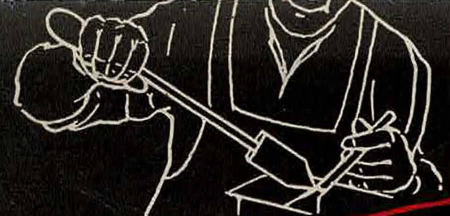

McPherson's

GUIDE for the HANDYMAN

TELLS HOW, WHAT, WHY, WHERE, IN THE WORKSHOP, FARM & HOME

McPHERSON'S Manuals, Catalogues, Data Charts, etc., are available to Workshop Personnel, Consulting Engineers, Students, Purchasing Officers and others.

Guide
for the
Handyman

•

It is "Know-how" which distinguishes the USEFUL Person from the USELESS.

Books can give you "Know-how" and Practice gives you skill.

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CONTENTS

Owing to the great diversity of items included in this volume it is not practicable to add an index which would guide the inquirer. Often he does not know what subject heading to seek in his search for a possible solution to his problem.

We suggest, therefore, that he peruse these pages at all times of technical difficulty so as to acquire a fair knowledge of the information available herein.

McPherson's Ltd.

To All Those Who Own Tools

Some of us are obliged to earn our living wholly, or in part, by means of tools. Some of us acquire tools because of that natural instinct for constructiveness that most men have in their make-up. Others just collect tools because they like to. Whatever the reason for possessing them, the use of those tools can be made much more enjoyable if we know "short cuts" to successful work.

This little book, in which a few such short cuts are given, is offered to the tool user by McPherson's Ltd. who, since 1860, have supplied tools and equipment for generations of craftsmen.

* * * *

In thousands of Australian homes today will be found tools — perhaps a hammer, a spade, or a saw, or some other tool that somebody's grandfather bought at McPherson's many years ago. We take no credit for the quality that enabled these tools to serve a lifetime. The quality was built into them by others; McPherson's Ltd. merely selected them for Australian users. But it is this careful choosing from the world's best that has given McPherson's Ltd. the reputation of selling good tools.

* * * *

Should the reader require further particulars about any phase of tool using, McPherson's will be glad to forward them.

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HOW TO SHARPEN A CHISEL

A straight-edge tool of this type shows its dullness in the form of a thin white, or bright, line along the edge. Until the bevel-edge has become so obtuse as to need grinding, this dullness can be removed on the oilstone. The test of sharpness is the disappearance of the thin bright line.

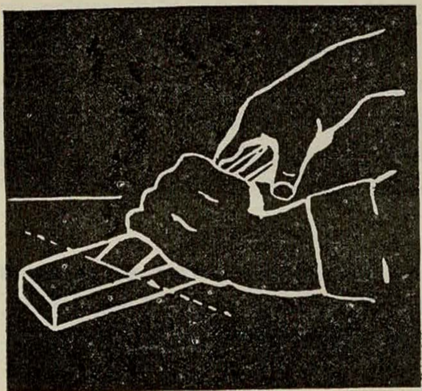


Fig. 1

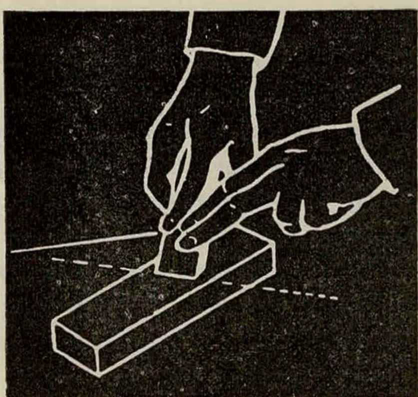


Fig. 2

PROCEDURE

Apply a few drops of oil to a perfectly level oilstone and grasp the tool as shown in the illustration at left. There should be no side-wise turn in the right wrist. Any twisted or turned position in this wrist is sure to give a certain amount of rolling or twist to the tool, thus impairing a true sharpening angle. Swing the right arm from the shoulder, bending it only at the elbow and holding the wrist rigid. Place the edge at an oblique angle across the face of the stone, as shown by the dotted lines, and rub backward and forward, bearing down with both hands.

If the bevel has been recently ground, hold the hands low to make the oilstone bevel correspond with the grinding level, see Fig. 1. With each sharpening, it is necessary to hold the hands a trifle higher, see Fig. 2, until, finally, the oilstone bevel becomes too obtuse, when the tool should again go to the grinder. In rubbing over the stone, move the hands **horizontally** — parallel with the stone — instead of giving them a dipping or scooping motion, as this latter tends to round the edge of the tool and to make the stone hollow out. For the same reason, **it is important to use, as much as possible, the entire face of the stone**, rubbing the tool over the entire length and occasionally turning the stone end for end.

When, after wiping the tool clean, you find the thin line of dullness has entirely gone, turn the tool over, keeping it PERFECTLY FLAT on the stone and, with one or two light, sidewise strokes, remove any burr or wire edge.

Grinders give the correct **bevel**, but the **flat** surface of an oilstone or hone is required to put on the finishing touches of a keen, lasting edge.

HOW TO SHARPEN — GENERAL

With two exceptions, all sharpening (both on grinders and oilstones) is performed with the edge of the tool working **against** the stone. The exceptions are (1) when sharpening on leather, as with a razor strop! (2) when the tool itself is held still and the stone is moved to do the sharpening — as in sharpening a scythe or sickle or the inside of a gouge or concave edge with an oilstone slip. The reason for sharpening against the edge is that this results in less "wire edge."

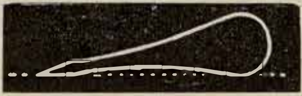


Fig. 3

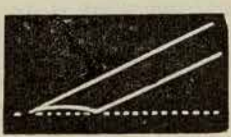


Fig. 4

Broadly speaking, there are only two ways of sharpening tools or knives: (1) by a grinding wheel; (2) by rubbing the tool on a sharpening stone. Grinding wheels have two great advantages: First, they cut steel fast; secondly, they give the tool a **concave** or hollow ground bevel. This does not mean, however, that grinding wheels can take the place of sharpening stones.

Now, about bevels. Look at the illustrations: the dotted line represents the flat surface of an oilstone or hone. Fig. 3 shows a cross section of a hollow ground razor. All hand tools and knives must be sharpened on this same "Hollow Ground" principle for best results.

Fig. 4 is exaggerated to show how like the razor is the **correctly** ground bevel of a chisel — both are concave. This concavity comes from

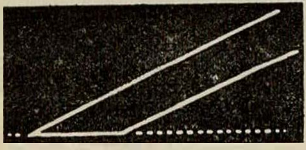


Fig. 5

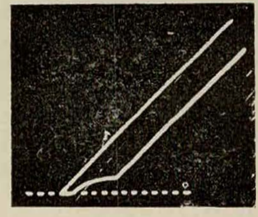


Fig. 6

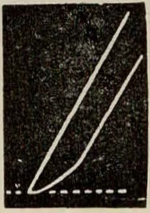


Fig. 7

the curve of the grinding wheel. Fig. 5 shows an **incorrectly** ground chisel. The bevel is **straight**, not concave. This is caused by not holding the tool in **one unchanging position** on the grinding wheel.

One object of the concavity is that it makes a **thinner** shaped wedge, so enters wood, etc., more easily than the straight bevel.

Another object is that this hollow ground bevel will last longer than that in Fig. 5. Here is the reason. Fig. 6 and 7 shows the hollow ground chisel and the straight ground chisel after they have been sharpened several times on the oilstone.

Note that the hollow ground chisel (Fig. 6) is still concave. It will not go to the grinder for some time. But the other (Fig. 7) is now convex — it works hard and slow. It should go to the grinder right away. It needs grinding much **oftener** than the chisel in Fig. 6. The **properly** sharpened tool will cut better and need less sharpening.

SHARPENING PLANE IRONS

GRINDING

If an artificial stone is used it should be used with a light touch, and the blade should frequently be dipped in water to cool it. Hard bearing on an artificial stone will heat the steel and draw its temper, resulting in a "burnt" iron, showing a blue colour. In such a state the edge is soft and useless for its purpose. Therefore, when grinding, hasten slowly; do not hurry. Use a light touch and quench frequently. You can use an artificial stone, either hand or power driven, in perfect safety so long as these simple precautions are taken.

First, the edge must be shaped. Hold the iron as shown in Figure 8. Use a gentle pressure, and pass the iron to and fro across the face of the stone until any "nicks" are ground right out and the edge is absolutely square with the sides.

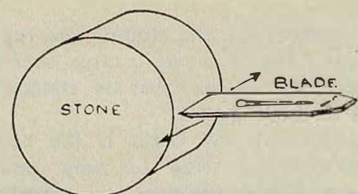
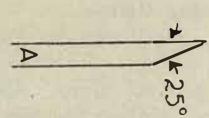
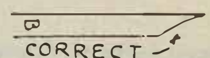


Fig. 8: Grinding the iron.





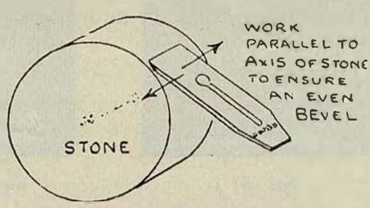
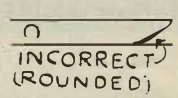


Fig. 9: Bevelling the iron.



Next the bevel must be ground to an angle of 25°. Use a motion right and left parallel with the axis of the blade as at Figure 9. Don't allow the slightest roundness to creep in as in C. A slight concavity is permissible as at B; in fact, the shape of the stone will give this.

GRINDING WHEELS

The development of the artificial abrasive wheel and instruction in its uses cannot be dealt with in the limited scope of this book. We recommend that those interested should obtain a copy of a book dealing exclusively with modern grinding wheels and abrasives.

HOW TO CARE FOR SHARPENING STONES

There are three objects to be attained in taking good care of a Sharpening Stone: first, to retain the life and sharpness of its grit; secondly, to keep its surface flat and even; thirdly, to prevent its glazing.

To retain the original freshness of the stone, it should be kept clean and moist. To let a Sharpening Stone remain dry a long time, or expose it to the air, tends to harden it. A new natural stone should be soaked in oil for several days before using. If a Sharpening Stone is kept in a dry place it should be kept in a box with closed cover, and a few drops of fresh, clean oil left on it.

To keep the surface of a Sharpening Stone flat and even simply requires care in using. Tools should be sharpened on the edge of a stone as well as in the middle, to prevent wearing down unevenly, and the stone should be turned end for end occasionally.

To restore an even, flat surface, grind the Stone on the side of a Grinding Wheel or rub it down with an emery brick.

To prevent a Sharpening Stone from glazing requires merely the proper use of oil or water.

The purpose of using either oil or water on a Sharpening Stone is to float the particles of steel that are cut away from the tool, thus preventing them from filling in between the crystals and causing the stone to glaze.

All coarse-grained natural stones should be used with water. Use plenty of it.

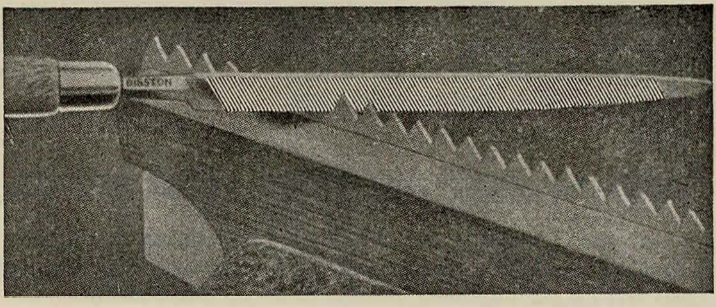
On medium and fine-grained natural stones, and on all artificial stones, oil should be used always, as water is not thick enough to keep the steel out of the pores.

To further prevent glazing, the dirty oil should **always be wiped off the stone thoroughly** as soon as possible after using it. This is very important, for if left on the stone, the oil dries in, carrying the steel dust with it. Cotton waste is one of the best things to clean a stone with.

If the stone does become glazed or gummed up, a good cleaning with petrol or ammonia will usually restore its cutting qualities, but if it does not, then scour the stone with loose emery or sandpaper fastened to a perfectly smooth board.

Never use turpentine on a Sharpening Stone for any purpose.

HOW TO SHARPEN WOODWORKING SAWS



It is not necessary to re-set the teeth of a well-tempered hand saw every time it needs sharpening. If the teeth are touched up with a file from time to time as a saw is used it will cut longer and better, and sufficient set will remain to enable the saw to clear itself.

If the teeth are uneven, it is necessary to "joint" the saw.

JOINTING

Unless the teeth are regular in size and shape the set can never be regular, and it is therefore necessary to "joint" the saw until all are of equal height. Place the saw in a clamp, handle to the right. Lay a mill file on the teeth, pass it lightly back and forth the length of the blade, on the tops of the teeth, until the file touches every tooth.

SHAPING THE TEETH

(To be done only when the saw has been "jointed.") After jointing, all teeth must be filed to the correct shape. The gullets must be of equal depth. The fronts and backs of the teeth must have the proper shape. The teeth must be of equal size. To do this, place the file well down in the gullet, and file straight across the saw, at right angles to the blade (under no condition hold the file at any other angle). If the teeth you are filing are of unequal size, press the file against the teeth having the largest tops until you reach the centre of the flat top made by "jointing," then move the file to the next gullet, and file until the rest of the top disappears and the tooth has been brought up to a point. Make no effort to bevel the teeth at this time.

SETTING THE TEETH

If it is not necessary to "joint" and "shape" the teeth, examine the saw to see if the teth have the proper amount of set. If they have not, set in accordance with the following instructions.

Note.—It is always necessary to set the teeth when you have "jointed" and "shaped" the teeth of your saw. The teeth of a handsaw should be set before filing to avoid injury to the cutting edges.

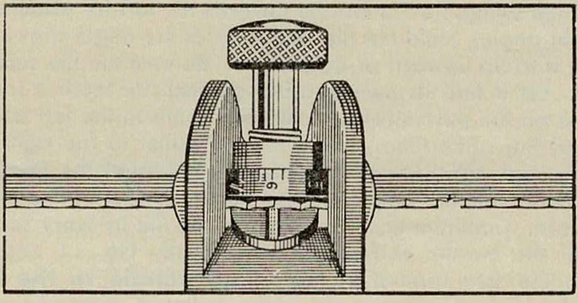
Purpose of Set.—The purpose of setting the teeth of saws is to make the saw cut slightly wider than the thickness of the saw blade. This gives clearance and prevents friction, which could cause the saw to bind and pull hard in the cut.

Depth of Set.—The depth of the set should not go, at the most, lower than **half the length of the tooth. This is important.** If deeper than this, it is sure to spring, crimp or crack the blade, if it does not break out the teeth. Soft, wet woods require more set and coarser teeth than hard, dry woods. For fine work on either hard or soft dry woods, it is best to have a saw with fine teeth and little set.

Setting with Saw Set.—The **upper half only** of each tooth should be sprung over, one to the right, one to the left, and so on alternately throughout the entire tooth edge.

SAW SET FOR SETTING HAND SAWS UP TO 16 GAUGE

The "Eclipse" No. 77 Saw Set is an adjustable saw set of exceptional quality and performance, with the following special features:



- Sets quickly and accurately the teeth of saws from 4 to 12 points and up to 16 gauge.
- The graduated anvil can be speedily adjusted by means of a knurled setting screw, to give the required depth.
- Unique dual action setting tool sets the tooth to required angle in one smooth, progressive movement.
- Teeth can be seen throughout the setting operation.

QUICK REMEDY FOR SAW THAT "RUNS"

When a few teeth of a saw are set out a little more on one side than on the other, causing the saw to "run" slightly, place it on the bench with the defective side up and give one light stroke the entire length of the blade with an oilstone, which will usually prove to be an effective cure. Of course, a saw in bad condition cannot be made to function correctly by this treatment. If you have a saw with too much set, both sides may be dressed down in this way.

FILING THE TEETH OF CROSS-CUT SAWS

Place the saw in clamp **with handle at right**. Stand at first position. Fig. 10, start at the point. Pick out the first tooth that is set **towards** you.

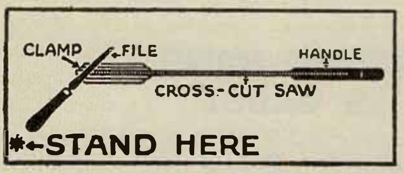


Fig. 10 — First position for filing handsaws for cross cutting.

