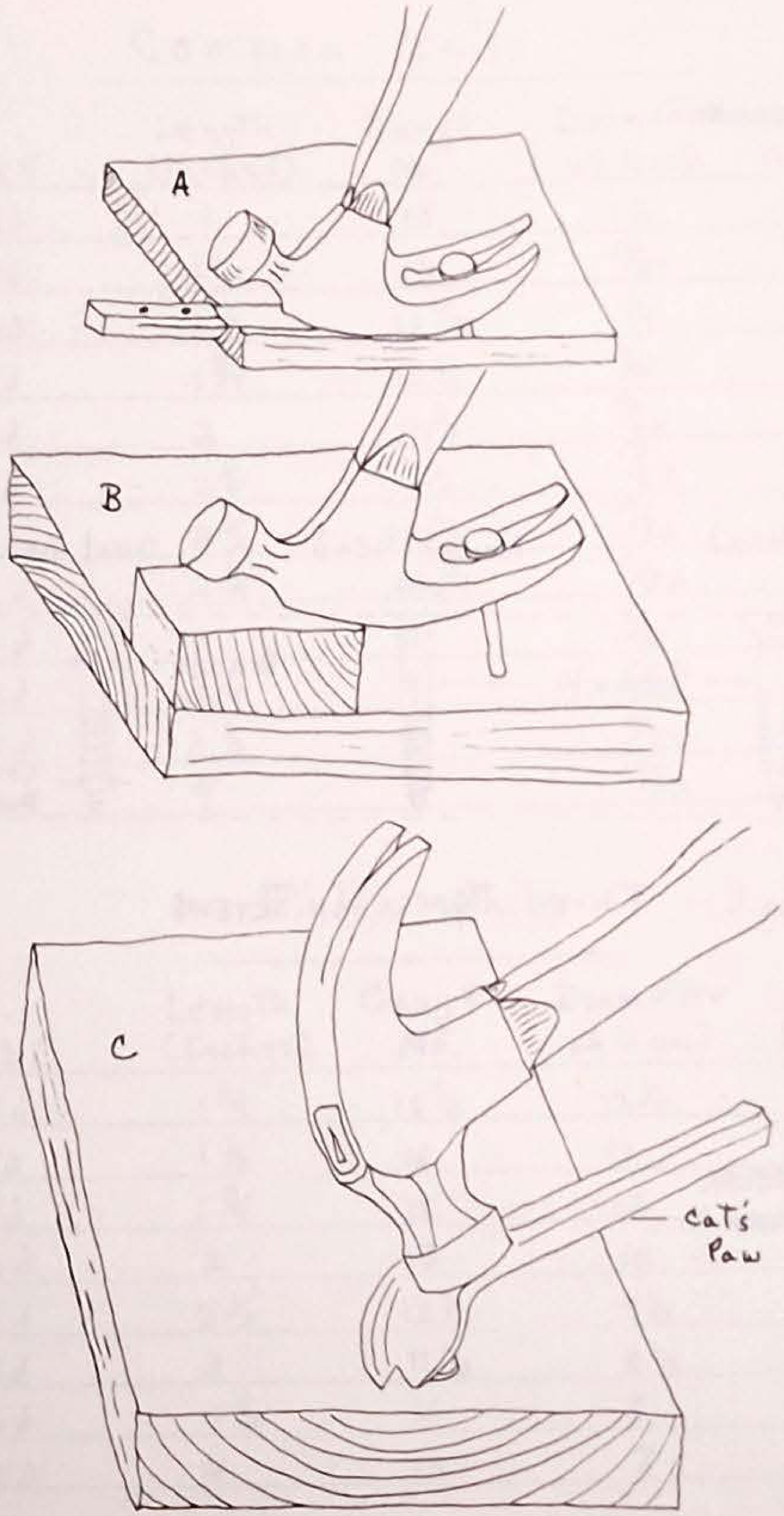
Pulling nails can be easy or extremely difficult depending on the nail that is being pulled, its location and your technique. New, smooth shanked nails are the easiest to pull. Threaded or coated nails can be almost impossible to get out.

Pulling nails is hard work so get yourself set with as much leverage working for you as possible. Stand on or brace the piece of wood that the nail is in so that it will not move when force is applied to pull the nail. If pulling the nail is likely to damage the piece of wood, place a putty knife or thin piece of wood under the hammer head to keep it from digging into the wood. Fig. 7A. If the nail is sticking out of the wood 3/4"-1", the hammer claw will only bend the nail, not pull it. Place a block of wood near the nail (fig. 7B) to bring the hammer claw up to a level where its leverage will do some good in pulling the nail. If the nail head is flush with the surface of the wood and the claw of the hammer won't fit under it, a cat's paw or nail puller is the tool to use. Place the claw of the cat's paw next to the head of the nail and hit it with a hammer (Fig. 7C) driving the claw under the nail head. Use the cat's paw like the claw of a hammer and pull the nail partially out of the wood. The head should be high enough now to get the claw of the hammer under it.

Nails And Nailing Patterns

There are many, many different kinds of nails. Fig. 8 shows just a few.

A nailing pattern is the number and spacing of nails required to hold different types of wood together in different parts of construction. Fig. 9 is a recommended nailing schedule showing the number of nails, the size, and the type of nailing used in construction.



Cat's paw

Fig. 7 – Pulling Nails

Framing member

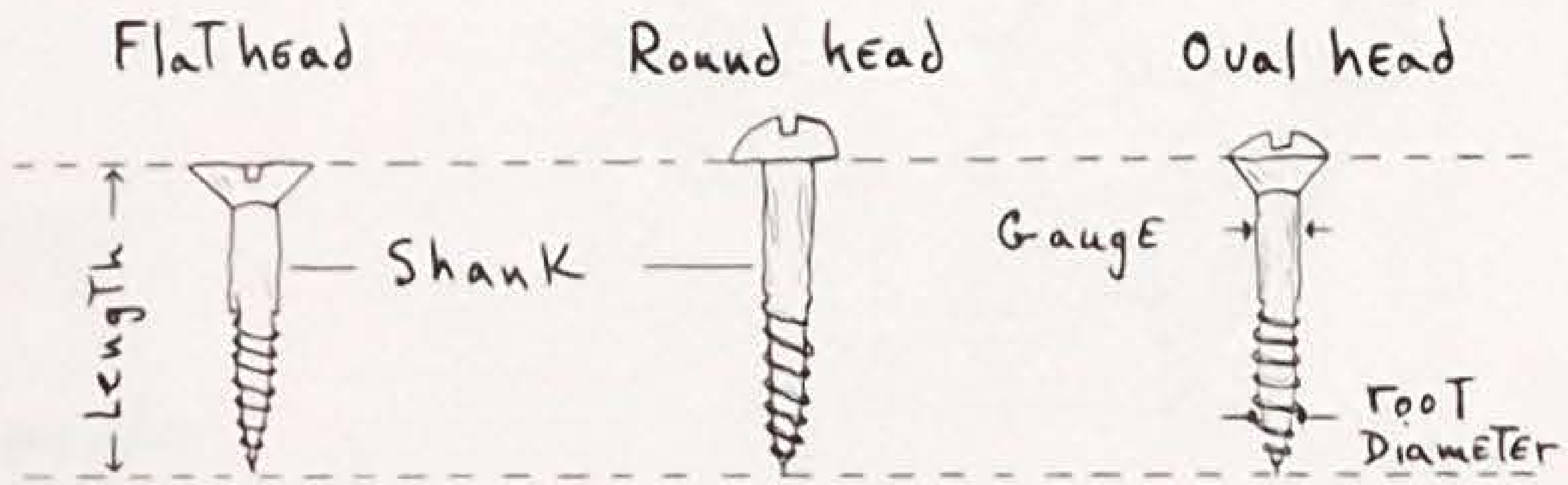


Fig.11 – Three Types of Screws

Nailing schedule,
Fig.9–See App. II

> *Nails should not be closer together than one half their length nor closer to the edge of a framing member than one quarter their length.*

WOOD SCREWS

There are three types of wood screws: flat, oval, and round head. Flat head screws are used in most ordinary construction and are specified as F.H.B. (flathead bright) in blueprints and plans. If screws are going to show in finish work, they should be brass, nickel or chrome plated and be round or oval headed.

Screws come in lengths from 1/4"-6". The diameter of the shank of the screw is described by a gauge number. Screws have a different gauging system than nails: as the gauge number goes up, the shank diameter becomes larger. Each length screw is available in many different gauge numbers When referring to screws by their gauge number, it is common practice to say "number 10 screw". 10 is the gauge number. Screws are completely described in the following fashion:

```
5        -  1¼"  x  no. 12   -  flat head  -  brass
|           |          |             |          |
number-length    -  gauge    -     head    -  type of
  of                                           screw
screws
```