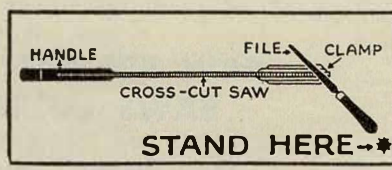
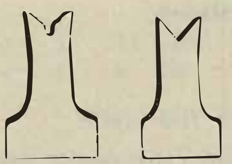


Fig. 11 — Second position for filing cross-cut saws.

Place file in the gullet to the left of this tooth. Hold file directly across the blade. Then swing the file handle towards the left for about 45 degrees (half of a right angle). Hold the file level and at the angle shown in Fig. 10. Do not allow it to tip upward or downward. Be sure the file sets well down in the gullet. Let it find its own bearing against the teeth it touches. The file should cut on the push stroke. It files the tooth to the left and the tooth to the right at the same time. Skip the next gullet to the right and place the file in the next gullet towards the handle. Repeat the filing operation on the two teeth the file now touches, being careful to file at the same angle as before. Continue this way, placing the file in every second gullet, till you reach the handle end of the saw. Study Fig. 11 before you go further. Turn the saw around in the clamp, **handle to the left.** Take second position, Fig. 11. Place file in the gullet to right of the first tooth set **towards** you. (This is the first of the gullets you skipped when filing the other side.) Turn file handle 45 degrees towards **right** this time. Now file as before. Continue this, placing file in every second gullet till you reach the handle of the saw.

THE CROSS-CUT SAW

Probably no other type of saw is made with so many different kinds of teeth as is the cross-cut saw.



Plain Raker — Swaged Raker

Hence we have the numerous shapes of teeth — the plain or tenor tooth; the two, four and six-cutter, with their rakers.

The raker-tooth was a discovery which led to faster cutting, the raker planing out and keeping the cut free from sawdust, which would interfere with the cutting or scoring teeth.

SETTING AND SHARPENING

To fit up a cross-saw properly it is necessary that the teeth be uniform in length. To accomplish this, place a file edgewise in the frame and secure it by thumb screws. Pass the tool lightly over the teeth until the file touches the shortest cutting tooth.

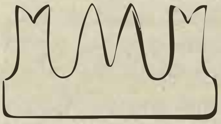


Fig. 12

Where swaged rakers are used, the swaging should follow the jointing. The two points of the rakers are first filed to sharp edges without reducing their length, after which each raker point should be swaged, or bent, outward and downward by the use of the swaging hammer.

Care should be taken to have the rakers shorter than the cutting teeth. If the rakers are too long they will not allow the cutting teeth to come in proper contact with the work, and the saw will not cut freely.

When filing, bring each tooth to a keen cutting edge, taking care not to reduce the length of the tooth any more than is necessary to remove the marks of jointing. The amount of bevel to the tooth should be determined by the class of timber to be cut. Hardwood requires less bevel than softwood. Figures 12 and 13 illustrate a style of "fitting" for very hard and dry timber. This style of fitting produces a long knife-like edge, which, though a shearing cut, readily severs the fibre of the hardest wood.

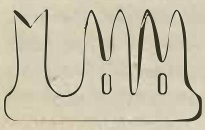


Fig. 13

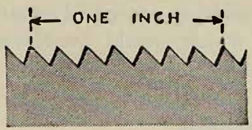
Fine-cut files are preferred for sharpening cross-cut saws, because they put a keener edge on the teeth than a coarser file.

FILING HAND SAWS FOR RIPPING

With one exception, this method is exactly the same as that given for cross-cut saws. This exception is that rip saws are filed with the file held **straight across** the saw at a right angle to the blade. Place saw in clamp with handle towards right. Start at the point. Place file in the gullet to the left of the first tooth set towards you. Continue, placing file in every second gullet, and filing straight across. When handle of saw is reached, turn saw around in the clamp. Start at the point, again placing file in first gullet skipped when filing from other side. Continue again in every second gullet till handle end is reached.

Select the Correct File for your Saws:—

Points to in. . .	3½	4	4½	5	6	7	8	9	10	11	12	—
Size of file . .	9	8	8	8	7	5½	5	5	4½	4	4	—



POINTS TO THE INCH

"Points to the inch" designates the size of teeth. A saw always has one more point to the inch than complete teeth in that inch.

PROPER CARE OF SAWS AND TOOLS

Moisture against a steel face, unless that face is well protected, means almost immediate rust. In order to keep a saw blade in the most perfect working condition, it must be entirely smooth on either side. Rust means pitting and, therefore, a rough surface. When you finish using a saw, rub it down with an oiled rag. In case the saw has been slightly rusted rub the blade down first with fine emery cloth and then apply the oil.

Another important thing is the way edge tools are put away. Always take care that the tooth edge is placed in such a position that no other tools will knock against the teeth and injure them.

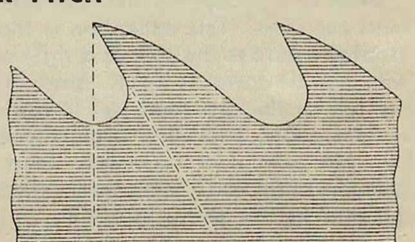
Common sense will lay down for you most of the necessary rules for caring for your tools. Keep them in good working order, in a clean container, or neatly arranged on hooks, and keep them in a dry place.

CLEANING RUSTY CROSS-CUT SAWS

An excellent method of cleaning and polishing a rusty cross-cut saw is as follows:—Drill a vertical hole in the centre of a small stump, and also saw a cut across it, passing through the hole; the depth of this cut should equal the width of the saw, minus the teeth. Invert the saw in the cut, allowing the teeth to project above the surface of the stump. Fill the hole around the saw with fine sand, and moisten with a little water. By working the saw as if sawing, it will quickly be scoured as clean and bright as when new.

CIRCULAR SAWS

HOOK OR PITCH



The hook, or pitch of the teeth, and the depth, size and shape of the gullets, all play an important part in the success or failure of the saw.

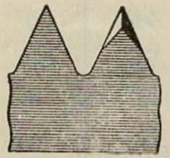
Too little hook will cause the teeth to tear and scrape instead of cutting. It takes much more power to force the saw through the log; the teeth get dull quickly, and the severe strain in the gullets stretches the rim so that the saw appears to lack tension.

Too much hook weakens the tooth and makes it liable to break out or dodge. The correct hook cuts the kerf out in shavings, but is never so extreme as to rob the tooth of its body, particularly at the base.

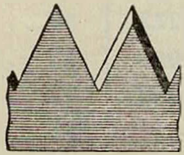
A good deal of hook may be carried, if the base of the tooth is rounded off into a good round gullet, giving plenty of space to carry off sawdust and at the same time leaving a strong base for the tooth.

FITTING SMALL CIRCULAR CUT-OFF SAWS

In fitting small circular cut-off saws, as in the fitting of small rip saws, it is essential in all cases that they be kept perfectly round. The teeth should be of uniform width and shape and the gullets of equal depth



Correct shape for teeth.



Teeth badly shaped.

and width. Every tooth should have the proper amount of bevel and this bevel should be alike on both sides of the tooth when a "V" tooth is used.

The point of the tooth only is bevelled. The point of the tooth being the only portion of the tooth that cuts, the remainder is left square across to carry out the sawdust.

In all saws where the teeth are sufficiently far apart to admit it the gullets should be kept round.

SET

The amount of set in these saws should be the least that will clear the plate sufficiently to prevent friction. The setting of the teeth is an important matter, and this work should be carefully done. The set should never extend too far into the body of the tooth, neither should the tooth be set too close to the point. Where an attempt is made to set the teeth too far into the body, the plate is often cramped, and saws are often cracked in this way.

On the other hand, they should never be set too near the points; they will be "needle-pointed" when bevelled. They will cut rough when in this condition and the points will be liable to bend back or crumble off in the cut.

SPEED OF CIRCULAR SAWS

The opinions of mill men vary as regards the proper speed for circular saws, but from our own observation, and the experience of some of the best sawyers and millwrights in the country, we have been led to adopt as the medium speed of all sizes of circulars a motion of nine to ten thousand feet per minute on the rim, the following table giving the number of revolutions per minute for the various sizes of circular saws:—

Size of Saw	Revs. per Min.	Size of Saw	Revs. per Min.	Size of Saw	Revs. per Min.
8	4500	30	1200	52	700
10	3600	32	1120	54	675
12	3000	34	1050	56	650
14	2585	36	1000	58	625
16	2222	38	950	60	600
18	2000	40	900	62	575
20	1800	42	870	64	550
22	1636	44	840	66	545
24	1500	46	800	68	529
26	1384	48	750	70	514
28	1285	50	725	72	500

DIRECTIONS FOR JOINTING BANDSAWS

Bevel each end of saw the length of two teeth. Fasten the saw in brazing clamps with the backs against the shoulder, and wet the joint with a creamy mixture made by rubbing a lump of borax in about a teaspoonful of water on a slate. Put in the joint a piece of silver solder the full size thereof, and clamp with tongs heated to a light red (not white) heat. As soon as the solder fuses blacken the tongs with water and take them off. Remove the saw, hammer it if necessary and file down to an even thickness, finished by draw-filing lengthwise.

TOOLS FOR CARPENTRY AND WOODWORK

As so many of the hints in this book are connected with woodwork in general, a few suggestions as to tools to use would be of interest.

It would also be helpful to have a knowledge of how to order timber.

TOOLS — A Useful Collection would be:—

1 German Jack Plane for very rough work — 1½ in.

1 Jack Plane, 2¼ in., for rough work and straightening slightly.

1 Trying Plane, 2½ in., for making surface perfectly straight.

1 Smoothing Plane, 2¼ in., for finishing job smoothly.

1 Rebate Plane, 1¼ in.

1 Rip Saw, 28 in., for cutting "down" the grain.

1 Hand or Panel Saw, for cutting across the grain.

1 Tenon Saw, for cutting tenons and shoudlers for fine work.

1 Turning Saw, for cutting circles, etc.

1 Nest of Saws.

4 Chisels, socket, ½ in., ⅝ in., ¾ in., and 1 in.

6 Chisels, firmer socket, ⅜ in., ½ in., ⅝ in., ¾ in., 1 in. and 1¼ in.

5 Augers, ½ in., ⅝ in., ¾ in., 1 in. and 1¼ in.

6 Bits, double twist, ¼ in., ⅜ in., ½ in., ⅝ in., ¾ in., and 1 in.

11 Bits, nails, Nos. 2 to 12.

1 Oilstone.
1 Claw Hammer.
1 Mortise Gauge.
1 Screwdriver.
1 Spokeshave.
1 Hatchet.
1 Wood Rasp, 12 in.
1 Pair Pincers, 7 in.
1 Clamp.

1 Two or Three Foot Rule.

1 Marking Gauge, single.

1 Brace, all iron, 10 in.

1 No. 2 Adze.

1 Pair Compasses, 8 in.

1 Spirit Level, 24 in.
1 Metallic Tape, 66 in.
1 Draw Knife, 10 in.
1 Square, 12 in.
1 Square, 6 in.
1 Mallet.
6 Bradawls.
1 Oil Can.
1 Pair Pliers, 7 in.

ORDERING TIMBER

The unit of measurement is "super" feet, which is the equivalent to one square foot of timber 1 in. thick. Therefore, two feet of 3 in. x 2 in. is equal to 1 super foot. As most timber is quoted at so much per super foot, it is useful to be able to measure the amount of timber in the order. A quick way to do this is to multiply the total length of the timber in feet by the dimensions in inches, and divide by 12.

Timber should be set out as under when ordering:—

Oregon	3 x 2	2/20,	3/14	
,,	4 x 1½	20/14,	$12/11^{6}$	P2S1E
,,	9 x 1½	4/22,	2/14	P1S1E
,,	3 x 3	22/12,		PAR
Jarrah	4 x 2	14/12,		

First, state the kind of timber, then the dimensions in inches, then the number of pieces and lengths of each. If exact lengths in inches are required (it is usual to order to nearest foot), indicate same with a small figure raised a little (as shown). Thus the first line means that 3 in. by 2 in. Oregon is required, two lengths of 20 ft., and three of 14 ft. The letters alongside mean:—

P2S1E — Planed two sides, one edge.
P.A.R. — Planed all round (as verandah post).
P.2.S. — Planed two sides (as a board).
P1S2E — Planed one side, two edges.
P.2.E. — Planed two edges.

The method of supering as given above does not apply to all timber, as flooring battens, etc., are sold per 100 running or lineal feet. Boards in varying thicknesses, such as shelving, are sold by the square foot.

PAINTING

Especially on wood, the first coat of paint should be rubbed well in and allowed to thoroughly dry before the succeeding coats are applied, each of which should be brushed out thoroughly and be quite dry before the application of another coat.

Two even coats, thoroughly dry, will give much better results than one heavy coat.

See that the surface is free from grease and dirt. If the job has been previously painted and is peeling, scaling off or cracking, burn off all the old paint.

See that the surface is perfectly dry. Moisture causes blistering, cracking, scaling and like troubles.

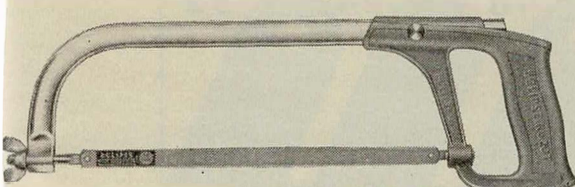
A pitchy surface should be treated either by burning or sealing with orange shellac. All knots should be carefully shellaced.

APPROXIMATE COVERING CAPACITIES OF FIRST QUALITY PAINT PRODUCTS

Type of Product	Sq. Ft. per Gal. (1 coat)
Exterior House Paint	850 (on wood).
Oil Wall Paint (Matt Finish)	880 on rough surface 1,150 on smooth wall } Reduced 5% Turps
Cold Water Paint	800/850 sq. yards per cwt.
Kalsomine	350/500 (5 lb. packet)
Cement Sealer	300/320 (on cement) 500/600 (on plaster)
Galvanised Iron Primer	900/1,000
Roof Paint	900/1,000
Flat Oil Stain	500/600
Varnishing Stain	500/600
Varnishes	550/600
Cement Paint	800 (on sealer) 420 (on old bare cement)

HACKSAWS

HACKSAW FRAMES

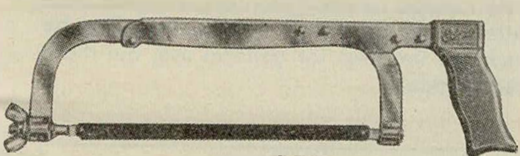


No. 20 T.

"ECLIPSE" TUBULAR HACKSAW FRAME No. 20 T

Adjustable from 8 to 12 ins. A substantial, rigid, reliable and perfectly balanced frame, designed to reduce fatigue.

The position of the handle ensures the forearm being in line with the blade.

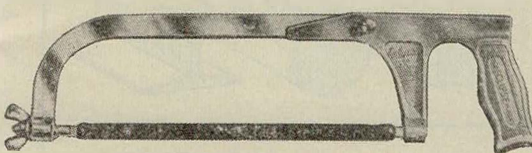


No. 80 P.G.

HACKSAW FRAMES No. 80 P.G.

Adjustable for 9", 10" and 12" blades.

A sturdy and robust adjustable frame with pistol-grip handle. The frame is plated and the handle is manufactured from a special blue plastic material.

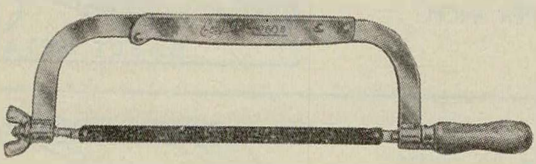


No. 40 P.G.

PISTOL GRIP PATTERN No. 40 P.G.

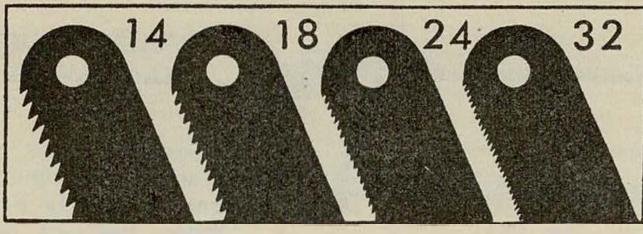
Adjustable 8 in.-12 in. Provides comfortable grip in a natural position. Adjustment is indicated by graduations upon the bow, which slide into a socket integral with the handle. Nickel-plated finish.

OVAL TELESCOPIC PATTERN No. 60 B



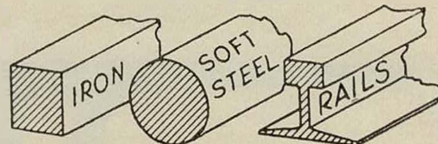
Adjustable 8 in.-12 in. A sturdy and robust frame with graduated scale and telescopic adjustment for the rear half into an oval tubular bow bend. Blued, rust-resisting finish.

PICKING THE PROPER BLADE FOR THE JOB

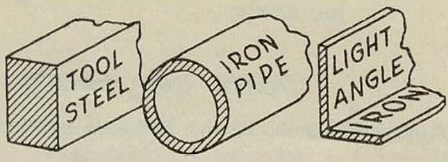


Blades are made with a varying number of teeth per inch, ranging from 14 to 32. Selection of the blade should be based upon material to be cut. Blades with 18 teeth per inch are the best for general use, but there is no such thing as an "all-purpose" blade.

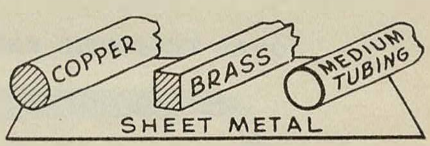
USE 14 TEETH PER INCH



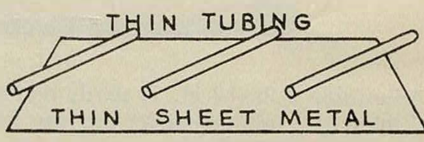
USE 18 TEETH PER INCH



USE 24 TEETH PER INCH



USE 32 TEETH PER INCH



INSERTING BLADE IN FRAME

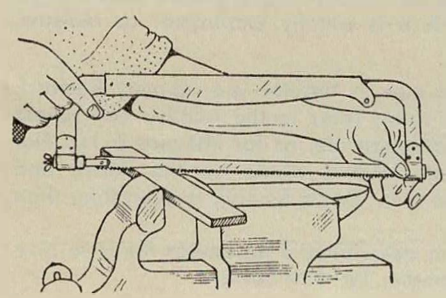
Insert the blade with teeth pointing away from the operator and tighten so the blade is well strained, but not to the point where the pins will shear or loosen. Be sure blade is square and true in the frame. Since edge-hardened blades are flexible, they should be strained tighter than those that **are hardened all over**. After the first few strokes it is good practice to tighten a new blade.

ADDITIONAL BLADE HELPS HACKSAW

When a hacksaw is used to cut metal tubing, the blade often sticks, and at the same time cuts the tubing at an incorrect angle. These problems can be eliminated if a second blade, with its teeth ground off, is fitted to the holder, alongside of the cutting blade. The regular blade cuts through the tubing while the guide blade rises on top of the tubing, holding the cutting blade up and at its correct angle. The guide blade can be removed easily when it is not to be used.

HOW TO CONSERVE HACKSAW BLADES

Breakage necessitates blade replacement much more frequently than does wear. Many blades are broken because too much pressure is applied when cutting a small surface. The concentration of pressure at a single point on the blade causes it to buckle and break. This failure occurs more readily when blade is weakly strained.



Cramping and binding causes considerable breakage that can be avoided by sawing with straight-line strokes, taking care not to tilt or cant the saw frame.

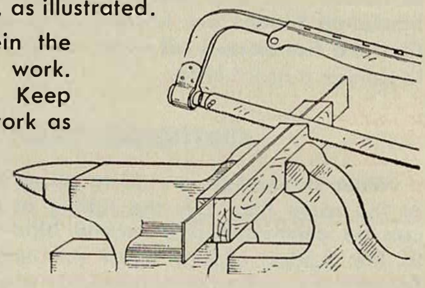
Insecurely held work, likewise, is a frequent cause of blade breakage. If the work becomes loose while cutting, the sudden binding and distortion of the blade is practically sure to cause breakage.

HINTS ON HACKSAW USE

Use normal care in handling the hacksaw. Don't use the frame as a hammer or pry. Make sure the material to be cut is held rigid and so placed that the maximum number of teeth engage throughout the cut. At least two teeth should be in contact with the work at all times.

Begin the cut carefully but with sufficient pressure to make the teeth cut . . . not merely **rub** on the metal. Lift the saw slightly on the return stroke to avoid dragging the teeth and thus dulling the cutting edge. Forty or fifty strokes per minute is about top speed for efficiency. For faster cutting, increase pressure . . . not the speed. When cutting very thin stock, a good method, if conditions permit, is to clamp it between two pieces of wood and saw through the whole assembly, as illustrated.

Never permit a condition wherein the teeth of the blade "straddle" the work. Stripped teeth are bound to result. Keep as many teeth in contact with the work as possible by changing angle of contact between blade and work, using a blade of finer pitch, or by "sandwiching" as explained above.



FILES

DISTINGUISHING FEATURES

LENGTH — The length of a file is always measured from the shoulder to the point, and does not therefore include the tang.

KIND OR TYPE — The common description of a file is usually derived either from the shape, as is the case with Round, Square, Half Round, Flat, or from the type of work on which it is usually employed, as Millsaw, Cantsaw, Warding.

CUT — There are three standard cuts in regular use, namely Bastard, Second Cut and Smooth, and these terms refer to the relative coarseness or fineness of the given file. In a particular file, as for instance a 10" Flat file, Bastard would be the coarsest, Smooth would be the finest, and Second Cut would be in between the two. Dead Smooth is even finer than Smooth.

The normal procedure therefore in describing a particular file is to give its length, name, and cut, as, for example, 10" Flat Bastard.

TYPES OF FILES

The **FLAT** file is one of the most popular files made and has a wide use on all classes of metal work. It is slightly tapered in width and thickness and is cut on both sides and edges.

The **HAND** file is similar to the Flat file but is parallel in width and tapers only in thickness. One edge is uncut or safe as it is usually called, allowing it to be used where a cut edge would damage the work.

The **HALF ROUND** file is one of the most popular of all engineers' files as it can be used to file both flat and concave surface. On concave surfaces the file is used with a rolling motion to prevent grooving the work.

The **ROUND** file is extensively used for the opening up of holes and for filing concave surfaces. Like the Half Round file it should be used with a turning motion to prevent grooving the work.

The **SQUARE** file is used principally for enlarging apertures of a square or rectangular shape.

The **THREE SQUARE** file has a limited use where its triangular shape is of value. Its section is equilateral and it is Double Cut.

The **WARDING** file was originally designed for the locksmith for filing the wards of locks and keys but its use has extended to work where a thin section file with a point sharply tapered in width can be used.

The **MILLSAW** file is primarily designed for the filing of saws but has many other useful applications, including the sharpening of various kinds of cutting tools which are usually tempered to a high degree of hardness and require a fine, smooth finish. Single Cut.

The **TRIANGULAR SAW** file is carefully made for the exacting work of sharpening handsaws, bandsaws, and all other types of saws having 60° angle teeth. The most commonly used are called Slim Tapers but some Regular Tapers, and Extra Slim Tapers are used, and all are Single Cut.

It is important that a file be chosen the side of which is slightly more than twice the depth of the saw tooth and of a length to permit of effective stroking of the work.

The edges of the file perform the important function of filing the bottom of the gullet and when a saw has been sharpened with a particular file, the gullets will have the same shape as the cross section of the file. Next time the saw is sharpened, the file then used must be the same as the previous file, or unnecessary filing and possible damage to the file will be caused.

The **BANDSAW** file is made with rounded cut edges to suit the gullet between bandsaw teeth.

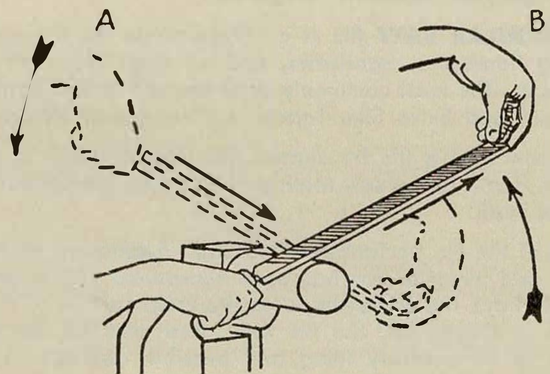
The **CANTSAW** file is for sharpening saws where the obtuse angle at the back of the file can be used to advantages such as on "M" shaped teeth.

HOW TO USE THE FILE

The file cuts by means of the teeth which have been raised by the process of the cut. If these teeth, as they are called, are examined under a powerful magnifying glass, they will be found to consist of a number of ridges with very sharp, fine points. The sharpness of these points determines whether or not the file itself is sharp.

When filing a flat surface, the file should be held firmly in a level position and pushed straight across the work. Nearly all files are tapered or "bellied" to allow for the file springing when pressure is put upon it and also to place only a few of the teeth in contact with the metal at one time. This reduces the power required to push the file across the metal, but it also makes it difficult to file a perfectly flat surface with a stroke that goes directly across the work. For this reason mechanics will draw file the piece when they wish to get it flat. This is done by holding the file in both hands at right angles to the work and rubbing the file back and forth, bearing down just hard enough to make the file cut. Draw filing is generally used when fitting keys or in light work where the surface must be flat and true.

It is often necessary to file a round surface. The file should be held with the handle elevated at the beginning of the stroke and as the stroke progresses the hand is lowered so that at the end of the stroke the hand is in the lowest position. The file must, of course, be raised on the return stroke and must be laid on the work at the beginning of the stroke with



a smooth, easy action. If it is allowed to strike the work, a disagreeable jolt results, and it also destroys the cutting edge of the teeth at the point where they strike the work.

CARE OF FILES

Files should never be used as a pry nor to file sandy castings or any surface which is harder than the file itself. One stroke of the file across the sandy surface of the casting will render it useless, as the sand will remove all the fine cutting edges.

In the storing of files it is as well to keep them in a separate compartment of the tool box, for they can quite easily be damaged by throwing on to them hammers, chisels, or other heavy tools. Another point to be watched is to keep files away from water or any acids likely to cause corrosion. It will be obvious that rust can destroy the sharpness of file teeth very quickly.

USING THE FILE TO ADVANTAGE

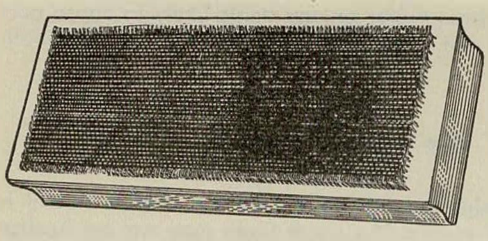
Of first importance when using a new file is to make certain that it is first used on fairly soft metals so that the small teeth may not be broken off by biting into tough metals. The order of metals upon which files should for preference be used is approximately as follows:—Start off on brass, gunmetal, bronze, and similar soft alloys so that the extreme newness of the cutting teeth should be worn off gradually and also that the maximum degree of cutting should be exercised on metals for which it is most essential; next on the list comes cast iron (that is, of course, cast iron from which the extremely hard outer layer has first been removed by an older file); which may be followed by wrought iron and steel respectively. If, for instance, this order was to be reversed the file would have a great number of its teeth broken off in the first few minutes of its application to the tough steel, while the remaining teeth would have their cutting edges prematurely dulled, so that by the time brass and similar soft metals were worked it would be found practically impossible to make any impression on their surface.

There are, however, exceptions to the above. Do not use a new file on lead or aluminium, as these soft metals will so clog up the teeth of the file that it will be almost useless for further work. If the job is a small one, make an old file do.

A new or almost new file should never be used on narrow surfaces, since it is practically impossible to prevent the teeth breaking. It will be found, too, that a file which is seemingly worn out so far as broad surfaces are concerned will work quite efficiently on narrow pieces of metal. It is also a worthwhile economy to keep an old file for first work on any casting or forging from which the very hard outside scale has not been removed. There are few filing operations more detrimental to a good file than work on such hard surfaces.

Again, in the actual filing much can be done to add to the life of a file. In filing, it is necessary to remove pressure from the file during the backward stroke so that it simply moves lightly across the surface of the work; if pressure is maintained on both strokes it is almost certain that many teeth will be broken during the return stroke. Another mistake which will prove expensive is that of using a coarse file on hard steel; for such material a file of medium roughness is to be recommended.

It is necessary when doing much filing to clean the file at intervals. This is not necessary in the case of cast iron or brass since the small particles which tend to clog up the teeth are easily removed by giving the



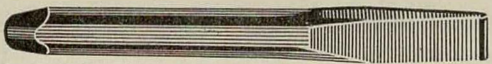
File Card for Cleaning Files

side of the file a smart tap on the bench from time to time which will cause the easily dislodged particles to fall away. When working on wrought iron, steel, copper, aluminium, etc., this method will not assist to any material extent. In such cases it becomes necessary to use what is known as a file card, which is actually a form of brush comprised of short steel wire bristles. By brushing this smartly across the file it will be found that most of the clinging particles of metal can be removed.

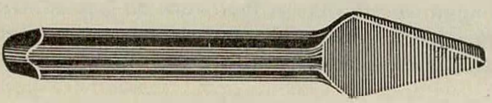
CHISELS

TYPES — There are four general types of cold chisels in common use. The common or flat chisel, usually referred to as a "chisel"; the crosscut chisel; the diamond point chisel; and the round nosed chisel, often called the "gouge."

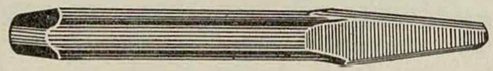
SIZES — The size of the cold chisel is generally given as the width of the cutting point. The size of the diamond point chisel is generally given as the size of the square stock at the cutting edge. It is made by drawing out the ends of the stock to a square sharp point, afterwards being ground so that one of the corners forms the apex of the cutting edge. The size of the round nosed chisel or gouge is given as the width of the stock from which the tool is made. The length of all these tools varies with the purpose for which they are to be used. It may be 6 inches, or longer.



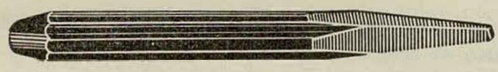
Flat Chisel



Crosscut Chisel

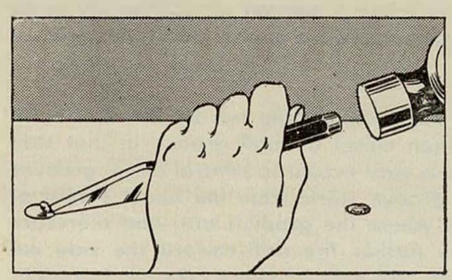


Round Nose Chisel

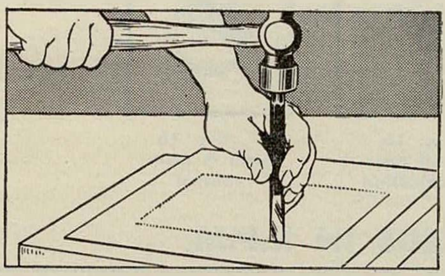


Diamond Point Chisel

HOW TO USE A COLD CHISEL



Probably the easiest way to remove a rivet head is to use a Crosscut Chisel, as illustrated. Cut through centre section first, then knock off the two side wings.



Use a Flat Chisel to cut sheet metal with a back plate. First scribe the line or design and with sheet laid on back plate, cut as illustrated. Finish edges with a file.

In the case of the flat chisel, the angle at which the chisel is held while at work is determined by the angle at which the cutting edge is ground. The lower face of the cutting edge acts as a guide while the wedging action of the metal tends to hold the chisel on a straight line. This is a matter which comes from practice.

A few simple but important rules govern the use of cold chisels. First of all, cold chisels are designed to cut only metals softer than the tool itself. Hardened steel such as drill rod, hacksaw blades, etc., cannot be cut with a chisel. Use a chisel large enough for the job at hand. Use the centre of the blade rather than just one point or corner. Always use a heavy hammer. Too light a hammer tends to burr the chisel head and does not sufficiently transmit the force of the hammer blow to the cutting edge.