Drilling Holes For Screws

For maximum holding power, the threads of the

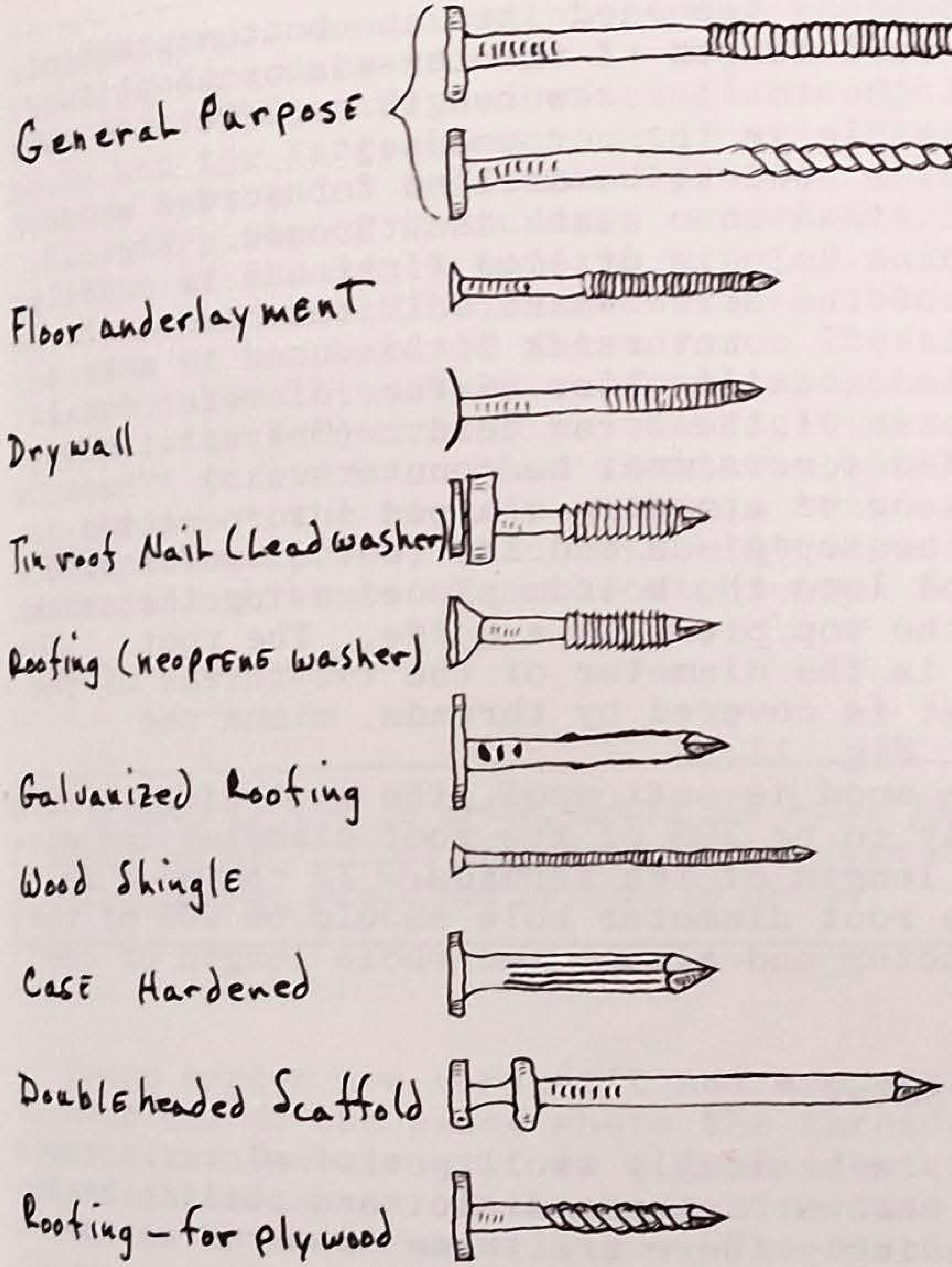


Fig. 8 - Special Purpose Nails

Common Nails

Size	Length (Inches)	Gauge No.	Diameter of Head	No./lb. (approx)
2d	1	15	1 1/16	876
3d	1 1/4	14	13/64	568
4d	1 1/2	12 1/2	1/4	316
5d	1 3/4	12 1/2	1/4	271
6d	2	11 1/2	17/64	181
7d	2 1/4	11 1/2	17/64	161
8d	2 1/2	10 1/4	9/32	106
9d	2 3/4	10 1/4	9/32	96
10d	3	9	5/16	69
12d	3 1/4	9	5/16	63
16d	3 1/2	8	11/32	49
20d	4	6	13/32	31

Finish Nails

Size	Length (Inches)	Gauge No.	Diameter of Head	No./lb. (approx)
3d	1 1/4	15 1/2	12 1/2	807
4d	1 1/2	15	12	584
5d	1 3/4	15	12	500
6d	2	13	10	309
8d	2 1/2	12 1/2	9 1/2	189
10d	3	11 1/2	8 1/2	121
16d	3 1/2	11	8	90
20d	4	10	7	62

Fig. 10 - Useful Nail Data

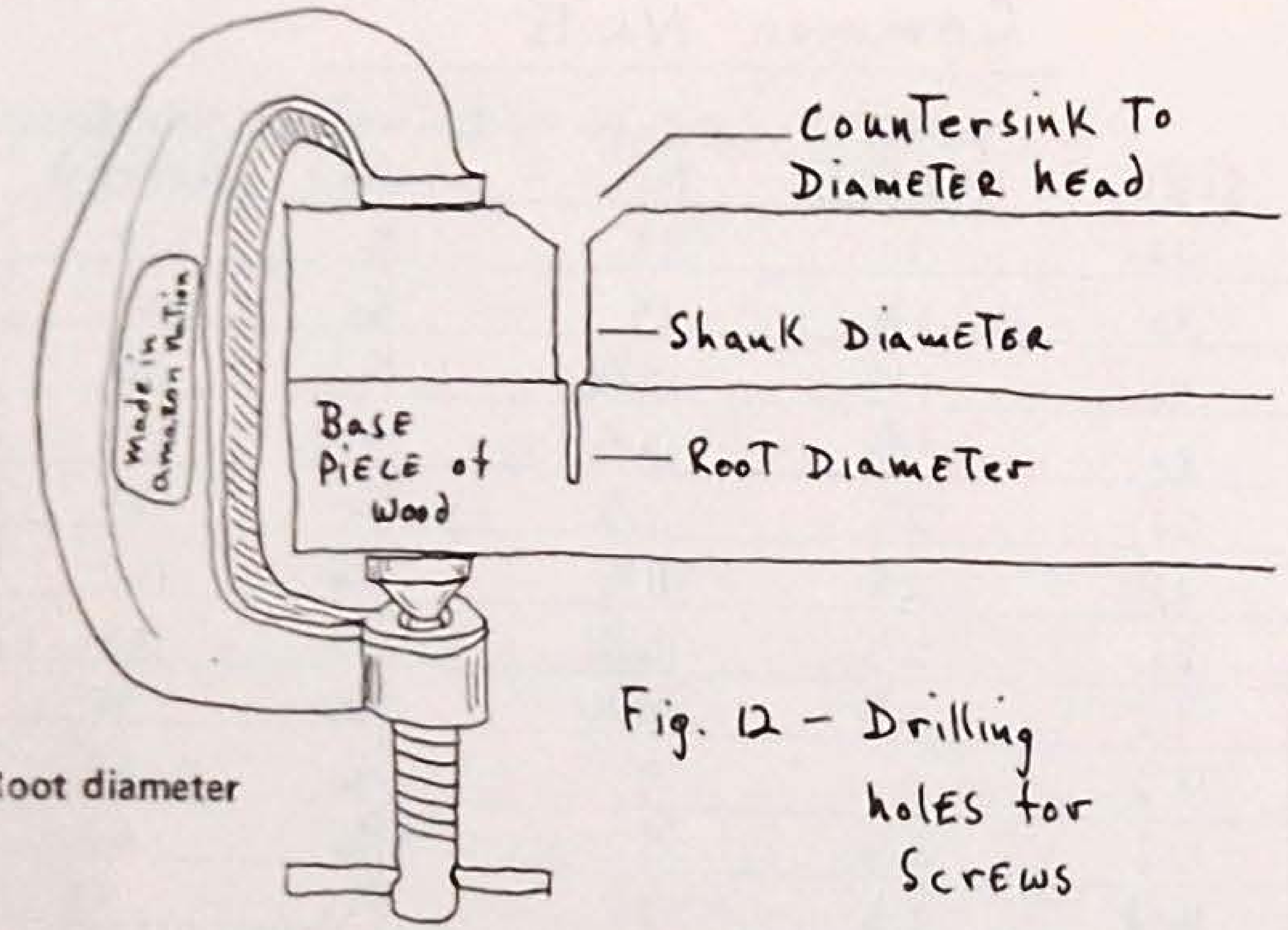


Fig. 12 – Drilling holes for Screws

Root diameter

Countersink–See Tools: Hand drills and drilling

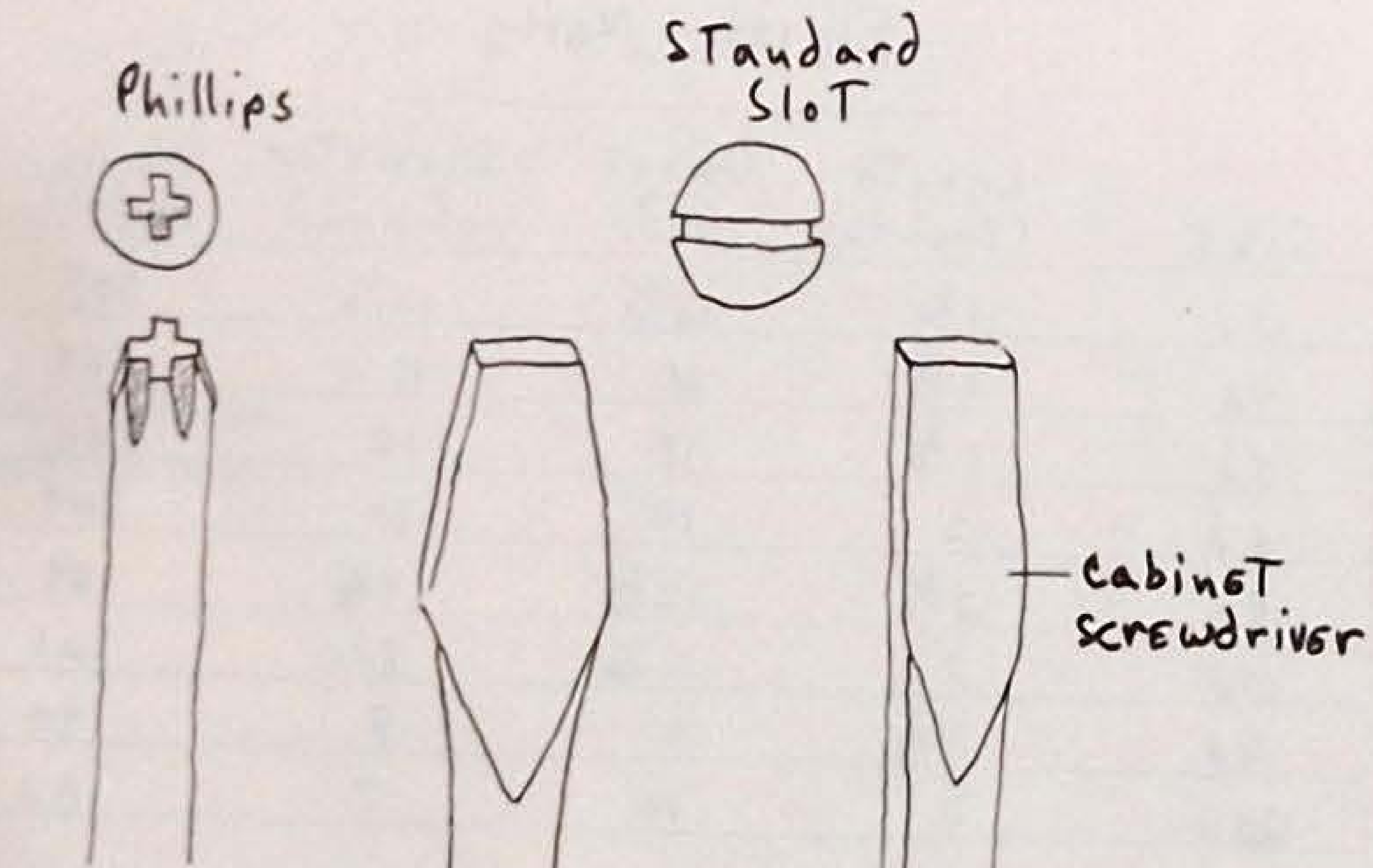


Fig. 13 – Phillips and Standard Screwdrivers

screw should be imbedded into the bottom piece of wood the full length of the threads or about two-thirds of the total screw length. (Sometimes this isn't possible in thinner woods.)

Two holes need to be drilled for screws whose body is divided into shank and threads. Fig. 12. The shank hole is drilled first and is exactly the size of the screw shank. If the head is to be countersunk, a countersink bit is used to make a conical indentation whose surface diameter equals the diameter of the screw head. (Only flat and oval headed screws must be countersunk.) The bottom piece of stock is clamped into position against the top piece and the root diameter hole is drilled into the bottom piece, using the shank hole in the top piece as a guide. The root diameter is the diameter of the two-thirds of the shank that is covered by threads, minus the threads. Fig. 11.

If the wood is soft wood, the root diameter hole needs only to be 70% of the root diameter and one-half the length of the threads. If the wood is hard, the root diameter hole should be 90% of the root diameter and almost the whole length of the threads.

Driving The Screws

There are basically two types of slots in the heads of screws: standard slot and phillip head. Correspondingly there are three types of screwdrivers: phillips, standard and cabinet.

The size of a standard screwdriver is described by giving the length of the blade from the ferrule to the tip. For carpentry, sizes 3", 4", 6" and 8" are the most used. The size of a phillips screwdriver is described by giving the point size. Phillips screwdrivers come in point sizes ranging from 0-4. The small numbers indicate smaller heads and the large numbers indicate larger heads. Numbers 1,2, and 3 are commonly used in carpentry.

The very tip of a standard screwdriver should be flat; it shouldn't come to a point. The width of the point should be as wide as the bottom of the slot in the head of the screw. The tip should fit into the slot snugly. If all these conditions are met, the screwdriver is the right size for the screw. A screwdriver that isn't the right size can strip out the slot in either a standard or phillips head screw, which makes it impossible to drive it in or out. Use the right tool for the job.

If a screw is hard to drive, drill the holes for it a little bigger. If all preparations have been done correctly, screws should not be hard to drive.

Brass screws are very soft and are easily twisted off at the place where the threads meet the shank. Sometimes it is a good idea to first drive a steel screw of the same size into the hole where the brass screw will go. The steel screw forges a path for the brass screw and ensures that it will not twist off.

Aside from the ordinary screwdriver, screws can be driven by a screwdriver bit mounted in a brace and by a ratchet screwdriver. The two latter

Brace, Ratchet--See Tools: Hand drills and drilling

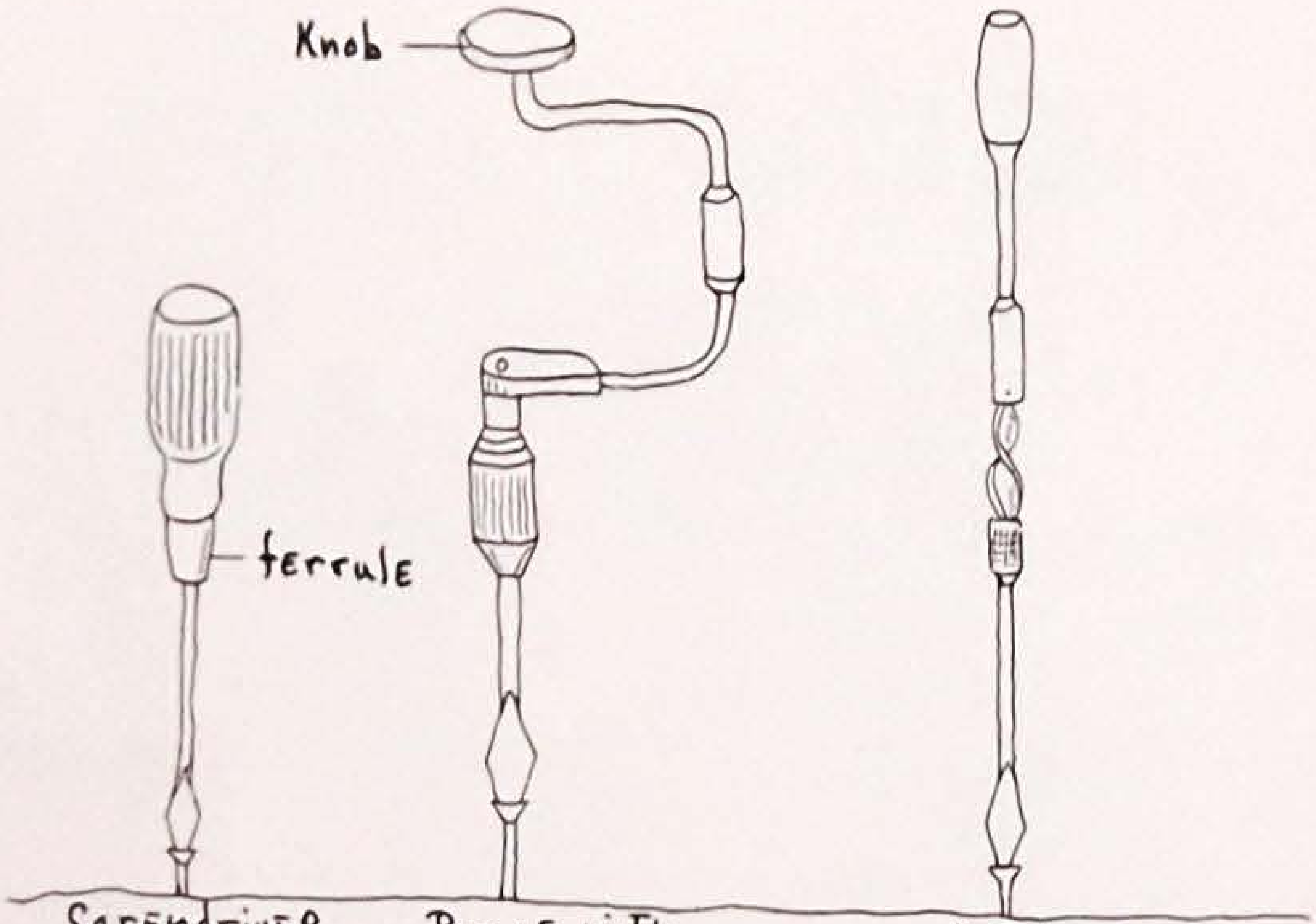


Fig. 14 — Three Ways of Screwing

Tap

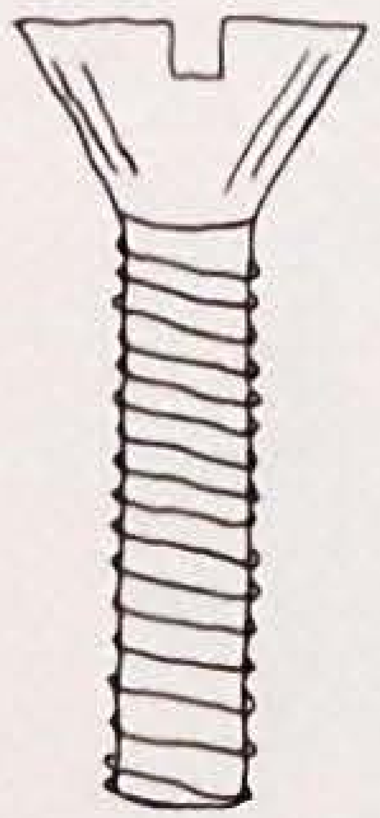


Fig. 15 — A Machine Screw

tools drive screws much faster than the first. Fig. 14.

MACHINE SCREWS

Machine screws are designed to be driven into holes in metal which are lined with threads that match the threads on the machine screw. They can not be driven into wood because their threads are not sharp enough to cut into the fibers.

Machine screws are described similarly to wood screws except that in addition to a gauge number, there is a number which indicates how many threads per inch the screw has:

10 - 1" - 10/24 - flat head - brass

The 10/24 means that the screw is a number 10 screw with 24 threads per inch.

A small drill bit size tool called a tap is used to cut threads in the sides of holes drilled into metal so that machine screws can be driven into the metal.

SPECIAL FASTENERS

There are many kinds of fasteners that are manufactured for the purpose of joining wood or steel to concrete. They all work on the same principle: A hole is drilled into the concrete, the fastener is inserted into the hole and due to expansion of some of its parts, it holds fast in the hole.

Drilling Into Concrete

If you try to drill holes for fasteners in solid concrete or concrete block wall with a regular drill and a masonary bit, you will find that three-quarters of the holes cannot be completed because the bit has run into a hard piece of gravel and can't get through it. A hammer drill is the right tool for the job. A hammer drill does two things at once: pushes the bit up and down in a hammering action, and rotates the bit like an ordinary drill. The hammering action breaks up the gravel and the drilling action brings out the waste. Hammer drills can be rented at rental stores. They drill through concrete like butter and the time and frustration they save are major.

Expansion Anchors

There are two kinds of drop-in concrete expansion anchors. Those in Fig. 17A are pounded into a hole drilled in the concrete. As the bolt or screw anchor is driven in, a metal part that is capable of expanding (either because it's made of lead or moveable) is forced over a conical wedge. The wedge forces the metal part against the walls of the hole thereby firmly holding the anchor. Those in Fig. 17B are held in the hole by similar methods of expansion, but these are dropped into the hole not pounded in. A machine screw is inserted into the threaded part of the anchor and tightened. As the screw is turned, two wedges are drawn together thereby expanding a moveable metal part which holds the anchor in the hole.