It is necessary to watch the point of the chisel and not the head. The experienced mechanic will very seldom look at the head of the chisel when chipping, as he will instinctively hold his hammer in such a position that it will strike the head of the chisel without his looking at it. This is necessary in order to keep the chisel in the proper position for cutting.

NOTES ON DRILLING

To get the best results from drills and drilling machines, the drill should advance into the work a definitely regulated amount for each revolution. The distance which the drill advances per revolution is termed the feed, and must be adjusted to suit the conditions under which the work is being performed.

When starting a drill, it often has a tendency to slide off to one side.

(F.g. 14). The drill can be brought back into the correct position by using a small gouge-pointed chisel, sometimes called a centre chisel; the process is termed "drawing the drill."

First note toward which side of the small dimple left by the drill point it is necessary to shift the drill. Then chisel a small groove in that side of the dimple. (Fig. 15.) If the start is very eccentric several chisel grooves will be necessary. Make sure the groove starts from the exact centre of the hole. The drill cuts more easily where the grooves are, and therefore the resistance of the opposite side pushes the drill toward the side cut by the chisel. (Fig. 16.) Drill drawing can only be done previous to reaching the full diameter of cut.

Fig. 14
Drill slides off-centre

Fig. 15
A small groove is chiselled

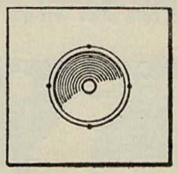


Fig. 16
Drill is now central

DRILL SPEEDS IN R.P.M.

Diameter of Drill	Soft Metals 300 F.P.M.	Plastics and Hard Rubber 200 F.P.M.	Annealed Cast Iron 140 F.P.M.	Mild Steel 100 F.P.M.	Malleable Iron 90 F.P.M.	Hard Cast Iron 80 F.P.M.	Tool or Hard Steel 60 F.P.M.	Alloy Steel Cast Steel 40 F.P.M.
1/16 (No. 53 to 80)	**18320**	**12217**	**8554**	**6111**	**5500**	**4889**	**3667**	**2445**
3/32 (No. 42 to 52)	**12212**	**8142**	**5702**	**4071**	**3666**	**3258**	**2442**	**1649**
1/8 (No. 31 to 41)	**9160**	**6112**	**4278**	**3056**	**2750**	**2445**	**1833**	**1222**
5/32 (No. 23 to 30)	**7328**	**4888**	**3420**	**2444**	**2198**	**1954**	**1465**	**977**
3/16 (No. 13 to 22)	**6106**	**4075**	**2852**	**2037**	**1833**	**1630**	**1222**	**815**
7/32 (No. 1 to 12)	**5234**	**3490**	**2444**	**1745**	**1575**	**1396**	**1047**	**698**
1/4 (A to E)	**4575**	**3055**	**2139**	**1527**	**1375**	**1222**	**917**	**611**
9/32 (G to K)	**4071**	**2712**	**1900**	**1356**	**1222**	**1084**	**814**	**542**
5/16 (L, M, N)	**3660**	**2445**	**1711**	**1222**	**1100**	**978**	**733**	**489**
11/32 (O to R)	**3330**	**2220**	**1554**	**1110**	**1000**	**888**	**666**	**444**
3/8 (S, T, U)	**3050**	**2037**	**1426**	**1018**	**917**	**815**	**611**	**407**
13/32 (V to Z)	**2818**	**1878**	**1316**	**939**	**846**	**752**	**563**	**376**
7/16	**2614**	**1746**	**1222**	**873**	**786**	**698**	**524**	**349**
15/32	**2442**	**1628**	**1140**	**814**	**732**	**652**	**488**	**326**
1/2	**2287**	**1528**	**1070**	**764**	**688**	**611**	**458**	**306**
9/16	**2035**	**1357**	**950**	**678**	**611**	**543**	**407**	**271**
5/8	**1830**	**1222**	**856**	**611**	**550**	**489**	**367**	**244**
11/16	**1665**	**1110**	**777**	**555**	**500**	**444**	**333**	**222**
3/4	**1525**	**1018**	**713**	**509**	**458**	**407**	**306**	**204**

Figures are for High-Speed Drills. The speed of Carbon Drills should be reduced by one-half. Use drill speed nearest to figure given.

DECIMAL EQUIVALENTS OF TWIST DRILLS

NUMBERS, LETTERS AND FRACTIONS

Drill	Diam. Ins.	Drill	Diam. Ins.	Drill	Diam. Ins.	Drill	Diam. Ins.
80	.0135	42	.0935	7	.2010	25/64	.3906
79	.0145	3/32	.0937	13/64	.2031	X	.3970
1/64	.0156	41	.0960	6	.2040	Y	.4040
78	.0160	40	.0980	5	.2055	13/32	.4062
77	.0180	39	.0995	4	.2090	Z	.4130
76	.0200	38	.1015	3	.2130	27/64	.4219
74	.0225	37	.1040	7/32	.2187	7/16	.4375
73	.0240	36	.1065	2	.2210	29/64	.4531
72	.0250	7/64	.1094	1	.2280	15/32	.4687
71	.0260	35	.1100	A	.2340	31/64	.4843
70	.0280	34	.1110	15/64	.2344	1/2	.5000
69	.0292	33	.1130	B	.2380	33/64	.5156
68	.0310	32	.1160	C	.2420	17/32	.5312
1/32	.0313	31	.1200	D	.2460	35/64	.5469
67	.0320	1/8	.1250	E	.2500	9/16	.5625
66	.0330	30	.1285	1/4	.2500	37/64	.5781
65	.0350	29	.1360	F	.2570	19/32	.5937
64	.0360	28	.1405	G	.2610	39/64	.6094
63	.0370	9/64	.1406	17/64	.2656	5/8	.6250
62	.0380	27	.1440	H	.2660	41/64	.6406
61	.0390	26	.1470	I	.2720	21/32	.6562
60	.0400	25	.1495	J	.2770	43/64	.6719
59	.0410	24	.1520	K	.2810	11/16	.6875
58	.0420	23	.1540	9/32	.2812	45/64	.7031
57	.0430	5/32	.1562	L	.2900	23/32	.7187
56	.0465	22	.1570	M	.2950	47/64	.7344
3/64	.0469	21	.1590	19/64	.2969	3/4	.7500
55	.0520	20	.1610	N	.3020	49/64	.7656
54	.0550	19	.1660	5/16	.3125	25/32	.7812
53	.0595	18	.1695	O	.3160	51/64	.7969
1/16	.0625	11/64	.1719	P	.3230	13/16	.8125
52	.0635	17	.1730	21/64	3281	53/64	.8281
51	.0670	16	.1770	Q	.3320	27/32	.8437
50	.0700	15	.1800	R	.3390	55/64	.8594
49	.0730	14	.1820	11/32	.3437	7/8	.8750
48	.0760	13	.1850	S	.3480	57/64	.8906
5/64	.0781	3/16	.1875	T	.3580	29/32	.9062
47	.0785	12	.1890	23/64	.3594	59/64	.9219
46	.0810	11	.1910	U	.3680	15/16	.9375
45	.0820	10	.1935	3/8	.3750	61/64	.9531
44	.0860	9	.1960	V	.3770	31/32	.9687
43	.0890	8	.1990	W	.3860	63/64	.9844
						1	1.0000

TAPPING DRILL TABLES

NOTE — The small index figures show clearance in thousandths of an inch on minimum minor diameter of the nut thread.

BRITISH STANDARD WHITWORTH — B.S.W.

Nominal Diameter of Thread B.S.W. Fractional Size	Nominal Diameter of Thread Decimal Equivalent in.	Number of Threads per inch	Drill Sizes For Commercial Tapping Recommended	Alternatives	
1/8	0.1250	40	**38** [8]	39 [7]	40 [5]
3/16	0.1875	24	**26** [13]	27 [10]	28 [6]
1/4	0.2500	20	**7** [15]	N [7]	13/64 [2]
5/16	0.3125	18	**F** [17]	8 [13]	10 [7]
3/8	0.3750	16	**5/16** [17]	1/4 [9]	D [5]
7/16	0.4375	14	**23/64** [13]	T [12]	S [2]
1/2	0.5000	12	**Z** [20]		13/32 [13]
9/16	0.5625	12	**15/32** [13]		—
5/8	0.6250	11	**17/32** [23]		33/64 [7]
11/16	0.6875	11	**19/32** [23]		37/64 [7]
3/4	0.7500	10	**41/64** [19]		5/8 [3]
7/8	0.8750	9	**3/4** [17]		47/64 [2]
1	1.0000	8	**55/64** [19]		27/32 [4]
1-1/8	1.1250	7	**31/32** [27]		61/64 [11]
1-1/4	1.2500	7	**1-3/32** [27]		1-5/64 [11]
1-1/2	1.5000	6	**1-5/16** [26]		—

BRITISH STANDARD FINE — B.S.F.

Nominal Diameter of Thread B.S.W. Fractional Size	Nominal Diameter of Thread Decimal Equivalent in.	Number of Threads per inch	Drill Sizes For Commercial Tapping Recommended	Alternatives	
3/16	0.1875	32	**22** [10]	24 [4]	5/32 [9]
7/32	0.2188	28	**14** [9]	15 [7]	16 [4]
1/4	0.2500	26	**4** [8]	5 [6]	6 [3]
9/32	0.2812	26	**C** [10]	B [6]	15/64 [2]
5/16	0.3125	22	**H** [12]	G [7]	17/64 [11]
3/8	0.3750	20	**P** [12]		O [5]
7/16	0.4375	18	**V** [11]		3/8 [9]
1/2	0.5000	16	**7/16** [17]		27/64 [2]
9/16	0.5625	16	**1/2** [17]		31/64 [2]
5/8	0.6250	14	**35/64** [13]		—
11/16	0.6875	14	**39/64** [13]		—
3/4	0.7500	12	**21/32** [13]		—
13/16	0.8125	12	**23/32** [13]		—
7/8	0.8750	11	**25/32** [23]		49/64 [17]
1	1.0000	10	**57/64** [19]		7/8 [3]
1-1/8	1.1250	9	**1** [17]		63/64 [2]
1-1/4	1.2500	9	**1-1/8** [17]		1-7/64 [2]
1-3/8	1.3750	8	**1-15/64** [19]		1-7/32 [4]
1-1/2	1.5000	8	**1-23/64** [19]		1-11/32 [4]

TAPPING DRILL TABLES (continued)

NOTE — The small index figures show clearance in thousandths of an inch on minimum minor diameter of the nut thread.

BRITISH ASSOCIATION — B.A.

Nominal Diameter of Thread: Designation No.	Nominal Diameter of Thread: Decimal Equivalent in.	Approx. Number of Threads per inch	Drill Sizes For Commercial Tapping: Recommended	Drill Sizes For Commercial Tapping: Alternatives
12	0.0512	90.7	**59**^{3}	60^{2} 62^{0}
11	0.0591	81.9	**3/64**^{2}	56^{2}
10	0.0669	72.6	**54**^{5}	55^{2}
9	0.0748	65.1	**53**^{3}	—
8	0.0866	59.1	**50**^{4}	51^{1}
7	0.0984	52.9	**45**^{6}	5/64^{2} 48^{0}
6	0.1102	47.6	**43**^{4}	44^{1}
5	0.1260	43.1	**36**^{8}	38^{3} 40^{0}
4	0.1417	38.5	**32**^{5}	33^{2} 34^{0}
3	0.1614	34.8	**29**^{9}	30^{2}
2	0.1850	31.3	**22**^{10}	24^{5} 26^{0}
1	0.2087	28.2	**16**^{11}	11/64^{6} 18^{3}
0	0.2362	25.4	**7**^{12}	9^{7} 11^{2}

UNIFIED FINE — U.N.F.

Nominal Diameter of Thread: U.N.F. Fractional Size	Nominal Diameter of Thread: Decimal Equivalent in.	Number of Threads per inch	Minor Diameter of Nut Thread: Maximum in.	Minor Diameter of Nut Thread: Minimum in.	Drill Sizes Recommended
1/4	0.2500	28	0.2190	0.2113	**7/32**^{7}
5/16	0.3125	24	0.2754	0.2674	**I**^{5}
3/8	0.3750	24	0.3372	0.3299	**Q**^{2}
7/16	0.4375	20	0.3916	0.3834	**25/64**^{7}
1/2	0.5000	20	0.4537	0.4459	**29/64**^{7}
9/16	0.5625	18	0.5106	0.5024	**33/64**^{13}
5/8	0.6250	18	0.5728	0.5649	**37/64**^{13}
3/4	0.7500	16	0.6907	0.6823	**11/16**^{5}
7/8	0.8750	14	0.8068	0.7977	**13/16**^{15}
*1 — N.S.	1 0000	14	0.9315	0.9227	**15/16**^{15}

* A size in common use. Usually termed 1″ National Special (formerly 1″ N.F.).

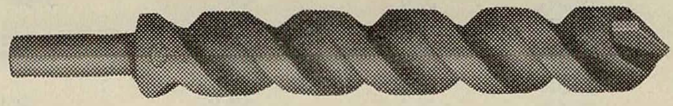
UNIFIED COARSE — U.N.C.

Nominal Diameter of Thread: U.N.C. Fractional Size	Nominal Diameter of Thread: Decimal Equivalent in.	Number of Threads per inch	Minor Diameter of Nut Thread: Maximum in.	Minor Diameter of Nut Thread: Minimum in.	Drill Sizes Recommended
1/4	0.2500	20	0.2067	0.1959	**13/64**^{7}
5/16	0.3125	18	0.2630	0.2524	**G**^{9}
3/8	0.3750	16	0.3182	0.3073	**O**^{9}
7/16	0.4375	14	0.3717	0.3602	**U**^{8}
1/2	0.5000	13	0.4284	0.4167	**27/64**^{8}
9/16	0.5625	12	0.4832	0.4723	**31/64**^{12}
5/8	0 6250	11	0.5391	0.5266	**17/32**^{5}
3/4	0.7500	10	0.6545	0.6417	**21/32**^{14}
7/8	0.8750	9	0.7681	0.7547	**49/64**^{11}
1	1.0000	8	0.8797	0.8647	**7/8**^{10}

T.E.C. MASONRY DRILLS

Penetrate Brick, Cement, Marble, Tile, etc., Quicker, Easier, More Accurately

It is a simple, fast and effortless job to drill through brick, tile, marble, slate and other masonry materials with the T.E.C. Masonry Drills. The sharp cutting point quickly penetrates and produces round, clean, accurate holes. Suitable for use in any rotary drill, hand brace, power tool or drill press, T.E.C. Masonry Drills will last longer than ordinary steel drills and offer many cost-saving advantages.



GENERAL INSTRUCTIONS FOR USE

1. Use no lubricant — the drill operates best dry.
2. Apply pressure — the "Carboloy" tip cuts at its best when hard up against the material.
3. Never wrench backwards — to clear, switch off drill and, while rotating, withdraw from hole.
4. Keep drill sharp – - regular sharpening, when cutting edge wears down to a 1/64" flat, not only means fast, clean accurate holes but reduces wear of the "Carboloy" tip.

Provided with sufficient oversize allowance to give the right hole size for correct installation of expansion bolts, anchors, toggle bolts and other fixing devices, T.E.C. Masonry Drills are made in a complete range of diameters, with straight, round shanks, from 5/32" to 1 1/4" for any size or type of wall plug or fixing device.

Drills are also made in 13" lengths in sizes 1/2" and over for penetrating double brick walls.

DRILLING GLASS

It is frequently necessary for holes to be drilled in glass, safety or otherwise, and it may be desirable to do this in the workshop to save the inconvenience of a visit to the glass merchant. Holes may be drilled as follows:—

Use a round tube made of copper or brass, the outside diameter being equal to the size of the hole required in the glass; a mixture of carborundum and oil should then be applied to the end of the copper tube with a piece of wood and the tube rotated in a drilling machine.

To prevent breakages, rest the glass on a piece of rubber or felt, which should be a little larger in area than the hole to be drilled.

Any roughness remaining in the hole should be removed with an old round smooth file dipped in turpentine.

DRILLING GLASS — ANOTHER METHOD

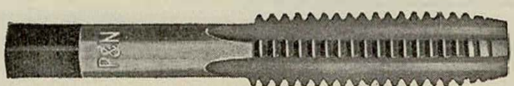
T.E.C. Cemented-Carbide Glass Drills are available in diameters 1/8 to 1/2 inch, from McPherson's Limited. These are preferable to other methods where more than one hole is required.