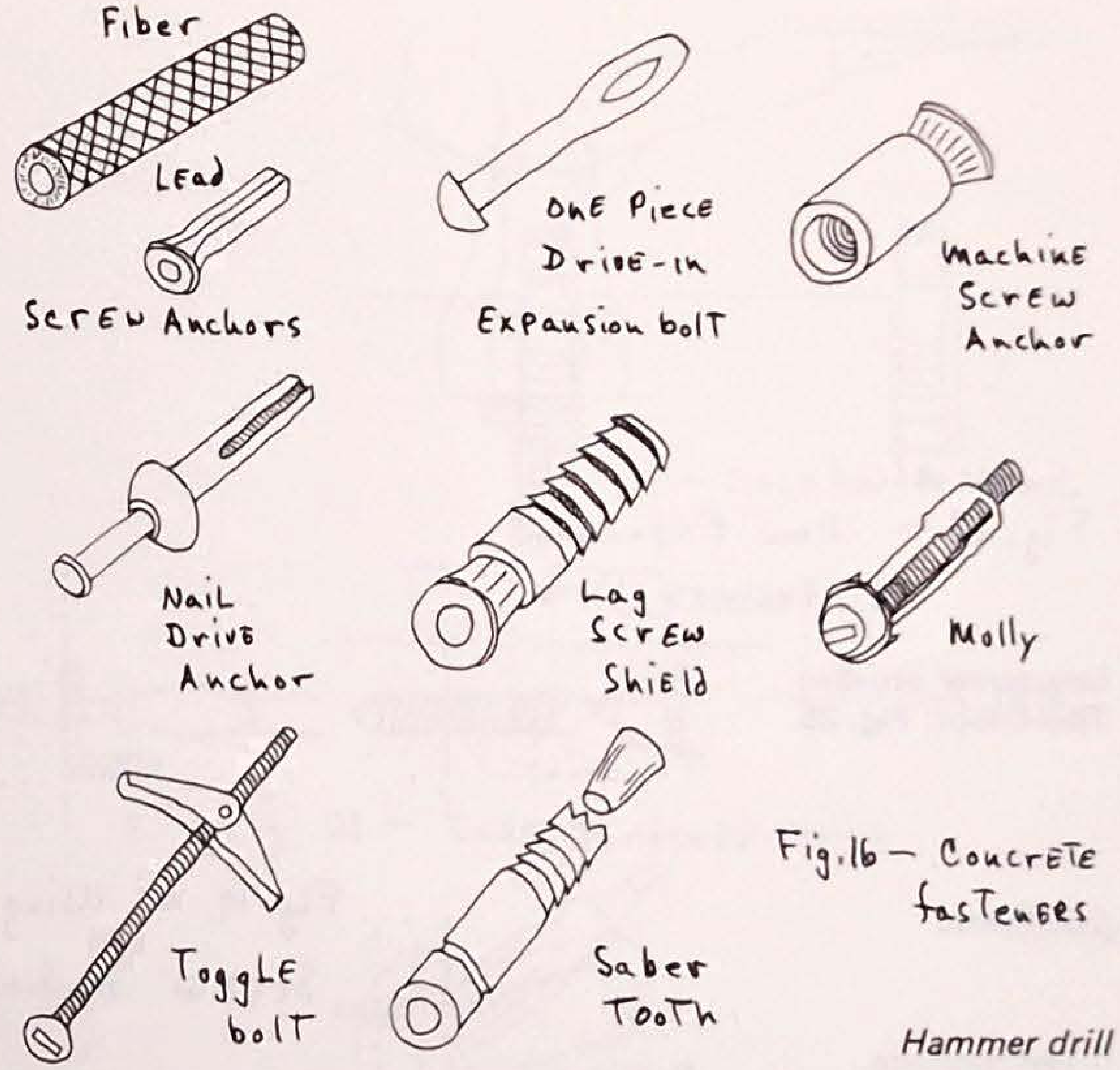


Fig. 16 – Concrete fasteners

Hammer drill

Machine screw

Machine screw–See This Chapt: Fig. 15

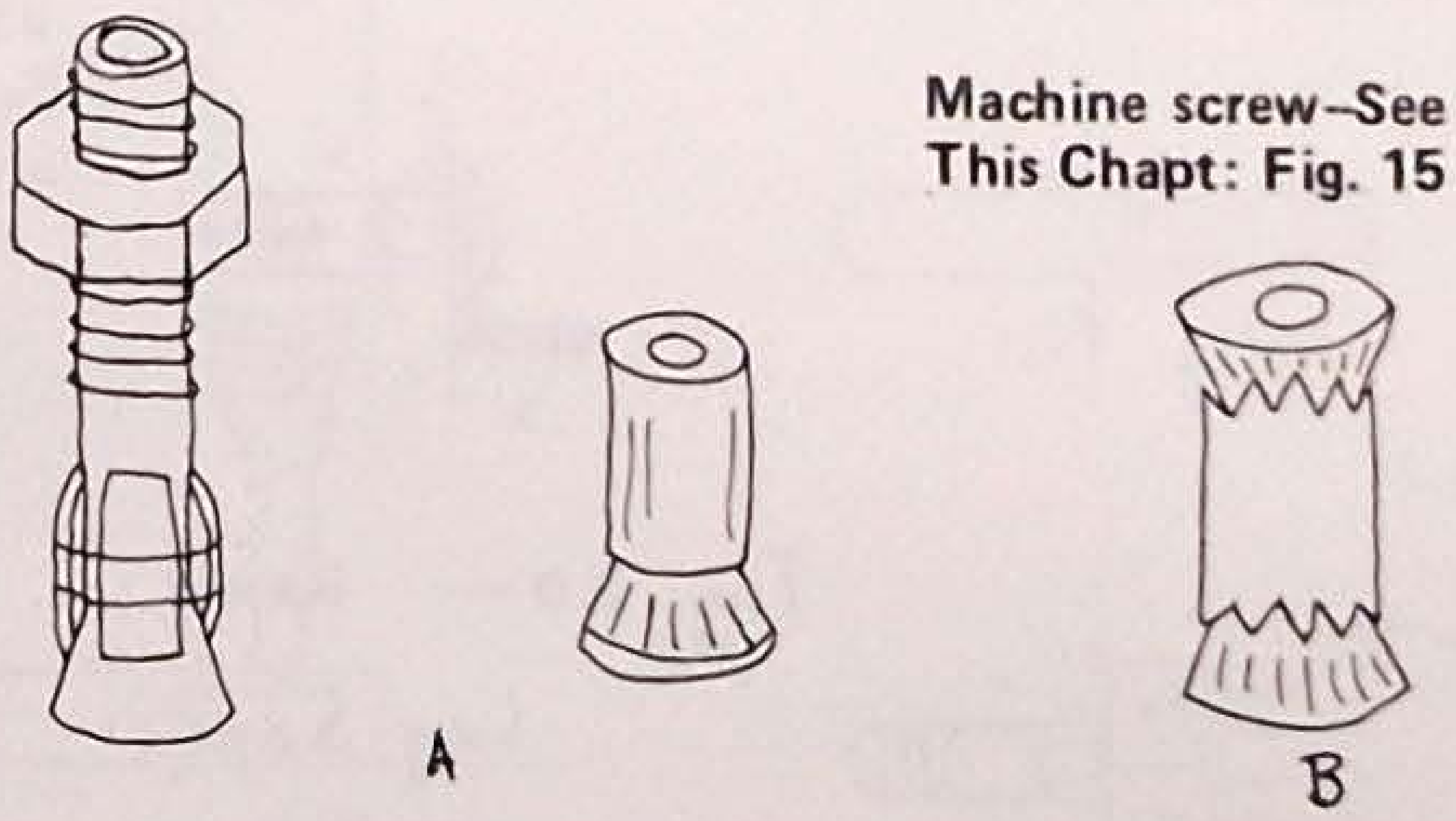


Fig. 17 – Expansion Anchors

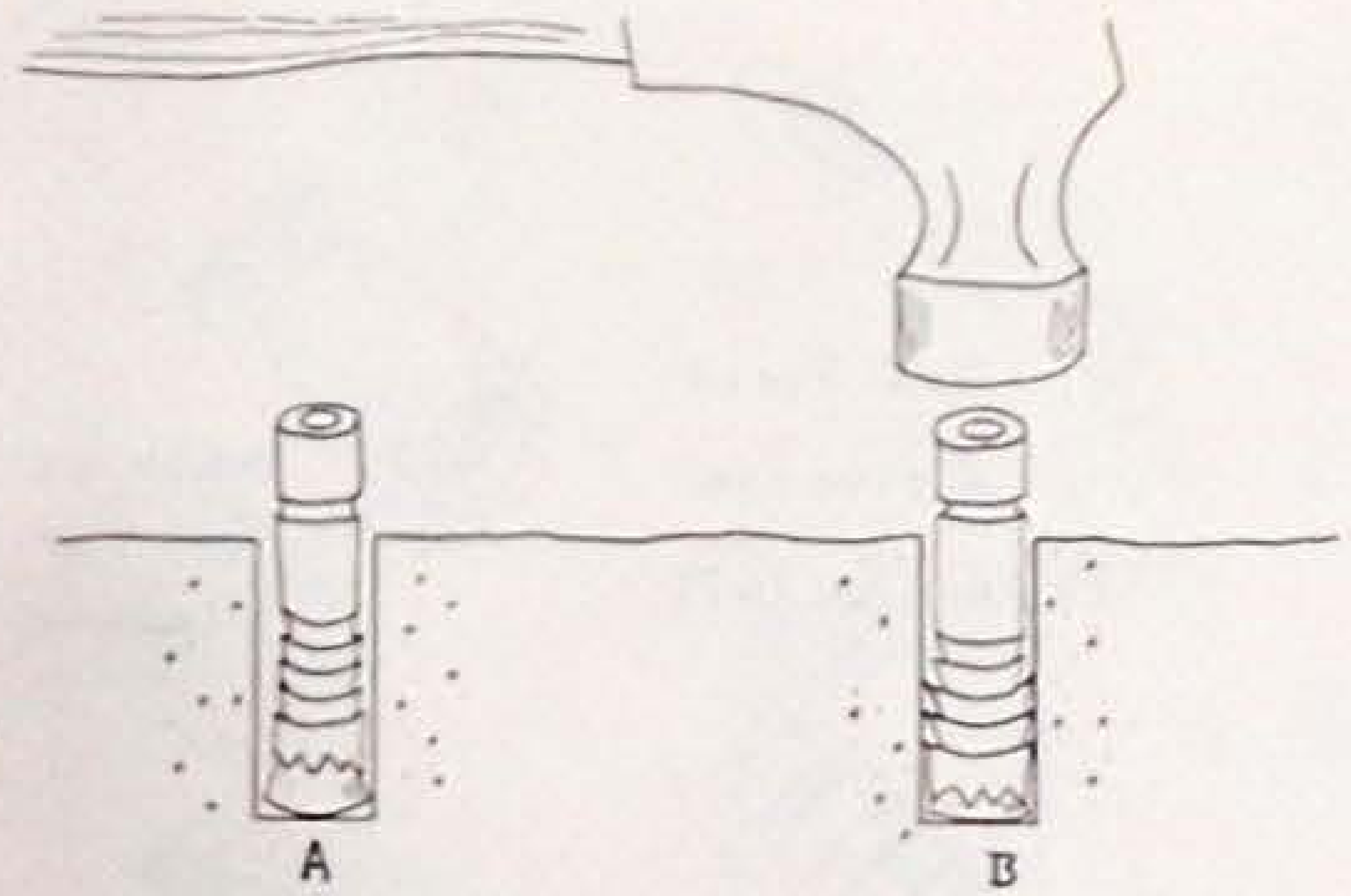
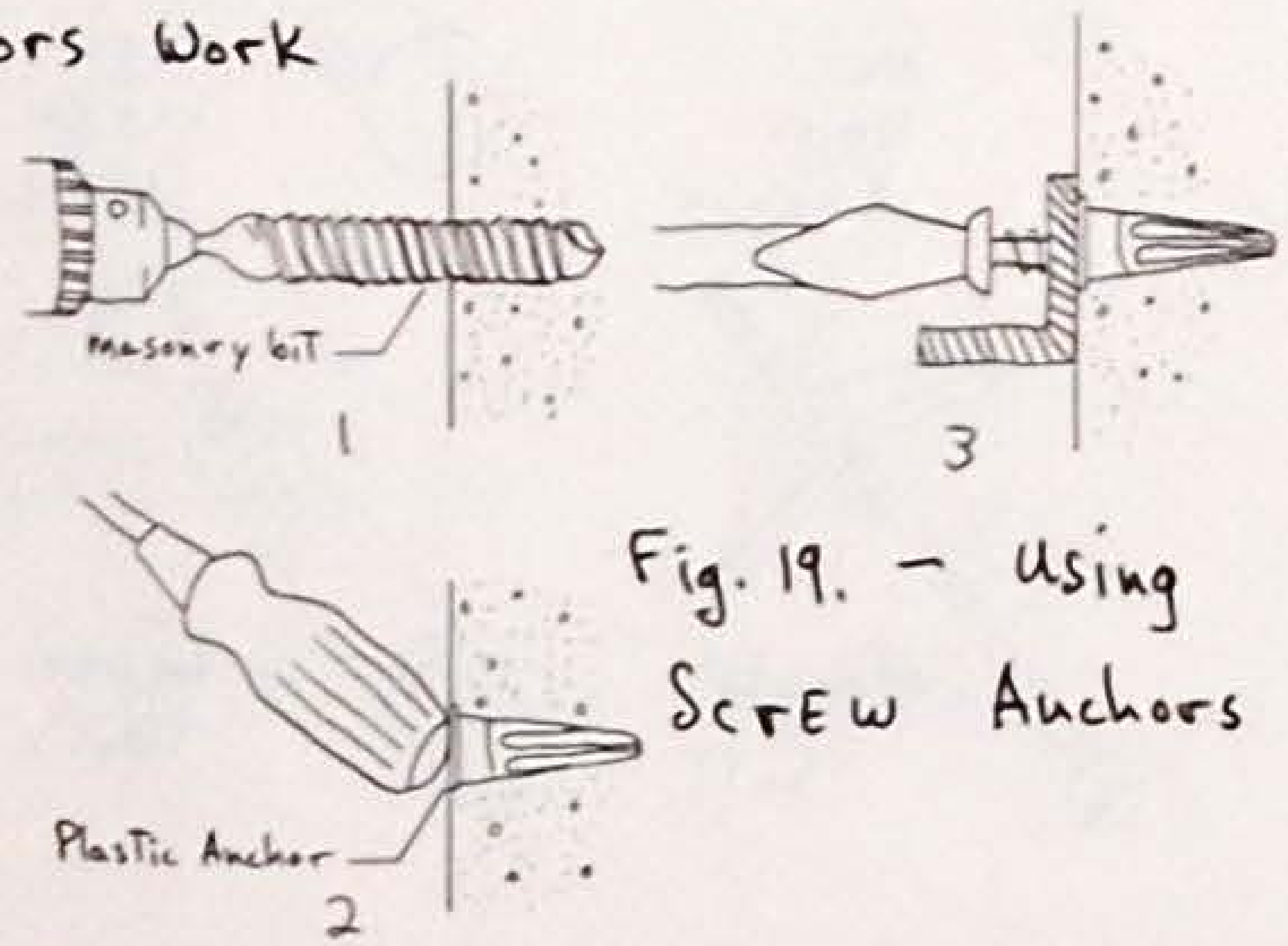


Fig. 18 — How Expansion Anchors Work

Lag screw etc–See This Chapt: Fig. 25



Cut thread

Fig. 19. — Using Screw Anchors

Green concrete

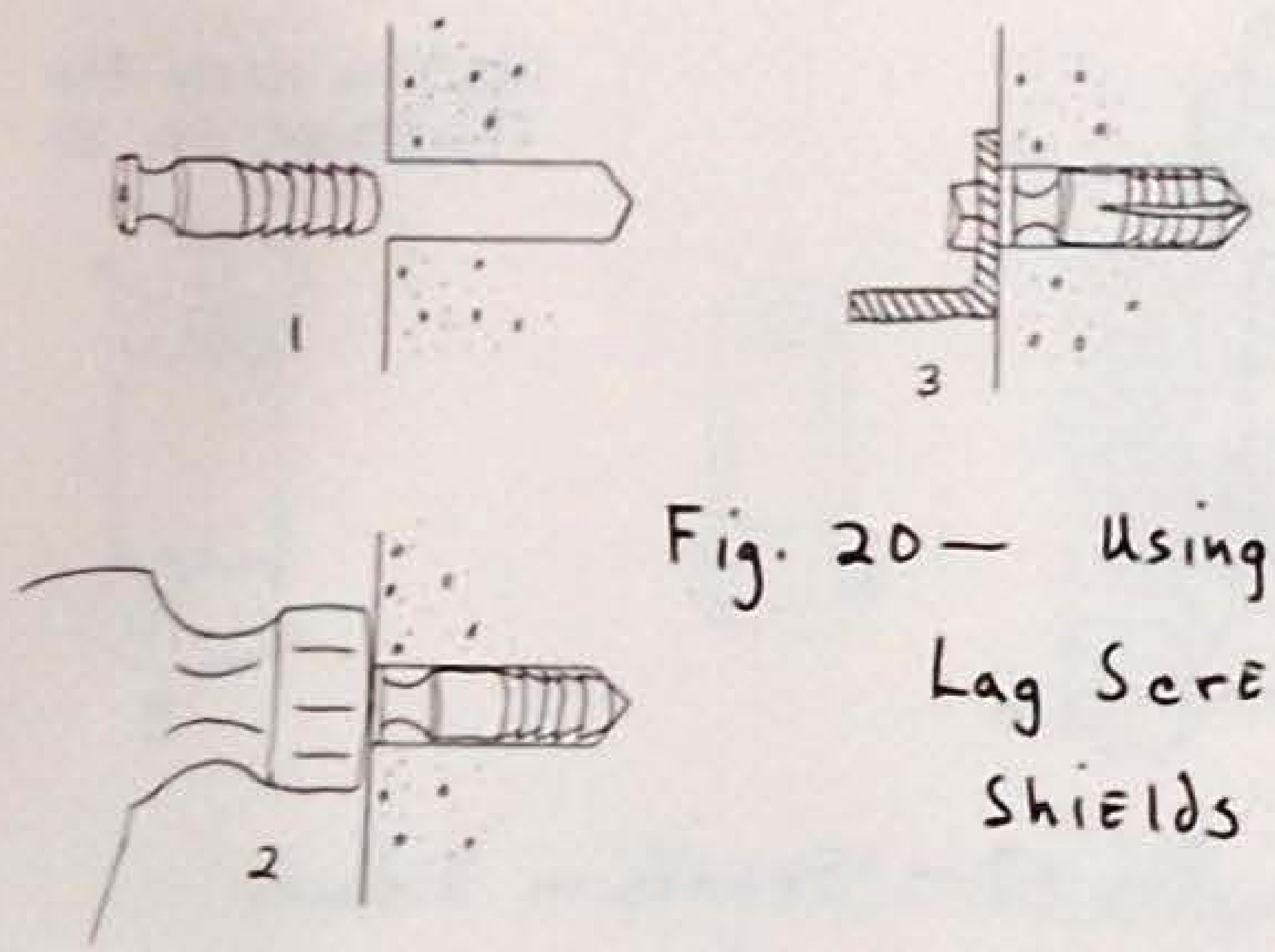


Fig. 20 — Using Lag Screw Shields

Screw Plugs: Fiber And Plastic

Screw plugs are plastic or braided jute fiber cylinders that are inserted into holes drilled into concrete. They are designed to accept wood screws, expand and firmly hold the screw as it is driven in. Fig. 19. Plastic plugs are good for supporting light loads, but if the weight on the screw will be great, a fiber plug should be used.

Expansion Shields

If a very large load needs to be supported, a lag screw and expansion shield should be used. Fig. 20. After a hole is drilled in the concrete or brick, an expansion shield is inserted. A cut thread lag screw is pushed through the hole in the angle iron or whatever needs to be supported, and is threaded into the shield which expands and holds the lag screw as it is driven. A cut thread screw has threads that are capable of cutting into metal.

Case Hardened Nails

A nail that is case hardened or oil quench hardened has been tempered for extra strength and resistance to bending. Case hardened (Fig. 8) nails can be driven into mortar and concrete that is still partially green. They are harder to drive than ordinary nails and do not hold as well, especially when the concrete spauls out around the nail as it is driven. Sometimes several nails must be driven into the concrete before one holds.

Always wear eye protection when driving case hardened nails. Their tempering makes them brittle and metal chips can easily fly into your eyes.

Power Actuated Tools

A power actuated tool is a gun-like tool operating on small caliber shells which drive a piston which in turn drives a case hardened nail into concrete or steel. There are different powered shells for different jobs: high, for attaching something to steel; and middle and low, for attaching items to concrete. These guns are rentable and are a very fast way of attaching wood to concrete or steel. This is a fast way of attaching bottom plates to concrete slabs or furring to concrete walls.

Hold the board against the concrete, place the gun perpendicular to the board and fire. The nail will go through the board and into the concrete drawing the board to the concrete.