Drilling of glass, pottery, tiles, etc., is tremendously simplified with these drills.

This Spearpoint type of Glass Drill should be used at approximately 1,000 r.p.m. with genuine turpentine (not substitute) as a lubricant.

Diameter: 1/8, 3/16, 1/4, 5/16, 3/8, 7/16, 1/2 in.

TAPS



The principal cause of breakage in taps is that of pulling the tap unevenly, thereby causing it to break. It is, therefore, necessary that the wrench that is used be handled carefully and that it be pulled with an even steady pressure all the way round. At the same time the fingers must be placed against the tap to prevent it from getting out of line when starting or from bending after it is started.

The best way to use the wrench is to hold it between the thumb and forefinger and turn the tap slowly. After each half-turn the tap should be backed off in order to break up the chip.

When tapping steel or bronze, lard oil is a good lubricant. Many mechanics use a thin mixture of white lead and machine oil as a lubricant when tapping cast iron. The machine oil acts as a lubricant while the white lead prevents the chips from falling to the bottom of a blind hole. If the iron is very hard, a little kerosene or turpentine on the tap will help materially.

For tapping aluminium, use kerosene as a lubricant.

Care must be taken to get the tap started straight. Most mechanics do this as follows:—

1. Place the tap in the hole, setting it approximately square as judged by the eye.

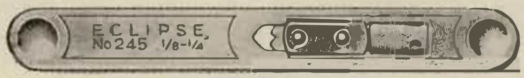
2. Give it one full turn, then look at it from two different angles 90 degrees apart. If it is straight in the two directions, give it another turn, being careful to hold it steady and straight.
3. Look at it again from the two positions to be sure it is still straight.
4. Continue watching the tap closely after each turn to be sure it is going straight.

If by any chance the tap does not start straight, it must be backed out from the hole and started again after having been straightened. The taper on the end of the tap makes this possible for, if care is taken, it will cut a new path provided it is held straight at the beginning.

HANDY TAPPING GUIDE

To assist in keeping the tap straight, take a faced nut of the required size and run it up on to the tap. Keep the faced surface of the nut flat against the work; the nut then guides the tap and keeps it straight.

"ECLIPSE" TAP WRENCHES



"ECLIPSE" SUPER TAP WRENCH

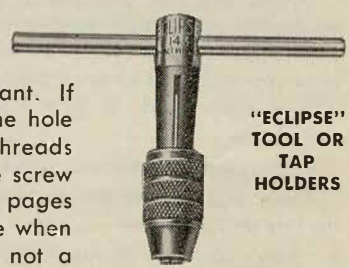
SUPER TAP WRENCH

The square of the tap is always gripped by the whole depth of the jaws owing to their neat and thin construction. An even and centralized pressure is thus exerted which ensures absolute rigidity and correct alignment of even the smallest taps in the range provided for.

The use of flat section material for the body of the tap wrench facilitates correct and rapid alignment and so permits easy starting and square tapping.


"ECLIPSE" TAP WRENCHES
ADJUSTABLE BAR TYPE

SELECTING THE TAP DRILLS


"ECLIPSE" TOOL OR TAP HOLDERS

The correct size drill for a tap is important. If the hole is too small, the tap will bind in the hole and very likely break. If it is too large, the threads in the hole will not be deep enough for the screw to hold. The correct sized drill is given on pages 28-29, which should be consulted each time when a drill is desired for a certain tap. It is not a good idea to trust to memory, as one is liable to get the wrong sized drill.

GENERAL HINTS

ANNEALING COPPER

Copper may be annealed by heating it to a dull red heat and then cooling it down immediately by plunging it into cold water. (If this process was applied to a steel it would have the effect of hardening rather than softening.) Copper tube is annealed in this same way, but care must be observed when quenching it in water, for very often a stream of steam and boiling water will be projected from the inside of the tube by the sudden act of cooling and is likely to cause unpleasant burns if it should come in contact with either the hands or the face.

RIVETING

The hole must be the correct size. For rivets up to ½ in. diameter the hole is generally drilled 1/32 in. larger than the rivet where it is to be heated. For sizes 5/8 in. diameter or larger, the hole is generally 1/16 in. larger for hot rivets. The allowable length for rivets varies with the different sizes. When hot riveting is being done, a table of lengths should be consulted before the rivets are ordered. The length of the rivet is important, because if it is too short the head will not be large enough to carry its load.

For cold riveting the hole should be drilled barely large enough to allow the rivet to go through easily. There must be as little clearance as possible.

Rivet Driving.—In driving cone-head or button-head rivets, they should be "plugged" squarely into the hole, care being taken not to bend over the point of the rivet but to upset it, filling the hole in its entire length. A riveting hammer should be powerful enough to form a perfect head without rocking the hammer to work down the edges. The hammer should be started lightly until the rivet has settled into the hole somewhat, to prevent bending to one side. In driving any kind of rivets held or backed up by a dolly-bar or hand-hammer, the riveter should run the hammer slowly until enough head is formed to hold the rivet in the hole, as otherwise the holder-on will have difficulty in keeping the hammer or dolly-bar on the rivet. Getting the rivets into the holes hot and "getting the heads up" is a necessary preliminary to obtaining tight work.

The length of the rivet is important. If it is not long enough, the rivet will not hold; and if it is too long, it will be necessary to hammer the rivet until the metal becomes crystallised and is liable to break when a strain it put on it. For the smaller sized rivets up to about 3/8 in. diameter, the extra length for riveting should be equal to about one-half the diameter of the rivet. For diameters greater than 3/8 in., the riveting length should be about one-third or one-quarter the diameter of the rivet.

OTHER USEFUL HINTS

SIMPLE METHOD OF LOCKING NUTS

Nuts are easily locked on bolts so that they will not be loosened by vibration. To do this, saw about half-way through one side of the nut, screw it in position on the bolt, and then close the saw slot with a hammer. To loosen the nut, simply pry open the slot with a chisel.

TO REMOVE GREASE FROM WOOD BEFORE PAINTING

Whitewash the parts at night and wash off in the morning. Let the surface dry before painting. Instead of whitewashing, a little slaked lime may be placed on the spots, dampened a little, and leave for a few hours before washing clean.

TO POLISH IRON OR STEEL

Slaked lime and alcohol applied with leather, chamois, a cork or a piece of soft wood will impart a fine polish to iron or steel.

TO FIND THE NUMBER OF BUSHELS IN A BIN

Multiply together the three dimensions in feet to get the number of cubic feet and deduct one-fifth and you will have approximately the number of bushels in the bin.

HOLDING DELICATE PARTS IN VICE

Sometimes considerable difficulty is experienced in holding tubes, pistons or polished parts securely in the vice when working on them. The usual practice is to use soft metal or fibre strips between the parts and the vice-jaws, partly with the object of protecting the parts, and partly to give greater security of grip. Even then pressure may have to be increased to hold the part securely, with the attendant danger of buckling or breaking the part.

A good idea is to cover the strips with resin before commencing; the work will be held firmly, and considerably less pressure on the jaws will be required.

DETECTING CRACKS IN METAL

If minute cracks are suspected in any part, the latter should be cleaned of surface dirt and then heated to about 80 deg. Fahr. A little red lead should be added to some paraffin oil, just sufficient to give it a red colour, and this should also be heated to 80 deg. Fahr. The oil should then be painted on the part with a soft brush so that the surface of the metal is saturated. Then wipe the surface dry with a rag and sprinkle some French chalk over it so that the whole surface is whitened. After blowing off any surplus, allow the part to cool down, which will take from 30 to 60 minutes. The contraction of the cracks will cause the coloured oil to work out and show up plainly on the white surface, thus indicating their position and extent.

CEMENT FOR GLASS AND IRON

Alum melted in an iron spoon makes a good cement for joining glass and iron. It is useful for cementing the glass part of a lamp to its metal base or stopping cracks.

TO REMOVE PANES OF GLASS

Lay soft soap over the putty for a few hours, and it will become soft, so that it may be easily scraped away, no matter how hard it has previously been.

HEAT TREATMENT OF STEEL

HEAT COLOURS AND TEMPER COLOURS

Heat Colour	Approx. Temperature °C.	°F.	Temper Colour	Approx. Temperature °C.	°F.
Brown-red	565	1049	Faint Straw	205	400
Dull red	680	1256	Straw	225	440
Blood red	730	1346	Deep straw	245	475
Medium cherry	750	1382	Bronze	270	520
Cherry red	780	1436	Purple	280	540
Bright cherry	825	1517	Full blue	295	563
Full red	850	1562	Light blue	310	590
Yellow-red	950	1742	Grey	330	626
Orange	1050	1922			
White	1300	2372			

Note: Heat colours above are in a **dull light.**

Steels are alloys of iron and carbon and are called plain carbon steels when they contain no other alloying additions. Carbon renders a steel susceptible to hardening, and the possible degree of hardening increases with the carbon content. Thus it is the higher carbon steels which are generally hardened.

Mild steels contain up to 0.3% carbon, machinery steel 0.3—0.5%, spring steels 0.6—0.9%, and tool steels 0.8—1.5%.

Heat treatment of plain carbon spring and tool steels consist of two operations, the first hardening and the second tempering. Hardening is performed by quenching into water or oil from above a certain temperature range which varies slightly with the type of steel. Hardening leaves the steel in its hardest and most brittle condition. By reheating or tempering the hardness can be reduced and the toughness increased as desired. The higher the tempering temperature the greater the amount of softening and toughening.

HARDENING: The correct temperature and quenching liquid are generally given by the steel supplier and should be closely followed. In modern practice properly designed electric, gas or oil fired furnaces are always used, and the temperature should be either indicated or automatically controlled by a pyrometer. Tools, particularly if of intricate shape, should always be warmed or pre-heated prior to placing in the high temperature furnace, and uniform heating is very desirable.

With tool steels the efficiency of the hardening can be roughly checked with a file. If the file "bites" readily, the steel has been at too low a temperature or has been insufficiently soaked. Too high a hardening temperature results in coarse grain and brittleness.

If proper furnaces or pyrometers are not available the hardening temperature must be judged approximately by eye, the colours corresponding to various temperatures being set out in the table above. This method is used in hardening from a blacksmith's fire.

Quenching is carried out in clean cold water, brine (1 lb. of common or rock salt per gallon is suitable) or oil. In the latter case a proprietary grade of prepared quenching oil is generally used. Do not use old sump oil. The use of properly designed and well fitting tongs is recommended.

TEMPERING: The hardness of steel falls fairly rapidly as the reheating or tempering temperature is increased. Thus for uniform results properly designed furnaces with temperature control instruments should be used wherever possible. Popular types are air circulating furnaces and molten salt baths, or oil baths for low temperatures up to 300°C. The latter is suitable for many tools and, in the absence of proper furnaces, satisfactory work can be done in a small pot over a gas ring. A glass thermometer reading up to 300 or 400°C. is suitable for measuring temperature. A heavy, high flash point oil is used, and it is generally preferable, for safety reasons, to secure a proprietary grade mixed specially for this work.

As an alternative to the methods above, satisfactory work can be produced by tempering by colour. Tints due to thin films of oxide form on heating previously bright steel surfaces, and the exact tint depends on the temperature. After hardening, a portion of the tool is polished with emery cloth or abrasive and then heated slowly by some suitable means (e.g., hot metal, or hot metal plate) until the desired colour is developed. The tool is then quenched to prevent further softening.

The disadvantage of colour tempering compared with a furnace is that no soaking time to secure uniformity can be allowed. Also it is not applicable to alloy steels.

PLAIN CARBON TOOL STEELS: The "temper" number is an indication of the carbon content and the proper selection is determined by the application. The table below is a guide:—

Carbon Content	Application
0.75—0.85%	Tools requiring good toughness but not maximum hardness, e.g., chisels, shear blades, punches, hammers, rock drills, dies, etc.
0.9 — 1.2%	Tools of good hardness and fair toughness. Taps, twist drills, screwing dies, metal cutting tools, etc.
1.3 — 1.5%	Maximum hardness. Files, scrapers.

All the above steels can be water or brine quenched from about 780°C. (cherry red). Very small sections can be oil quenched to avoid danger of cracking. Uniform and slow heating is desirable and oversoaking in the fire should be avoided because of danger of overheating. Tempering temperature range from 150°–320°C., depending on application, but following is a guide.

Faint to deep straw	Metal cutting tools
Deep straw to bronze . .	Shear blades, press dies, wood cutting tools
Purple to blue	Chisels, punches, saws, drifts

SPRING STEELS: Most plain carbon steels can be hardened in oil from 800–820°C. (bright cherry red) and tempered to a blue to grey. Large springs can be tempered slightly higher — up to 400°C. The "burning off" method can also be used — i.e., heating to the temperature at which the quenching oil starts to burn.

ALLOY STEELS: These should always be treated with proper furnace and temperature control equipment, and the steel supplier's instructions followed.

CASE HARDENING: This can be applied to low carbon (0.1–0.25%) mild steels in order to secure a hard surface with a softer tough core.

The usual method is to pack the work in a sealed container with case hardening crystals such as Hardite and soak at 880–950°C. until the desired depth of case is secured. The case can be measured by quenching and fracturing a small diameter test piece. After carburising the parts are reheated to about 790°C. and water quenched.

Where a very thin hard skin (0.002–0.003 thick) only is required, a powder such as Kasenit can be used. The steel is heated to 850–900°C. (full red), dipped into the powder (in a small container), the work reheated, and then quenched in cold water.

NOTE: These notes only touch on some of the simpler aspects of heat treatment. For further information there are many excellent text books obtainable on the subject.

HOW TO SOLDER

The edges of the metals to be joined must first be well cleaned with a file or by scraping, unless, of course, new metal is being used, when there would be no need for further cleaning.

Heat the soldering iron until nearly red hot, and then dip the point quickly into "BAKER'S" Soldering Fluid. Apply the solder, dip again quickly, and withdraw. This operation is known as tinning, and it will be found that the tip of the copper bit is now covered with a coating of solder. The soldering iron should always be kept well tinned by repeating this operation. In the event of the iron getting thoroughly dirty, the tin must be filed off and the iron re-tinned as described above.

Smear the edges of the metal to be joined with "BAKER'S" Soldering Fluid, then make the joint by drawing the hot tinned iron along the edges of the metals, adding solder as required. The best method of smearing the edges with "BAKER'S" Soldering Fluid is to use a small stick, such as a skewer or thick match, feathering the end, and use it in the same way as a paint brush.

SOLDERING TANKS

When repairing leaks in fuel tanks, radiator tanks, etc., it is seldom wise to rely on soldering over the leaks to give a satisfactory permanent repair, solder being prone to develop cracks after a short period under vibration or slight flexing strains, and it is usual to place a patch of thin sheet brass or copper over the defect, sweating it securely on to the tank.

Cases are occasionally found, however, in which it is difficult to fit the sheet-metal patch snugly to the repair, due to sharp angles or thick butted and lapped seams. In such cases it will be found that a patch of wire gauze, such as is used in strainers or filters, is much more easily applied and soldered, and, by reason of its inherent flexibility, it will withstand strains due to vibration, etc., over a much longer period. In combination with the solder, it has a similar reinforcing effect to the steel mesh used for reinforced concrete surfaces.

SOLDERING LARGE OPENINGS

For such repairs it is a good plan to keep an assortment of various sizes of tinned iron or copper rivets. Cut off nearly all the shank of one that is a suitable size to fit over the hole, and apply soldering flux over the rivet head. Then use a well-tinned and correctly heated soldering bit with a little solder, and a strong and neat repair will result.

WIRELESS WORK

For wireless work a resin-cored solder is recommended. This may be obtained from McPherson's Ltd.

The flux and solder should be used very sparingly. If the soldering has been done carefully the heat from the Soldering Iron would evaporate all the flux. If, however, there is any flux remaining it is advisable to wash this off, especially when working on bright metals, such as copper and brass.

MAKING SOLDER STICK TO CAST IRON

Soldering cast iron is greatly facilitated if, after the iron is thoroughly scraped and cleaned, it is rubbed with a piece of wet bluestone or soft brass. The brass must be soft enough so that some of it will stick to the iron; this can be readily observed. Thereafter, use the solder in the usual way.