Toggle Bolts

A toggle bolt is a long screw with a spring loaded wing attachment which is useful for holding things onto hollow walls such as concrete block, sheetrock or paneling. Drill a hole in the wall large enough so that the folded up wings can fit through. Remove the butterfly wings from the toggle screw and insert the screw through whatever is being attached to the wall. When the fixture is on the toggle bolt, screw the wings back on

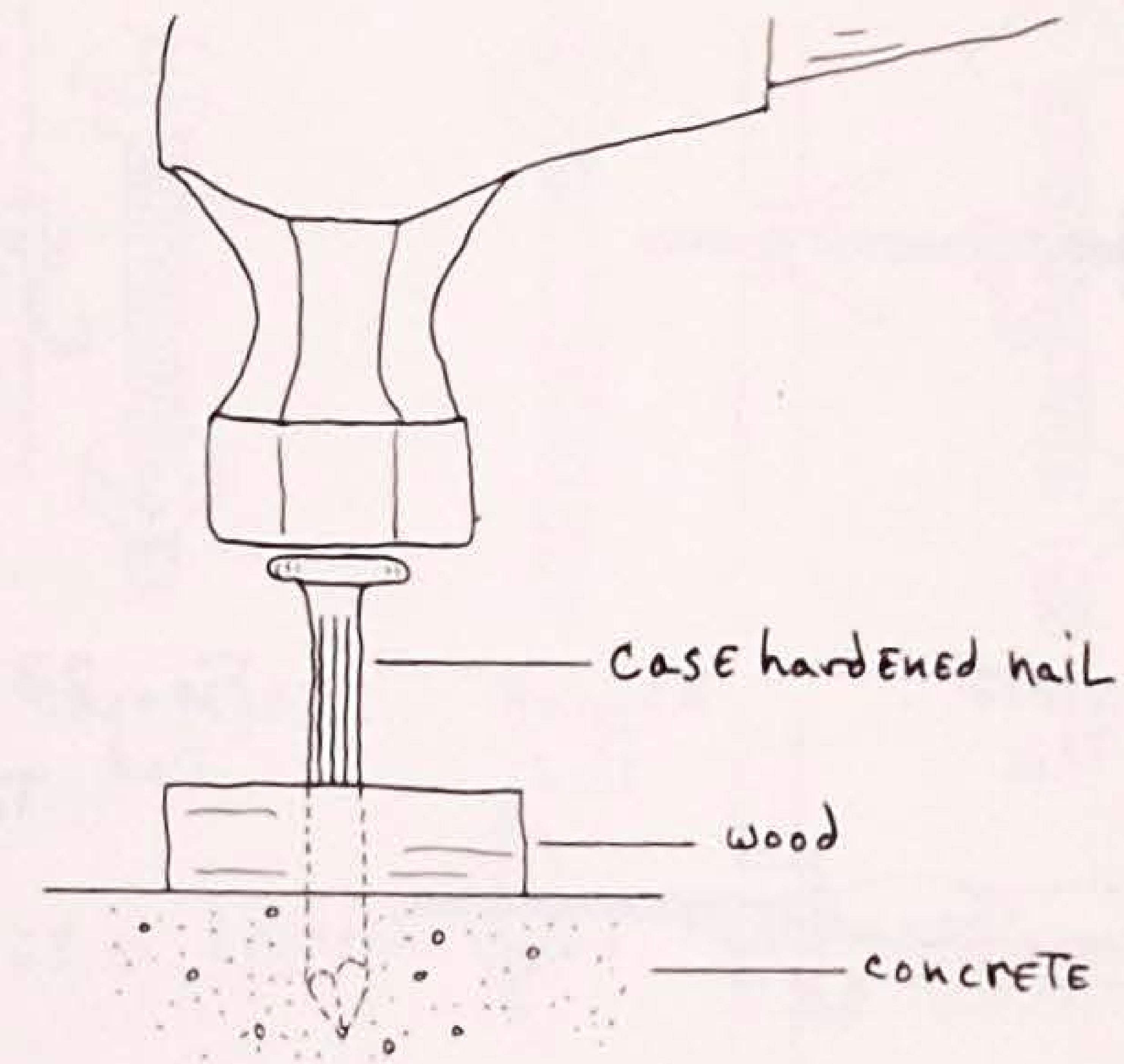


Fig. 21 — Case Hardened Nails

furring

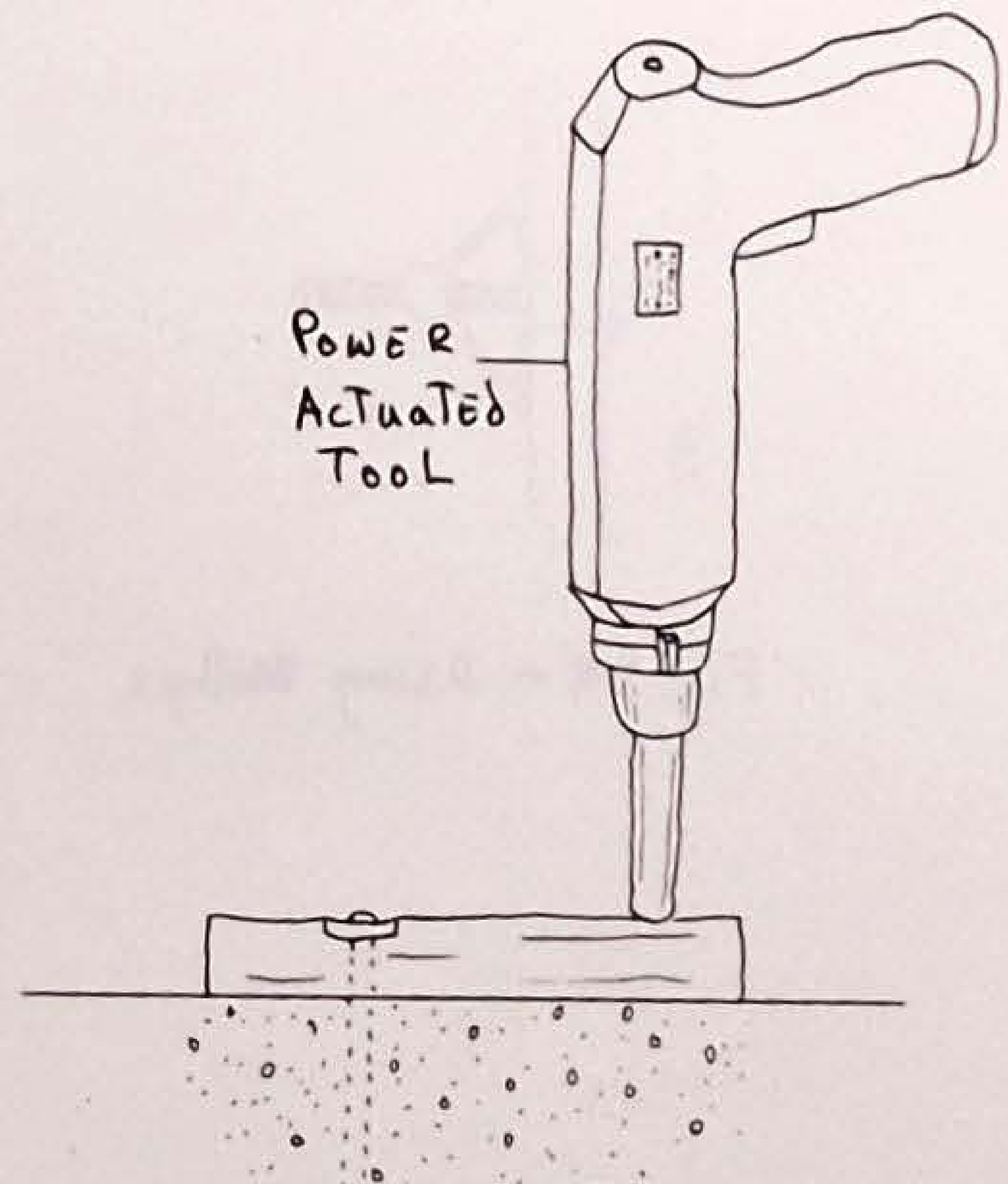


Fig. 22

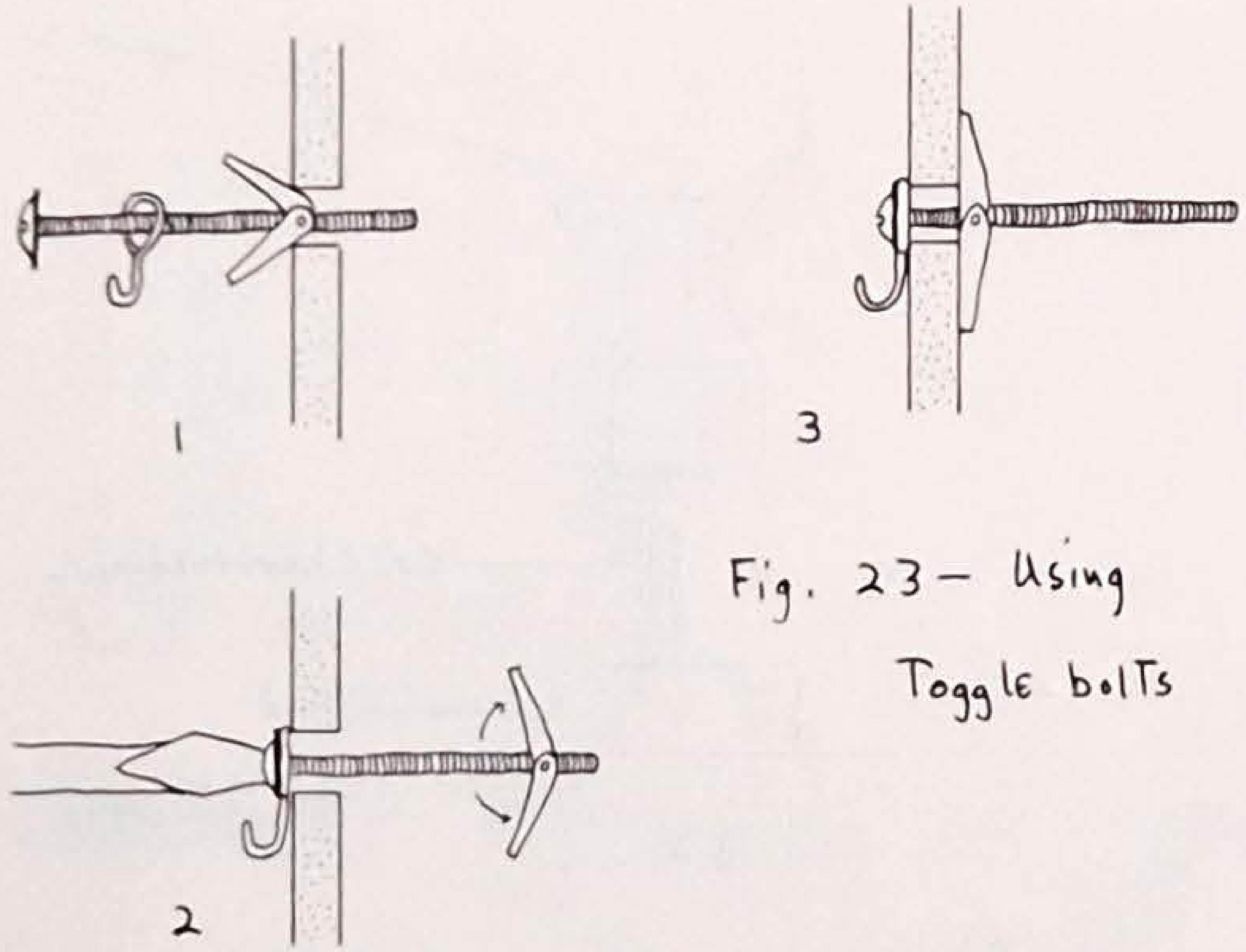


Fig. 23 – Using Toggle bolts

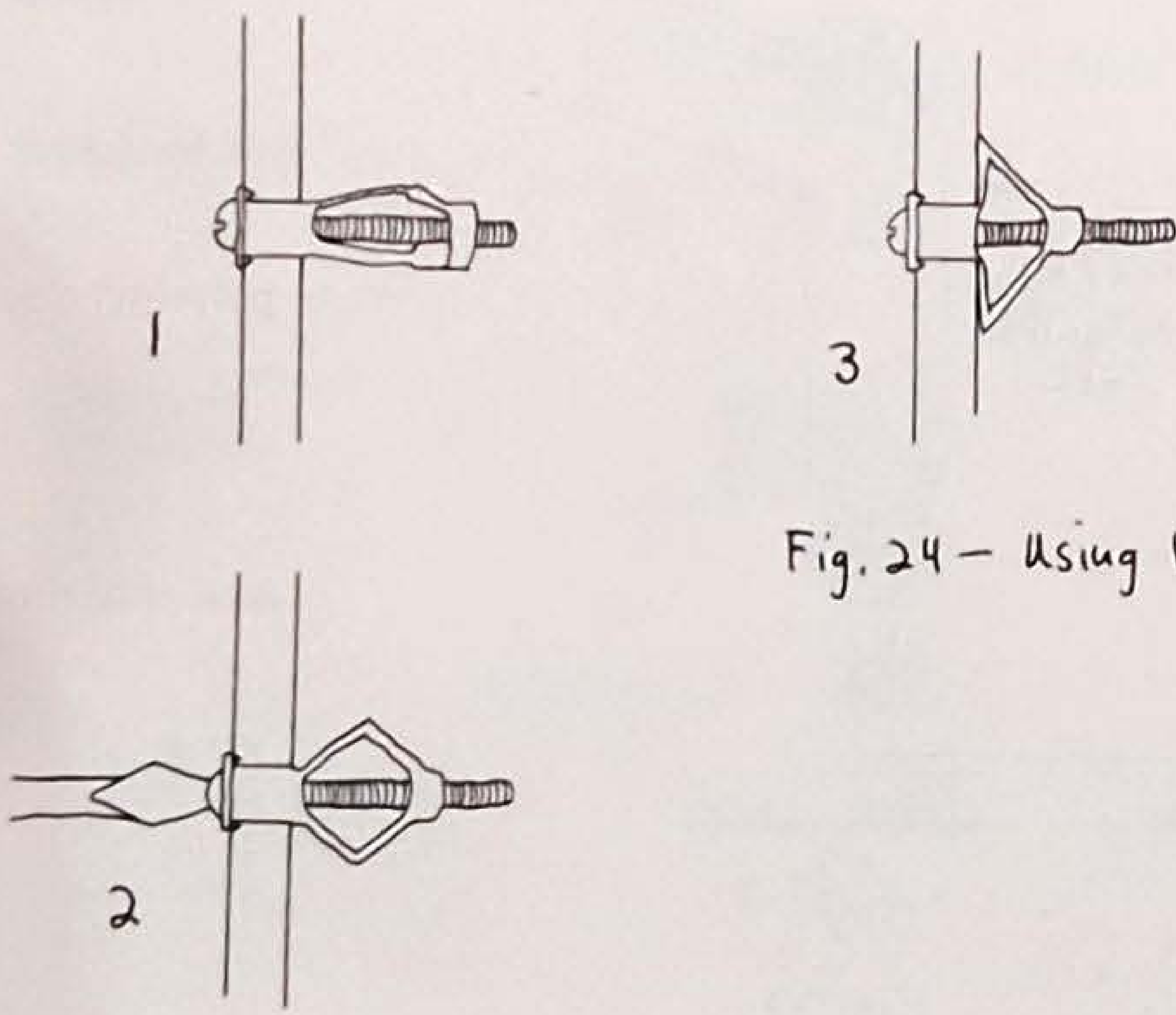


Fig. 24 – Using Mollys

<u>just a little</u>. Push the end of the bolt and wings through the hole. When the wings clear the hole, they will spring open. Pull the head of the screw toward you until the wings contact the inside face of the wall. Drive the screw in, keeping the tension on the wings so they won't turn as the screw is turned. When the installation is complete, the wings are tight against the inside face of the wall, spreading the weight of the load over the area covered by the diameter of the wings.

Toggle screws come in varying diameters for different loads. The length of the screw should minimally equal the thicknesses of the wall sheathing and item to be attached, plus the length of toggle wings.

Fastening Into Drywall Or Paneling

Light loads can be supported by sheetrock, but if anything heavy needs to be attached to the wall, it should be screwed into wood backing attached to the framing. Most modern contractors attach bathroom fixtures such as towel racks to the sheetrock by means of mollys or toggles. The constant use such fixtures get will gradually work these fasteners loose. The fastener is strong enough but the sheetrock is not rigid enough.