TO KEEP SOLDERING BITS TINNED

Under certain conditions of heat and the presence of sulphur in a bituminous coal fire portion of the copper bit becomes oxidised. The action is often local, taking the form of pitting similar to that observed frequently in steam boilers. The remedy is always to keep the soldering copper in perfect condition, well tinned and cleaned, and never heated too hot. To keep the copper tinned, it should be rubbed on top of a soft brick in some resin and solder. The bit must be quite clean before solder will adhere to it, and the cleaning is done by scouring upon the soft surface of the brick. A few bits of sal-ammoniac dropped into the resin will help matters wonderfully in tinning, for sal-ammoniac is the natural flux for copper, as tallow is for lead, and resin for tin, brass and zinc.

BRAZING

Brazing is a method of joining metal parts together by means of an alloy known as spelter solder, or simply as spelter, which is melted into the joint and unites with the metals. Brazing is practically the same as hard soldering, there is the following distinction. Brazing means the joining of metals by a film of brass (a copper-zinc alloy); hard soldering is the term ordinarily applied when silver solder is used, the latter being an alloy of silver, copper, and zinc. For brazing, a red heat is necessary, and a flux (borax or boracic) is used to protect the metal from oxidation, and to

Simple type of Blow-Pipe

dissolve the oxides formed. The part to be brazed is heated either by means of a blow-torch, gas forge, or a coke or charcoal fire. For very small work, an alcohol lamp or gas jet is often used, the heat being intensified by using a blowpipe. As a considerable amount of heat is required to melt the spelter solder, brazed work will withstand more heat without breaking or weakening than parts which are united by soldering. The chief advantage of a brazed joint, however, lies in its superior strength.

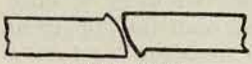
The ordinary process of brazing consists, briefly, in assembling the parts to be brazed, applying a suitable flux and the spelter solder melts and unites with the parts to be joined. The method of holding the parts in place while brazing depends upon their shape. If practicable, they should be secured in such a way that the work can be turned over during the process of brazing without disturbing the relation of the parts, thus affording a better chance to apply the flux and spelter. Brazing is an operation requiring considerable experience. The secret of successful brazing is the thorough cleaning of the joint that is to be brazed.

The principal difference between dip brazing and ordinary brazing is that the work is immersed into the spelter solder while the latter is in a liquid state. The spelter is contained either in a cast-iron tank or graphite crucible, the size of which depends upon the size of the parts to be brazed. Muffle brazing differs from ordinary brazing in that the parts to be united are enclosed in a tube or muffle. This ensures uniform heating, clean smooth surfaces, and is especially adapted to brazing alloys, the melting temperatures of which are rather close to that of the spelter.

WELDING

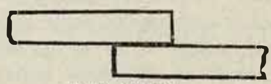
CLASSES OF WELDS

Welds are classified according to way in which the ends are formed prior to making the weld. The different welds ordinarily made in hand-forging practice are the scarf weld, butt weld, lap weld, cleft or split weld, and jump weld. It will be seen that the surfaces, in most instances, are



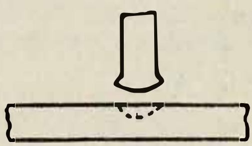
SCARF WELD.

BUTT WELD.



LAP WELD.

CLEFT WELD.



JUMP WELD.

rounded or crowned. This is done so that, when the heated ends are brought together, they will unite first in the centre. Any slag or dirt which may have adhered to the heated surfaces will then be forced out as the welding proceeds from the centre outward. When making a lap-weld, the hammering should begin at the centre in order to work out all the slag, as the faces in this case are not rounded.

In ordinary forge welding two pieces of wrought iron or mild steel are heated until they become soft and plastic and will unite when one is pressed or hammered against the other. The quality of the weld depends largely upon the welding heat. If the ends to be welded are not hot enough, they will not stick together; inversely, if the work remains in the fire too long, it becomes overheated and burned, which greatly injures the metal. Iron which has been overheated has a rough, spongy appearance and is brittle. The danger of burning is increased when the air blast is too strong and the fire is oxidising. It is important to heat the work slowly to secure a uniform temperature throughout the ends to be welded. With rapid heating, the outside may be raised to the welding temperature, while the interior is much below it; consequently, the weld will be defective.

FIRE FOR WELDING

When heated iron comes into contact with the air, it absorbs oxygen, thus forming a scale of oxide of iron on the surface, which prevents the formation of a good weld. A fire for heating parts to be welded should have a fairly thick bed between the tuyere and the work, so that the oxygen in the air blast will be consumed before it reaches the parts being heated. When there is only a thin bed of fuel beneath the work, or if too strong a blast is used, the excess of oxygen will pass through and oxidize the iron. The hotter the iron, the greater the formation of scale. The surface being heated can be given an additional protection by covering it with some substance — flux — that will exclude air. Ordinarily, the air blast for a forge fire should have a pressure varying from 3 to 5 ounces per square inch.

WELDING FLUXES

In heating steel for welding, the tendency is for the surfaces to become oxidized, or covered with oxide of iron which forms a scale when the hot iron comes into contact with the air. If this scale is not removed, it will cause a defective weld. Wrought iron can be heated to a high enough temperature to melt this oxide so that the latter is forced out from between the surfaces by the hammer blows; but when welding machine steel, and especially tool steel, a temperature high enough to melt the ozide would burn the steel, and it is necessary to use a flux. This is a substance, such as sand or borax, having a melting temperature below the welding temperature of the work, and it is sprinkled upon the heated ends when they have reached about a yellow heat. The flux serves two purposes. It melts and covers the heated surfaces, thus protecting them from oxidation, and, when molten, aids in dissolving any oxide that may have formed, the oxide melting at a lower temperature when combined with the flux. Wrought iron can be welded in a clean, well-kept fire without using a flux of any kind, except when the material is very thin. The fluxes commonly used are fine, clean sand and borax. When borax is used, it will give better results if burned. This can be done by heating it in a crucible until reduced to the liquid state. It should then be poured on to a flat surface to form a sheet; when cold, it can easily be broken up and pulverised. The borax powder can be used plain or it can be mixed with an equal quantity of fine, clean sand and about 25 per cent of iron (not steel) filings. For tool steel, a flux made of 1 part of sal-ammoniac and 12 parts of borax is recommended.

MELTING POINTS

To convert degrees Fahrenheit into degrees Centigrade: 5 x (degrees F. minus 32) divided by 9.

To convert degrees Centigrade into degrees Fahrenheit: (degrees C. x 9) divided by 5: then add 32.

	Deg. Fahr.		Deg. Fahr.
Cast Iron	2210	Brass	1900
Wrought Iron	2912	Lead	608
Steel	2500	Solder	330
Copper	2160	Tin	446
Silver	1830	Zinc	800
Gold	2280		

LUBRICANTS FOR CUTTING TOOLS

Material	Drilling	Reaming	Milling	Turning	Tapping and Die Threading
Machinery Steel	Soluble Oil	Lard Oil	Soluble Oil	Soluble Oil	Soluble Oil or Lard Oil
Tool Steel, Carbon and High Speed	Soluble Oil or Lard Oil	Lard Oil	Soluble Oil	Soluble Oil Lard Oil	Sulphur base or Lard Oil
Alloy Steel Forgings, etc.	Soluble Oil or Lard Oil	Lard Oil	Lard Oil	Soluble Oil Lard Oil	Sulphur base or Lard Oil
Brass	Lard Oil and Kerosene Mixture	Soluble Oil	Soluble Oil or dry	Soluble Oil	Soluble Oil or Lard Oil
Bronze	Soluble Oil or dry	Soluble Oil or dry	Soluble Oil or dry	Soluble Oil	Soluble Oil or Lard Oil
Copper	Soluble Oil	Soluble Oil	Soluble Oil or dry	Soluble Oil	Soluble Oil or Lard Oil
Aluminium	Lard Oil and Kerosene Mixture	Lard Oil	Soluble Oil or dry	Soluble Oil	Soluble Oil or Lard Oil
Monel Metal Malleable Iron Castings, etc.	Lard Oil Soluble Oil	Lard Oil Soluble Oil	Soluble Oil Soluble Oil	Soluble Oil Soluble Oil	Lard Oil Soluble Oil
Cast Iron	Dry	Dry	Dry	Dry	Lard Oil

HOW TO READ A MICROMETER

A Micrometer is a guage operated by means of a screw. This screw, in a Micrometer adapted to English measurement, has 40 threads to an inch; thus, with one complete turn of the screw it advances 1/40th of an inch. One-fortieth of an inch equals 25 thousandths of an inch, i.e., 40/1,1000 = 1/25 or .025".

To the spindle is attached a thimble "A," the lower edge of which is bevelled and which is divided into 25 parts, each of which represents one-thousandth of an inch. On the inner sleeve "B" a vertical line parallel to the axis is cut. This is called the datum line and when the Micrometer is closed the line on the thimble marked "O" coincides with it. This is zero and all measurements are calculated from it. The sleeve "B" is graduated with a number of transverse lines and with each complete revolution of the thimble a new transverse line comes into view, that is each transverse line above zero denotes an opening of the Micrometer of .025". Every fourth line is marked 1, 2, 3, 4, and so on. These figures represent tenths or one hundred thousandths of an inch. Suppose the thimble were screwed out so that graduation 2, and three additional subdivisions were visible (as shown in Fig. 17), and that graduation 10 on the thimble coincides with the datum line on the sleeve. The reading would be 0.200 + 0.075 + 0.010 or 0.285 inch.

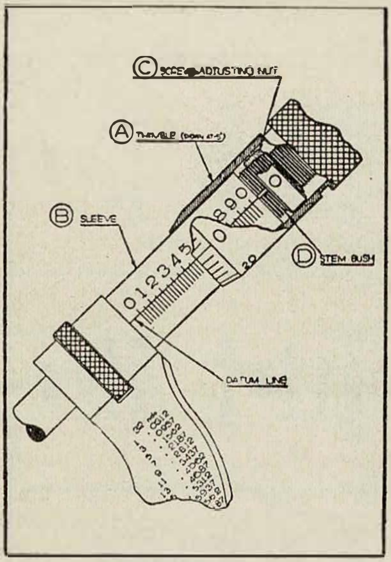


Fig. 17

HOW TO READ A MICROMETER GRADUATED IN 1/10,000"

To make a Micrometer read to ten thousandths of an inch it is provided with a Vernier which is graduated on the sleeve, and this is read in conjunction with the graduation on the thimble. On the sleeve are graduated ten divisions which occupy the same space as nine divisions on the thimble. It will be obvious, therefore, that the difference in width between each division on the thimble and each division on the sleeve is one-tenth of a graduation. As the graduations on the thimble are thousandths, the difference is therefore one-tenth of a thousandth. When, therefore, the graduated line on the thimble (i.e., the thousandth line) does not exactly coincide with the vertical line on the sleeve, it is necessary to note which is the first vernier line which coincides exactly with a graduated line on the thimble. If this is the first line, i.e., that line numbered 1, add one-tenth to the thimble reading, if the second vernier line is the first exactly to coincide, add two tenths, and so on up to nine tenths, after that the thimble reading gives the next complete thousandth. Anyone can familiarise himself with taking exact measurements after a few minutes' practice.

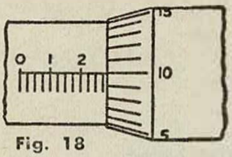


Fig. 18

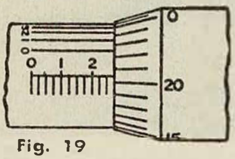


Fig. 19

MENSURATION

RIGHT-SIDED FIGURES

The area of a square, × rhombus or rhomboid × length × breadth.

The area of a triangle = (1) ½ base × perpendicular height; (2) the base multiplied by one-half its height.

Area of any right-lined figure of four or more unequal sides is found by dividing it into triangles, finding area of each, and adding together.

IRREGULAR AND OTHER FIGURES

Surface and cubic content of prism or cylinder — (1) (area of two ends) plus (length × perimeter) = surface; (2) area of base × height = content.

For a cone or pyramid — (1) ½ (slant height × perimeter of base) plus area of base = surface; (2) 1-3 (area of base × perpendicular height) = content.

For a cube — (1) sum of areas of all the sides = surface; (2) length × breadth × depth = content.

The area of an ellipse = long axis × short axis × 0.7854.

SPHERES AND SOLIDS

Square of the diameter of a sphere × 3.1416 = convex surface.

Cube of the diameter of a sphere × .5236 = solidity.

Diameter of a sphere × .806 = dimensions of equal cube.

Diameter of a sphere × .6667 = length of equal cylinder.

Square inches × .00695 = square feet.

Cubic inches × .00058 = cubic feet.
Cylindrical inches × .0004546 = cubic feet.
Cylindrical feet × .0290946 = cubic yards.
183.346 circular inches = 1 square foot.
2,200 cylindrical inches = 1 cubic foot.

RULES RELATIVE TO THE CIRCLE, ETC.

To Find Circumference—

Multiply diameter by 3.1416. Or divide diameter by 0.3183.

To Find Diameter—

Multiply circumference by 0.3183. Or divide circumference by 3.1416.

To Find Radius—

Multiply circumference by 0.15915. Or divide circumference by 6.28318.

SQUARE

A side multiplied by 1.4142 equals diameter of its circumscribing circle.

A side multiplied by 4.443 equals circumference of its circumscribing circle.

A side multiplied by 1.128 equals diameter of an equal circle.

A side multiplied by 3.547 equals circumference of an equal circle.

Square inches multiplied by 1.273 equal circle inches of an equal circle.

To Find the Area of a Circle—

Multiply circumference by one-quarter of the diameter.
Or multiply the square of diameter by 0.7854.
Or multiply the square of circumference by .07958.
Or multiply the square of half diameter by 3.1416.

To Find the Surface of a Sphere or Globe—

Multiply the diameter by the circumference.
Or multiply the square of diameter by 3.1416.
Or multiply four times the square of radius by 3.1416.

SQUARE ROOTS

1.	1.000	8.5	2.915	22.	4.690	36.	6.000
1.5	1.225	9.	3.000	23.	4.796	37.	6.083
2.	1.414	9.5	3.082	24.	4.899	38.	6.164
2.5	1.581	10.	3.162	25.	5.000	39.	6.245
3.	1.732	11.	3.317	26.	5.099	40.	6.325
3.5	1.871	12.	3.464	27.	5.196	41.	6.403
4.	2.000	13.	3.606	28.	5.292	42.	6.481
4.5	2.121	14.	3.742	29.	5.385	43.	6.557
5.	2.236	15.	3.873	30.	5.477	44.	6.633
5.5	2.345	16.	4.000	31.	5.568	45.	6.708
6.	2.449	17.	4.123	32.	5.657	46.	6.782
6.5	2.550	18.	4.243	33.	5.745	47.	6.856
7.	2.646	19.	4.359	34.	5.831	48.	6.928
7.5	2.739	20.	4.472	35.	5.916	49.	7.000
8.	2.828	21.	4.583				

CUBE ROOTS

1.	1.000	8.5	2.041	22.	2.802	37.	3.332
1.5	1.145	9.	2.080	23.	2.844	38.	3.362
2.	1.260	9.5	2.118	24.	2.884	39.	3.391
2.5	1.357	10.	2.154	25.	2.924	40.	3.420
3.	1.442	11.	2.224	26.	2.962	41.	3.448
3.5	1.518	12.	2.289	27.	3.000	42.	3.476
4.	1.587	13.	2.351	28.	3.037	43.	3.503
4.5	1.651	14.	2.410	29.	3.072	44.	3.530
5.	1.710	15.	2.466	30.	3.107	45.	3.557
5.5	1.765	16.	2.520	31.	3.141	46.	3.583
6.	1.817	17.	2.571	32.	3.175	47.	3.609
6.5	1.866	18.	2.621	33.	3.208	48.	3.634
7.	1.913	19.	2.668	34.	3.240	49.	3.659
7.5	1.957	20.	2.714	35.	3.271	50.	3.684
8.	2.000	21.	2.759	36.	3.302		

USEFUL CONVERSION FACTORS

To convert	Into	Multiply by
Inches	Millimetres	25.4
Square Feet	Square Metres	0.0929
Square Miles	Acres	640
Acres	Square Yards	4840
Cubic Feet	Cubic Metres	0.0283
Cubic Inches	Cubic Centimetres	16.39
Cubic Inches	Litres	0.0164
Cubic Feet	Imp. Gallons	6.23
Imp. Gallons	Litres	4.55
Imp. Gallons	U.S. Gallons	1.20
Imp. Gallons (water)	Pounds (at 63 deg. F.)	10
Cubic Feet (water)	Pounds	62.3
Cubic Feet (air)	Pounds (at 0 deg. C.)	0.00557
Kilogrammes	Pounds	2.205
Kilogrammes	Ounces (Av.)	35.27
Kilogrammes	Ounces (Tr.)	32.15
Grammes	Grains	15.43
Pounds (Av.)	Grammes	453.6
Pounds (Av.)	Grains	7000
Kgs./lineal metre	Lbs./lineal ft.	1.488
Kg.-metres	Ft.-lbs.	7.23
Kgs./sq. cm.	Lbs./sq. in.	14.22
Miles	Kilometres	1.609
Kgs./sq. cm.	Tons/sq. ft.	1.10
Lbs.sq. in.	Tons/sq. ft.	15.6
Knots	Ft./hr.	6080
Knots	M.p.h.	1.152
M.p.h.	Ft./sec.	1.467
At'spheres (pres.)	Lbs./sq. in.	14.7
Horse-power	Ft.-lbs./sec.	550
Horse-power	Watts	746
K.W. hrs.	Horse-power hrs.	1.34
Horse-power-hrs.	B.th.u.s.	2550

WEIGHT PER SQUARE FOOT OF SHEETS, DIFFERENT METALS, IN LBS.

THICKNESS				WEIGHT, Lbs. per Sq. Ft.			
S.W.G.	Ins.	Ins.	MM.	Steel	Copper	Brass	Aluminium
—	3/8	.375	9.35	15.3	17.3	16.2	5.29
—	5/16	.312	7.93	12.7	14.4	13.5	4.40
1	—	.300	7.62	12.2	13.9	13.0	4.23
2	—	.276	7.01	11.3	12.8	11.9	3.89
3	—	.252	6.40	10.3	11.7	10.9	3.55
—	1/4	.250	6.35	10.2	11.6	10.8	3.52
4	—	.232	5.89	9.46	10.7	10.0	3.27
5	—	.212	5.38	8.65	9.80	9.16	2.99
6	—	.192	4.88	7.83	8.88	8.29	2.71
—	3/16	.187	4.75	7.63	8.65	8.08	2.64
7	—	.176	4.47	7.18	8.14	7.60	2.48
8	—	.160	4.06	6.53	7.40	6.91	2.26
9	—	.144	3.66	5.87	6.66	6.22	2.03
10	—	.128	3.25	5.22	5.92	5.53	1.80
—	1/8	.125	3.18	5.10	5.78	5.40	1.76
11	—	.116	2.95	4.73	5.37	5.01	1.64
12	—	.104	2.64	4.24	4.81	4.49	1.47
13	—	.092	2.34	3.75	4.26	3.97	1.30
14	—	.080	2.03	3.26	3.70	3.46	1.13
15	—	.072	1.83	2.94	3.33	3.11	1.02
16	—	.064	1.63	2.61	2.96	2.76	.902
—	1/16	.062	1.58	2.53	2.87	2.68	.874
17	—	.056	1.42	2.28	2.59	2.42	.790
18	—	.048	1.22	1.96	2.22	2.07	.677
19	—	.040	1.02	1.63	1.85	1.73	.564
20	—	.036	.914	1.47	1.67	1.55	.508
21	—	.032	.813	1.31	1.48	1.38	.451
22	—	.028	.711	1.14	1.30	1.21	.395
23	—	.024	.610	.979	1.11	1.04	.338
24	—	.022	.559	.897	1.02	.950	.310
25	—	.020	.508	.816	.925	.864	.282
26	—	.018	.457	.734	.833	.777	.254
27	—	.0164	.417	.669	.759	.708	.231
28	—	.0148	.376	.604	.685	.639	.209
29	—	.0136	.346	.555	.629	.587	.192
30	—	.0124	.315	.506	.574	.536	.175

PULLEYS, BELTS AND POWER TRANSMISSION

An important factor in the use of belting for power transmission is the elasticity of the belt. This depends on its original quality, and the treatment it receives in service. Best quality leather belting is made from the prime or butt part of ox hide covering the backbone, and there is little or no stretch in it. Such a belt must have been properly tanned and curried and scientifically treated in manufacture in order that it contains within itself no agencies of destruction.

A good idea when you have bought a new belt, is to hang it up with weights attached to the bottom. Let it hang for two or three days. This will avoid the belt stretching when put on the job, a frequent cause of trouble.

NECESSARY ATTENTION

So long as the original condition of the belting is maintained the best is being got out of it, but lack of attention soon brings about deterioration.

Economy does not end with the purchasing of even good belts. Frequent inspection is necessary in order to see that they are intact and whether an occasional dressing is desirable. The object of belt dressing is to increase the co-efficient of friction of a belt, thus enabling it to pull a heavier load with a given tension; moreover, such dressing acts as a preservative. Broadly speaking, a belt should be cleaned and greased every six months, and if belt slippage occurs, possibly through overload, dressing may be applied sparingly to enable it to continue to pull its load until such time as the driven machine can be shut down and the belt tightened. This requires care, as the evils of over-tight belts are far-reaching; for instance, over-heating, shafting drawn out of alignment, increased friction on bearings, or over-stretching the belt are but a few.

BELT DRESSINGS

Belts should be cleaned and greased every five or six months to give the grain side a soft adherent surface. The following mixtures are recommended: Take two parts of beef tallow to one part of cod liver oil (by weight); melt the tallow and allow it to cool until the finger can be inserted without burning, then add the cod liver oil and stir until cooled. A light coat of this mixture should be applied to the driving side of the belt after it has been cleaned. Resin or resinous mixtures should never be used to prevent belts from slipping. They will cause temporary adhesion, but the belt soon becomes glazed and slips more than before the resin was applied.

A dressing recommended for rubber belts consists of equal parts of red lead, black lead, French yellow and litharge, mixed with boiled linseed oil and enough japan to make it dry quickly. Animal oil or grease should never be used on rubber belts. Specially prepared belt dressings can always be obtained from McPherson's Ltd.

Run the grain side next to the pulley face. In the case of a good belt, the grain side may transmit nearly twice the power conveyed by the flesh side. In a new belt, the grain side may be distinguished by its rough unfinished surface, whereas the outside is smooth and polished.

USE OF GUIDES

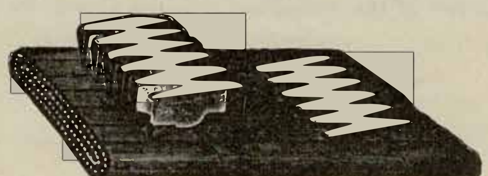
The fixing of a wood or iron guide against the edge of a belt where it is inclined to leave the pulley is a practice not to be recommended. If a belt will not maintain its proper position, the remedy is not to force it to do so in the way indicated. The trouble can usually be traced to bad alignment or bad joints. The latter is among the most common faults in belt transmission work. How can a belt be expected to run straight if the joint is not made square? Great care must, therefore, be taken in cutting the ends to ensure straight running. In cutting belt ends a steel square should be used, and when applying belt fasteners each hole must be punched into the belt with the greatest precision, so that every hole does its share of work.

CORRECT FASTENING

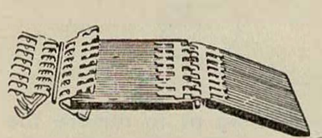
The average strength of a laced joint is given as about 70 per cent. of that of the belt. The average strength of metal fastenings is less than for lacings.

TYPES OF BELT FASTENERS

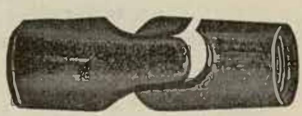
"Bristol" Steel Belt Lacing



Ready to Apply **Finished Joint**



Flexible Steel Belt Lacing



Hooks and Eyes for Round Belts

If a belt is required to do a little extra work, a little tighter lacing will often enable it to run well but, nevertheless, it is always an expensive experiment to overload a belt, as overloading tends to shorten its life.

LACED BELT JOINTS

A laced belt joint is not recommended for use on small belts.

When making a laced joint, cut the ends of the belt perfectly square and punch the holes exactly opposite one another in the two ends. In each end there should be two rows of staggered holes. The recommended number of holes for various widths is given in the table, "Belt Laces and Holes for Laced Joints." Begin to lace in the centre of the belt and be careful to keep the belt ends exactly in line and to lace both sides with equal tension. The lacing should not be crossed on that side of the belt which runs next to the pulley.

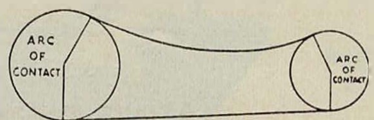
BELT LACES AND HOLES FOR LACED JOINTS

Width of Belt, Inches	Width of Lace, Inches	No. of Holes	Distance of Holes from End First Row, Inches	Distance of Holes from End Second Row, Inches
2 -2½	5/16	3	⅜	¾
2¾-3¼	5/16	5	½	1
3½-4½	⅜	5	⅝	1⅛
5	⅜	7	⅝	1⅛
6	⅜	9	¾	1¼
8	½	11	¾	1⅜
10	½	13	1	1¾

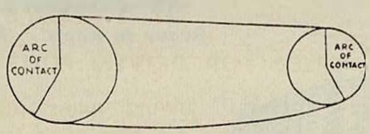
HINTS ON BELT DRIVING

Before starting any new belt-driven machinery, everything should come under the test of the measuring rod, the plumb, the level, and the square.

Arc of contact is increased by the sag of the belt.



Arc of contact is much smaller when the lower belt is slack.



Sometimes the pulleys are so hung on the shafting as to remove the periphery from the centre of the pulley to one of the sides, with the result the belt was run to one side, or even off the pulley. It is often found that shafts which are not perfectly parallel have the same effect on the pulley and the belt. The shaft that is out of alignment, even in the smallest degree, will make a big difference upon the face of a pulley of large diameter fixed upon that shaft.

A badly-balanced pulley running at high speed will impart an unsteady motion to the belt running on it.

A heated bearing will throw ropes out of the grooves, or cause belts to leave the pulleys.

All belts should run with the slack side on top. The sag of the slack, or upper side, helps the belt to hug the pulley, and there is a gain of fully 20 per cent as compared with a belt running the reverse way.

An exception to this rule should be made when belts are run in places where the air is full of abrasive dust. This dust is carried round the pulleys by the belt and wears away the surface of the pulleys, especially at the crown. In this case the belt should be run with the slack side on the bottom; the flap or vibration of the belt tends to shake off the dust, and longer belt and pulley life is the result.

A Circular Saw Belt should not be narrower than one-fourth the diameter of the saw. The spindle pulley should not be less in diameter than the width of the belt.

FORMULAE

For Finding Horse Power Transmitted by Single Leather Belting

W. — Width of Belt in inches. V. — Velocity of Belt in feet per minute. H.P. — Horse Power.

$$H.P. = \frac{W. \times V.}{800}$$ for Single Leather Belting.

For Finding Horse Power Transmitted by Double Leather Belting

$$H.P. = \frac{W. \times V.}{550}$$ for Double Leather Belting.

Example: 12 inch Double Belt travelling at 4,000 feet per minute.
$12 \times 4{,}000 \div 550$. Answer: 87 Horse Power.

RULES FOR CALCULATING DIAMETERS AND SPEEDS OF PULLEYS

SPEED FOR DRIVEN PULLEY REQUIRED

Diameter and speed of driving pulley, and diameter of driven pulley are known. Rule: Multiply the diameter of the driving pulley by its speed in revolutions per minute, and divide the product by the diameter of the driven pulley.

Example: If the diameter of the driving pulley is 15 inches and its speed 180 revolutions per minute, and the diameter of the driven pulley, 9 inches, then the speed of the driven pulley $= \frac{15 \times 180}{9} = 300$ revolutions per minute.

DIAMETER OF DRIVEN PULLEY REQUIRED

Diameter and speed of driving pulley, and revolutions per minute of driven pulley are known. Rule: Multiply the diameter of the driving pulley by its speed in revolutions per minute, and divide the product by the required speed of the driven pulley.

Example: If the diameter of the driving pulley is 24 inches and its speed 100 revolutions per minute, and the driven pulley is to rotate 600 revolutions per minute, then the diameter of the driven pulley

$$= \frac{24 \times 100}{600} = 4 \text{ inches.}$$

DIAMETER OF DRIVING PULLEY REQUIRED

Diameter and speed of driven pulley, and speed of driving pulley are known. Rule: Multiply the diameter of the driven pulley by its speed in revolutions per minute, and divide the product by the speed of the driving pulley.

Example: If the diameter of the driven pulley is 36 inches and its required speed 150 revolutions per minute, and the speed of the driving pulley is 600 revolutions per minute, then the diameter of the driving

$$\text{pulley} = \frac{36 \times 150}{600} = 9 \text{ inches.}$$

SPEED OF DRIVING PULLEY REQUIRED

Diameters of driving and driven pulleys, and speed of driven pulley are known. Rule: Multiply the diameter by the driven pulley by its speed, and divide the product by the diameter of the driving pulley.

Example: If the diameter of driven pulley is 4 inches, its required speed 800 revolutions per minute, and the diameter of the driver 26 inches,

then the required speed of the driver $= \frac{4 \times 800}{26} =$ 123 revolutions per minute, approximately.

RULES FOR CALCULATING SPEEDS OF GEARING

The relative speeds of shafts connected by spur or bevel gearing can be determined by the foregoing rules for pulley-and-belt drives, provided the **pitch diameter** or the number of teeth in the gear is substituted for the pulley diameter, in each case, as shown by the following examples:

INDUSTRIAL GEARING

RULES AND FORMULAE FOR SPUR GEARS

Diameter, when applied to gears, is always understood to mean the pitch diameter.

Diametral Pitch is the number of teeth to each inch of the pitch diameter.

Example: If a gear has 40 teeth and the pitch diameter is 4 inches, there are 10 teeth to each inch of the pitch diameter and the diametral pitch is 10, ar, in other words, the gear is 10 diametral pitch.

Wanted	Knowing	Rule	Formula
Outside Diameter	The Pitch Diameter and the Diametral Pitch	Add to the Pitch Diameter the quotient of 2 divided by the Diametral Pitch	$D = D' + \frac{2}{P}$
Outside Diameter	The Pitch Diameter and the Number of Teeth	Divide the Number of Teeth plus 2 by the quotient of Number of Teeth and by the Pitch Diameter	$D = \frac{N + 2}{\frac{N}{D'}}$
Outside Diameter	The Number of Teeth and Addendum	Multiply the Number of Teeth plus 2 by Addendum	$D — (N + 2)s$
Number of Teeth	The Pitch Diameter and the Diametral Pitch	Multiply Pitch Diameter by the Diametral Pitch	$N = D'P$
Number of Teeth	The Outside Diameter and the Diametral Pitch	Multiply Outside Diameter by the Diametral Pitch and subtract 2	$N = DP — 2$
Thickness of Tooth	The Diametral Pitch	Divide 1.5708 by the Diametral Pitch	$t = \frac{1.5708}{P}$
Whole Depth of Tooth	The Diametral Pitch	Divide 2.157 by the Diametral Pitch	$D = \frac{2.157}{P}$
Clearance	The Diametral Pitch	Divide 0.157 by the Diametral Pitch	$f = \frac{0.157}{P}$
The Diametral Pitch	The Circular Pitch	Divide 3.1416 by the Circular Pitch	$P = \frac{3.1416}{P}$
The Diametral Pitch	The Pitch Diameter and the Number of Teeth	Divide Number of Teeth by Pitch Diameter	$P = \frac{N}{D'}$
The Diametral Pitch	The Outside Diameter and the Number of Teeth	Divide Number of Teeth plus 2 by Outside Diameter	$P = \frac{N + 2}{D}$

RULES AND FORMULAE FOR SPUR GEARS (continued)

Wanted	Knowing	Rule	Formula
Pitch Diameter	The Number of Teeth and the Diametral Pitch	Divide Number of Teeth by the Diametral Pitch	$D' = \frac{N}{P}$
Pitch Diameter	The Number of Teeth and Outside Diameter	Divide the product of Outside Diameter and Number of Teeth by Number of Teeth plus 2	$D' = \frac{DN}{N + 2}$
Pitch Diameter	The Outside Diameter and the Diametral Pitch	Subtract from the Outside Diameter the quotient of 2 divided by the Diametral Pitch	$D' = D - \frac{2}{P}$
Pitch Diameter	Addendum and the Number of Teeth	Multiply Addendum by the Number of Teeth	$D' = sN$
Outside Diameter	The Number of Teeth and the Diametral Pitch	Divide Number of Teeth plus 2 by the Diametral Pitch	$D = \frac{N + 2}{P}$

SPEED OF DRIVEN GEAR REQUIRED

Number of teeth in driving gear, its speed, and number of teeth in driven gear are known. Rule: Multiply the number of teeth in the driving gear by its speed in revolutions per minute, and divide by the number of teeth in the driven gear.