Molly Bolts

Molly bolts are used to attach items to hollow walls covered with such things as sheetrock or paneling.

Drill a hole in the wall and push the molly in. Tap the head until the prongs are embedded in the wall. (The hole size required for each size molly is given on the box.) Turn the screw until a definite resistance is felt. Fig. 24-3. This means that the flexible metal arms have spread and are holding the molly tight against the wall. Remove the screw, place the fixture in position on the screw, reinsert it, and tighten.

Special Wood Fasteners

Lag screws are heavy duty wood screws, and carriage bolts are heavy duty machine screws--both are used in rough carpentry. Hanger bolts have wood threads on one end and machine threads on the other. One end can be screwed into the framing and items can be repeatedly attached to the other end because of the machine threads and nut. Stove bolts are mostly used in metal work but can be used to bolt two pieces of wood together.

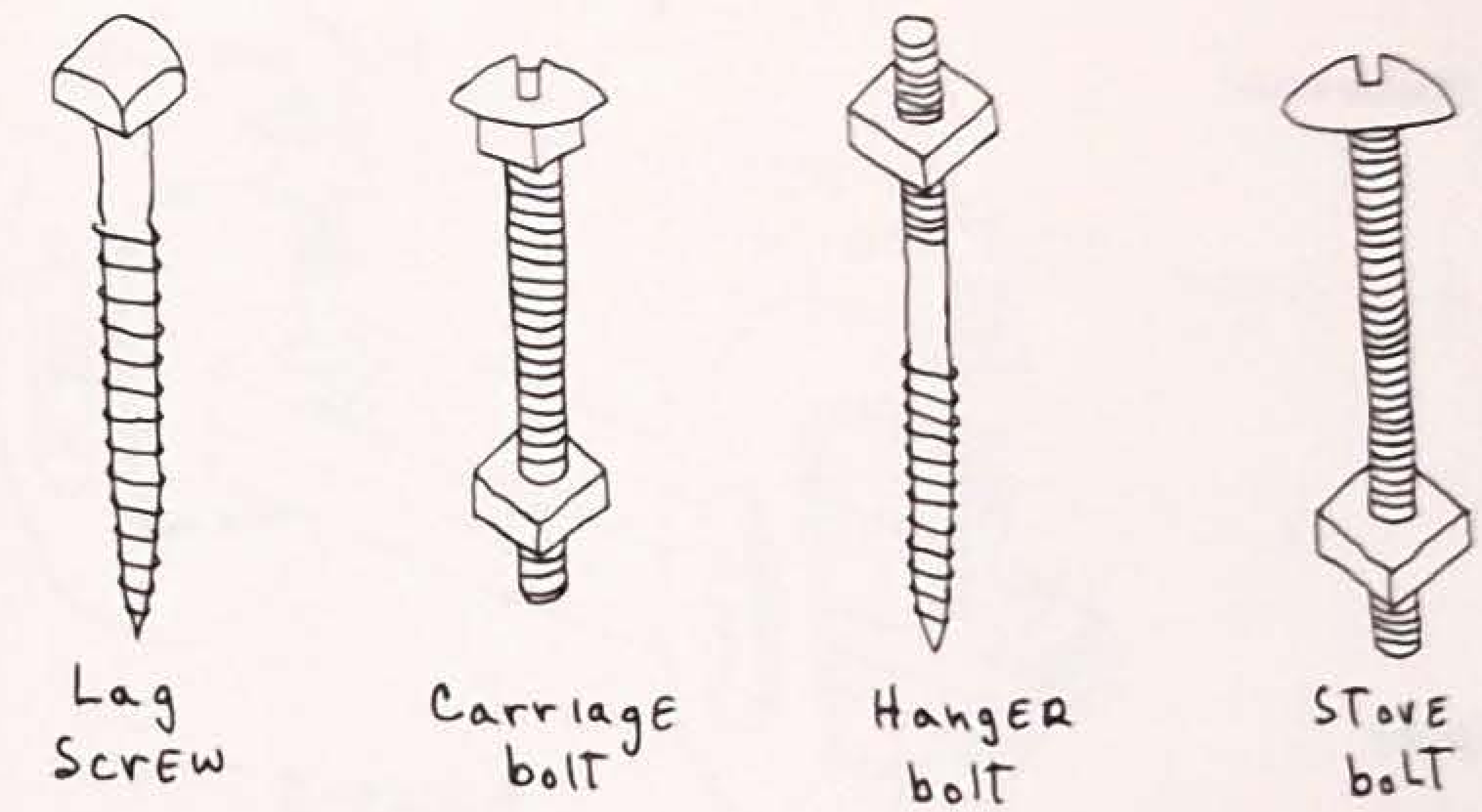


Fig. 25 - Special Wood Fasteners

Framing

GLUES

There are many kinds of glue; some with very specific applications. Four generally used glues are described below.

White polyvinyl glue

Polyvinyl glue (white glue): Commonly called elmer's glue, this glue comes in plastic squeeze bottles and is ready to use without mixing. It is a very good glue for wood that will not come in con-contact with moisture or heat. This means that it should only be used inside. It has an assembly time of 5 minutes, sets up and no longer needs clamping after 30 minutes and gains full strength in two days. Assembly time is the length of time available to align the pieces to be glued between spreading the glue and the applying of pressure (clamping).

Assembly time

Plastic resin

Plastic Resin (Urea Resin) Glue: Plastic resin glue comes in a white powder which contains a catylist/hardener. When mixed with water, the catylist begins to work and the glue hardens because of chemical action. It is water resistant, not waterproof, but can be used to glue items that will come in contact with water for only a short time. Plastic resin glue has an assembly time of 15 minutes at room temperature and sets up in 4 to 8 hours. Adding heat can reduce the setting time.

Epoxy

Epoxy Glues: Epoxy glues are the only waterproof glues available. They are very expensive, but are also the very strongest of glues. The wood around the joint will break off or decay before the epoxy joint will. Epoxy comes in two parts that must be mixed to set off the gluing action. Epoxy has a long assembly time but also must be clamped for longer periods. However, epoxy is the one glue that clamping isn't crucial to. It will hold as well with a 1/16" glue film as with .005 inch film (.005 inch is the preferred thickness of the glue between two pieces).

Contact cement

Gluing counter tops

Contact Cement: Contact cement is a light brown liquid that needs no mixing. It is applied to each surface separately and allowed to dry. When it is no longer tacky (a piece of paper won't stick to the surface) the two surfaces are pressed together. No clamping is necessary. Contact cement is used for gluing plastic laminates such as formica and paneling to counter tops and stud walls. It has no moisture content so it can be used to glue thin wood veneer to surfaces without curling the edges. Glues that contain water affect the surface of the wood by raising the grain or warping slightly. This is caused by absorbtion of water into the wood fibers.

Gluing–See Joining: Edge Joints (Finishing the joint)

Contact cement is tricky to work with because once the two surfaces have been pressed together, they will never come apart. After the glue is dried and the two surfaces are ready to be bonded, it is a good idea to place a large sheet of shiny paper or thin wooden lath between the counter and the sheet of plastic laminate while the sheet is being positioned. When the sheet is where you want it, pull the paper or lath out from under it and press the laminate firmly to the surface. This is not meant to be a complete explanation of how to apply plastic laminates to countertops, but only an explanation of one principle involved in using contact cement.

Clamping

One thing that makes a glued joint strong is an even glue film between the two surfaces. After the glue is spread so that it covers the surface, the clamps are applied. They press the pieces together, spreading the glue evenly between them. A bead of glue about 1/16" thick should squeeze out. A glue film that is about .005 inches thick has optimal strength. If white glue is being used, it should not just be squeezed on in a bead along the surface. It should be spread evenly with a finger or brush. Fig. 26 shows three clamps commonly used for gluing.

When gluing miter and butt joints, it is necessary to apply two coats of glue. The end grain of the pieces to be glued will absorb a lot of glue so after one coat has been applied and absorbed, apply another.

Glue film

Gluing--See Joining: Edge and Miter Joints

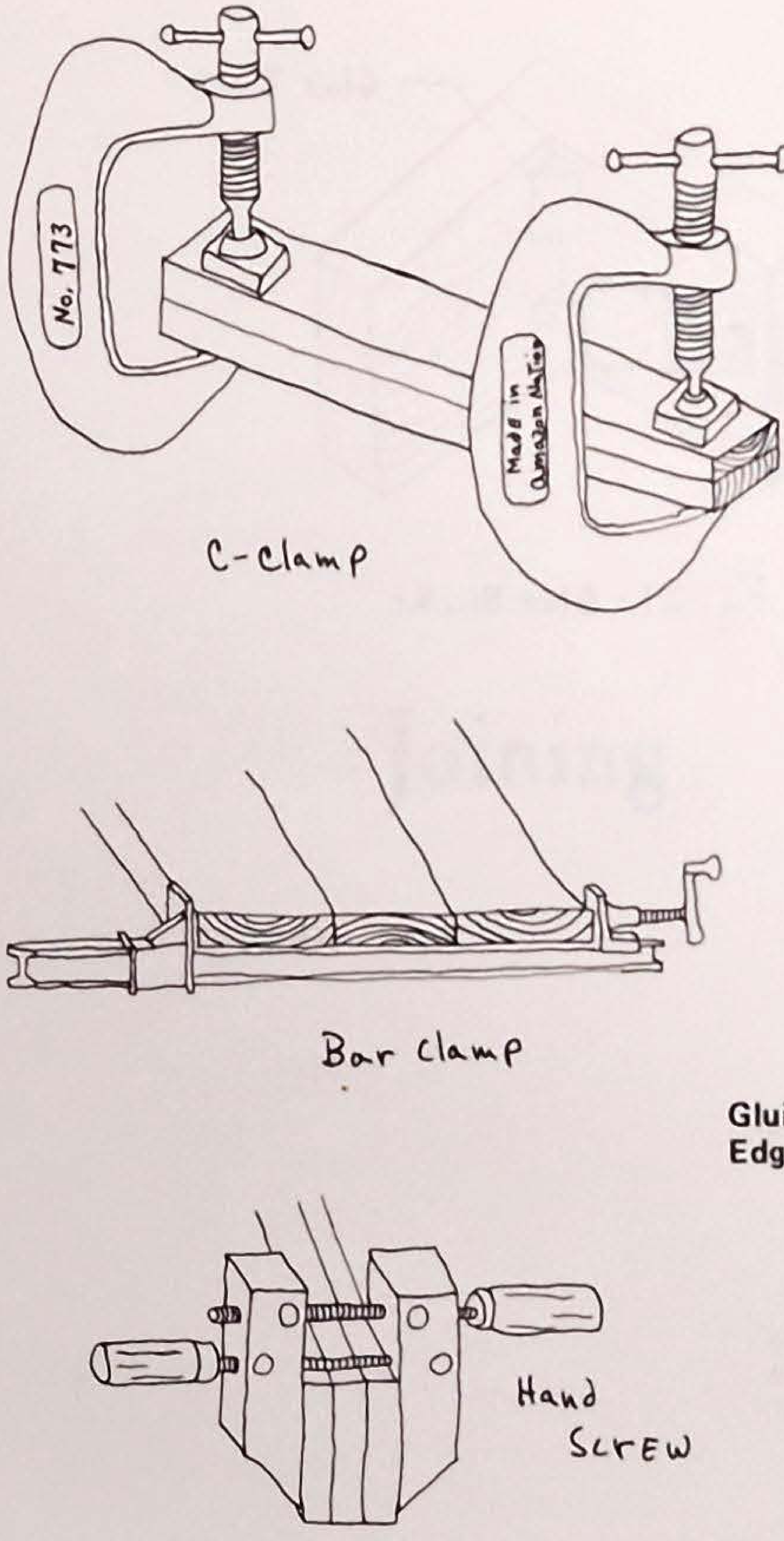


Fig. 26 – Three Kinds of Clamps

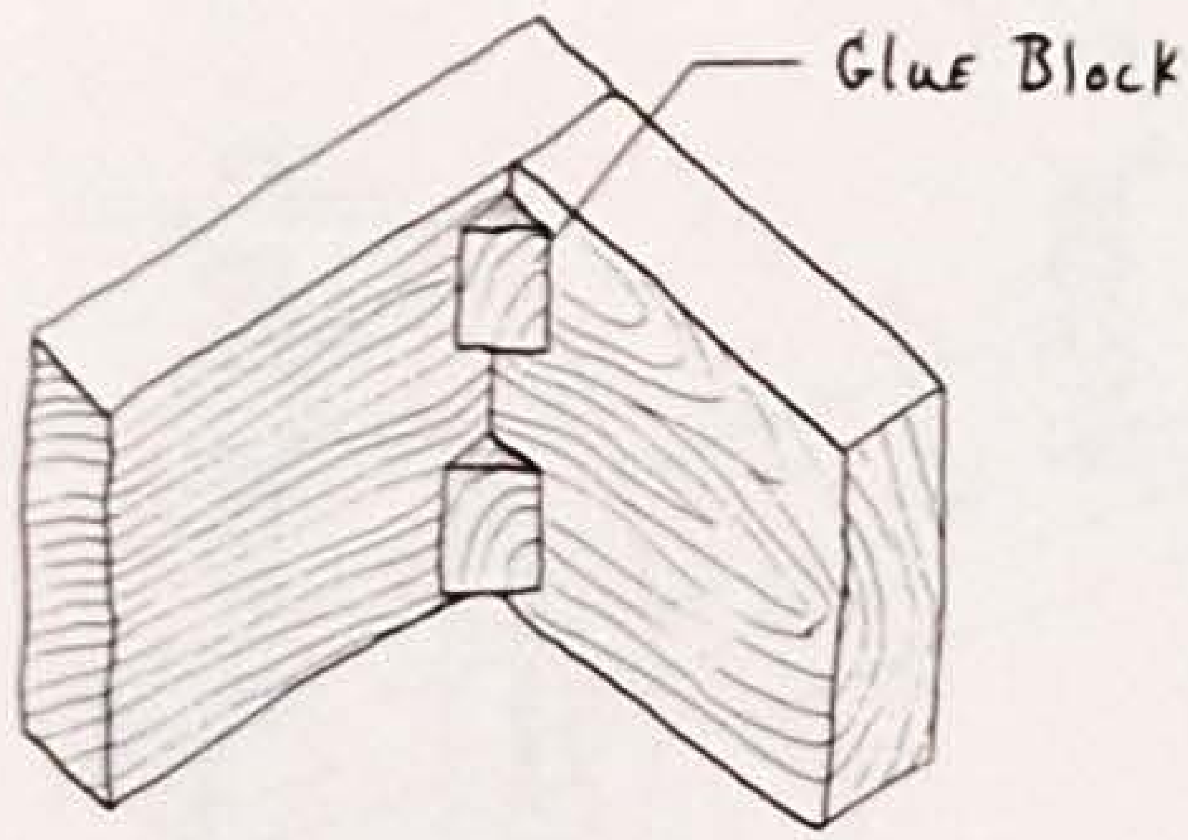


Fig. 27 - Glue Blocks

Bar clamps and pipe clamps are available in bar lengths that range from 2' to 8'. These clamps are ideal for clamping edge joints.

C-Clamps come in sizes that allow a largest opening of 1"-12". They are all-purpose and useful for fitting into hard to get at places.

Hand screws are used mainly in woodworking and cabinet making. The jaws are long and wide and distribute even pressure. Hand screws with jaws having a total length of 4" to 12" are commonly used.

Glues In Construction

Contact cement is used to afix plastic laminates to counters. It is also used sometimes along with nails to help hold paneling to the studs.

White glue or construction adhesive is used by some contractors to help hold the subflooring to the joists. Gluing helps prevent squeaks in the floor as it gets older.