Example: If the driving gear has 20 teeth and rotates 80 revolutions per minute, and the driven gear has 40 teeth, then the speed of the

driven gear $= \frac{20 \times 80}{40} = 40$ revolutions per minute.

If one or more intermediate gears are placed in a direct train between the driving and driven gears, the speed ratio will remain the same.

PITCH DIAMETER OF DRIVEN GEAR REQUIRED

The pitch diameter of the driving gear, its speed, and speed required for driven gear are known. Rule: Multiply the pitch diameter of the driving gear by its speed in revolutions per minute, and divide by the required speed of the driven gear.

Example: If the pitch diameter of the driver is 8 inches, its speed 75 revolutions per minute, and the speed required for the driven gear 20 revolutions per minute, then the pitch diameter of the driven

gear $= \frac{8 \times 75}{20} = 30$ inches.

WATER SUPPLY

Consult us for particulars of pumps which may be used for sprinkler systems.

TANKS — CIRCULAR CORRUGATED IRON

Diam. ft.	Diam. in.	Height of Tank 4 ft. gall.	5 ft. gall.	6 ft. gall.	8 ft. gall.	Diam. ft.	Diam. in.	Height of Tank 6 ft. gall.	8 ft. gall.
3	3	200	250	300	400	4	4	540	720
3	6	240	300	360	480	4	6	590	787
3	9	280	350	420	560	5	0	720	960
4	0	310	390	470	620	6	0	1050	1400

SQUARE IRON — Capacity

2 ft. 8 in. sq., 100 gals.; 3 ft. 3 in. sq., 200 gals; 3 ft. 8 in. sq., 300 gals.; 4 ft. 0 in. sq., 400 gals.

TO COMPUTE THE CAPACITY OF A TANK

Square or Rectangular — Multiply the length by the breadth and the product by the depth; the result multiplied by 6¼ (6.2321) will give the base and contents in gallons.

Circular — Rule A: Multiply the circumference by itself and the product by half the height. Example: Circumference 20 ft., height 6 ft. 20 ft. x 20 ft. x 3 ft. = 1,200 gals. approximate capacity.

Rule B: Multiply the diameter by itself and the product by five times the height. Example: Diameter 6 ft., height 6 ft. 6 ft. x 6 ft. x 30 ft. = 1,080 gals. approximate capacity.

WATER DATA

1 pint pure water weighs 1¼ lbs.
1 gallon pure water contains 277.274 cubic ins.
1 cubic foot distilled water, 62 deg. Fahr., weighs 62.321 lbs.
1 cubic yard distilled water, 62 deg. Fahr., weighs ¾ ton.
1 cubic fathom distilled water, 62 deg. Fahr., weighs 6 tons.

The Ajax Pump Catalogue gives full particulars, specifications, performances of all types of hand and power pumps for all purposes. Copies available free on request.

NOTES ON PUMPS

THE SUCCESSFUL ACTION of a pump depends, firstly, on the suction pipe joints being absolutely airtight.

TOTAL SUCTION HEAD should not exceed 20 to 25 ft. as a general rule; under good conditions a suction head of 28 ft. may be workable. This may be computed by adding together the vertical height from lowest summer water level to centre of pump and the friction in the suction piping.

HORIZONTAL SUCTION PIPES, when necessary, should always fall from the pump; all air will then pass upwards. When this is not convenient care must be exercised to see that there is no chance of air lodging along the top of the inside of piping. If this may occur it is absolutely essential to fit cocks so that all air may be allowed to escape. When different sizes of horizontal suction piping are used air cocks are generally necessary. The shorter the suction piping the greater the efficiency. Never use elbows, and as few bends as possible.

A FOOTVALVE AND STRAINER is in all cases recommended, and in some instances essential.

DELIVERY PIPES should not be of less diameter than half the bore of the working barrel, and, if of considerable length, larger than this. If delivery pipes are of small diameter, great friction is caused, and much more power than necessary is required to work the pump.

PUMPING FORMULAE

The equivalents of a gallon, a cubic foot, and a cubic inch of water are as follows:—

A gallon of water contains 277.274 cubic inches, or 0.16045 cubic feet, and weighs 10 lbs.

A cubic foot of water weighs 62.32 lbs., and contains 6.23 galls. For ordinary calculations 6¼ galls. is near enough.

A cubic inch of water weighs .03616 lb., and equals .0036 galls.

To find the cubic capacity of a pump-barrel or of a given length of pipe, multiply the square of the diameter by .7854, and the product by the length in inches. The result appears in cubic inches.

Example: Find the cubic contents of a 3-inch pump-barrel with 9-inch stroke.

$3 \times 3 \times .7854 = 7.06 \times 9$ inches $= 63.54$ cubic inches.

To calculate the quantity of water in a long length of pipe, square the diameter of the pipe. The product is the number of pounds in each lineal yard of pipe. Multiply this by the total length in yards and divide the product by 10. The quotient is the aggregate number of gallons.

Example: A 5-inch pipe = 5 x 5 = 25 lbs. of water per yard. Following this up, 100 yards would contain:

25 x 100 = 2,500 lbs. ÷ 10 = 250 galls. in 100 yards.

A fair average working speed is thirty strokes or revolutions per minute. The amount raised per hour can be found by multiplying the cubic capacity of the pump-barrel by 30, and the product by 60.

Example: Cubic contents of a 3-inch barrel with 9-inch stroke = 63.54 cubic inches x 30 x 60 = 114,372 cubic inches, which, divided by 277 = 412 galls. (approx.).

RULES RELATING TO PUMPS

To Find the Pressure per Square Inch of a Column of Water.—

Multiply the height in feet by .433. The pressure per circular inch may be found by multiplying the height in feet by .341. Example: Required the pressure in lbs. per square inch of a column of water 200 ft. high.

200 x .433 = 86.6 lbs. per square inch.

To Find the Pressure of a Column of Water in lbs.—If the base be circular, square the diameter in inches, and multiply by .341, which gives the weight of one foot in height, therefore, by multiplying the number of feet in height, the pressure is found. If the base be square, multiply by .433. Examples: Required the pressure of a column of water 12 in. in diameter and 20 ft. high —

12 x 12 x .341 x 20 = 982.080 lbs. if the base be circular.

12 x 12 x .433 x 20 = 1247.04 lbs. if the base be square.

To Find the Quantity of Water in a Pipe.—The square of the diameter in inches gives the weight of water in lbs. for 3 ft. in length, and by striking off one figure to the right the number of gallons is found. Example: Required the quantity of water which a pipe 15 in. in diameter and 9 ft. long will contain.

15 x 15 x 3 = 675 lbs., or 67.5 gallons.

To Find the Diameter of Pipe required to discharge a given quantity of water at a given speed per minute.—Rule: Multiply the number of cubic feet of water per minute by 144; divide by the velocity of flow in feet per minute, divide by .7854, and take out the square root, which will give diameter of pipe.

To Find the Velocity of flow of water in a pipe required to discharge a given volume of water in a given time.—Rule: Multiply the number of cubic feet of water by 144, and divide the product by the area of the pipe in square inches.

FARM WATER SUPPLY REQUIREMENTS

Farm water supply requirements will vary considerably from day to day and from season to season, but no basis for computing the average requirements for following figures may be used. The pump selected should be of sufficient capacity to supply the day's requirements in two or three hours' pumping, thus leaving a margin to cover peak demands.

DAILY CONSUMPTION

	gallons per day
Working horses per head	20
Milking cows per head	20
Dry cattle per head	10
Sheep per head	2
Pigs per head	2
Poultry per 100 birds	7
Domestic use per person	25
Septic tank per person	8
Garden, per ¼ acre	500

SIMPLE REPAIRS FOR CRACKED PIPES

A temporary repair for a broken or cracked water pipe that is not under much pressure can be made by forcing stiff roofing tar into the crack and then wrapping several layers of adhesive tape around the pipe over the tar. If the pipe carries gasoline, shellac should be used instead of tar. For pipes that carry considerable pressure, brighten the metal around the crack with emery paper, then wrap a clean wire closely around the pipe over the crack and then flow solder over the wire. If properly done, this repair should last as long as the pipe.

Never use any faulty piping on a suction line.

TO BEND METAL PIPES

Get some dry, clean sand. Prepare a tapered wooden plug and drive tightly into one end of the pipe, after making sure that no foreign substance is in it. Stand on end and pour in sand, tapping gently to get it down, until it is filled to within an inch of the top. Make a dozen or fifteen thin soft-wood wedges 6 in. long, and drive them 4 in. into the piping until the end is completely blocked, so that the sand cannot escape. The piping is now, to all intents, solid, and may be heated and bent to the desired angle like ordinary bar-iron. Warning! Do not use damp or wet sand, for when it is heated it will either burst the piping or blow out the plugs.

Alternatively, "MACMET" Pipe Bending Metal may be purchased from McPherson's Ltd. for this purpose. It may be used over and over again.

TO UNSCREW WATER TAPS

Tank-taps can be unscrewed for repairs with little waste of water. Partly fill a strong sugar-bag with sand, tie it firmly to a long pole, and lower into tank till it can be pressed firmly against tap aperture; then unscrew the tap. Pressure of water will force the sandbag into the hole, closing it till the tap has been repaired. In this way, also, the extra piping can be attached to the tank without waiting till it is empty.

TABLE HEREUNDER GIVES THE FRICTION LOSS, IN FEET,

due to friction, in various sizes of new, smooth, straight cast iron pipes per 100 feet, when discharging the stated quantities per minute.

Gallons	DIAMETER OF PIPE IN INCHES										
per min.	¾ in.	1 in.	1¼ in.	1½ in.	2 in.	2½ in.	3 in.	4 in.	5 in.	6 in.	7 in.
5	14.5	3.4	1.2	.45	—	—	—	—	—	—	—
8	—	8.8	2.8	1.1	.27	—	—	—	—	—	—
10	—	13.6	4.5	1.9	.42	—	—	—	—	—	—
15	—	34.0	10.0	4.5	1.0	—	—	—	—	—	—
20	—	54.6	17.9	7.2	1.7	.56	.22	—	—	—	—
30	—	—	40.4	16.2	3.8	1.2	.5	—	—	—	—
40	—	—	—	28.5	6.6	2.2	.9	.21	—	—	—
50	—	—	—	45.0	10.6	3.5	1.4	.33	—	—	—
60	—	—	—	65.0	15.4	5.0	2.0	.48	.15	—	—
70	—	—	—	88.3	21.0	6.8	2.7	.65	.21	—	—
80	—	—	—	—	27.2	8.9	3.6	1.08	.26	.11	—
90	—	—	—	—	34.2	11.2	4.5	1.0	.35	.14	—
100	—	—	—	—	42.6	14.0	5.6	1.3	.43	.17	—
120	—	—	—	—	—	20.2	8.1	1.9	.63	.25	—
140	—	—	—	—	—	27.3	11.0	2.6	.86	.33	—
150	—	—	—	—	96.0	31.5	12.5	3.0	—	—	—
160	—	—	—	—	—	35.9	14.3	3.4	1.1	.45	—
180	—	—	—	—	—	45.0	18.0	4.3	1.4	.56	—
200	—	—	—	—	—	56.1	22.5	5.3	1.7	.70	.32
250	—	—	—	—	—	87.0	35.0	8.3	2.7	1.1	.51
300	—	—	—	—	—	126.0	50.8	12.0	3.9	1.6	.72

DRILL SPEEDS IN R.P.M.

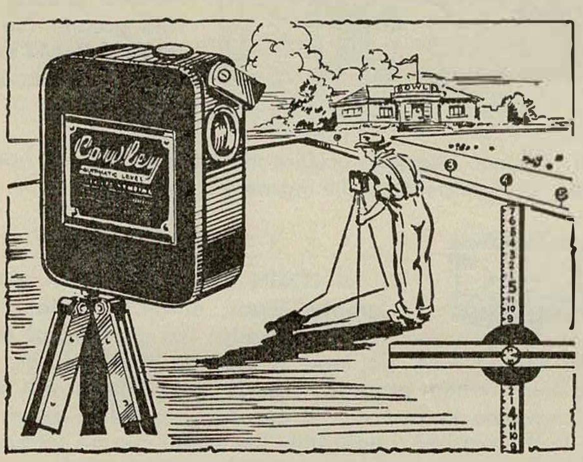
Diameter of Drill	Soft Metals 300 F.P.M.	Plastics and Hard Rubber 200 F.P.M.	Annealed Cast Iron 140 F.P.M.	Mild Steel 100 F.P.M.	Malleable Iron 90 F.P.M.	Hard Cast Iron 80 F.P.M.	Tool or Hard Steel 60 F.P.M.	Alloy Steel Cast Steel 40 F.P.M.
1/16 (No. 53 to 80)	18320	12217	8554	6111	5500	4889	3667	2445
3/32 (No. 42 to 52)	12212	8142	5702	4071	3666	3258	2442	1649
1/8 (No. 31 to 41)	9160	6112	4278	3056	2750	2445	1833	1222
5/32 (No. 23 to 30)	7328	4888	3420	2444	2198	1954	1465	977
3/16 (No. 13 to 22)	6106	4075	2852	2037	1833	1630	1222	815
7/32 (No. 1 to 12	5234	3490	2444	1745	1575	1396	1047	698
1/4 (A to E)	4575	3055	2139	1527	1375	1222	917	611
9/32 (G to K)	4071	2712	1900	1356	1222	1084	814	542
5/16 (L, M, N)	3660	2445	1711	1222	1100	978	733	489
11/32 (O to R)	3330	2220	1554	1110	1000	888	666	444
3/8 (S, T, U)	3050	2037	1426	1018	917	815	611	407
13/32 (V to Z)	2818	1878	1316	939	846	752	563	376
7/16	2614	1746	1222	873	786	698	524	349
15/32	2442	1628	1140	814	732	652	488	326
1/2	2287	1528	1070	764	688	611	458	306
9/16	2035	1357	950	678	611	543	407	271
5/8	1830	1222	856	611	550	489	367	244
11/16	1665	1110	777	555	500	444	333	222
3/4	1525	1018	713	509	458	407	306	204

Figures are for High-Speed Drills. The speed of Carbon Drills should be reduced by one-half. Use drill speed nearest to figure given.

"BETTER METHODS" SECTION

This section gives details of improved appliances which have been devised to give better results. In time saved, convenience, ease of operation and more permanent satisfaction, these articles are excellent investments and are recommended to the Handyman by McPherson's Limited.

COWLEY AUTOMATIC LEVEL

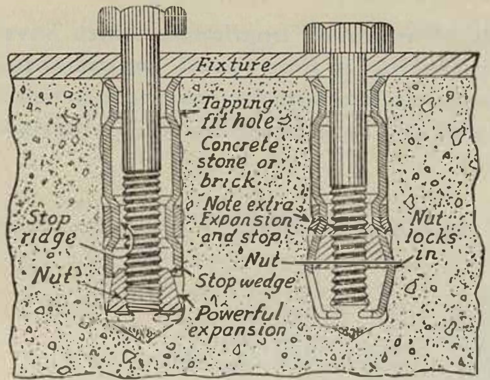


The COWLEY AUTOMATIC LEVEL — it solves your levelling problems the easy way. This amazing instrument, thousands of which are at present being used in the Building and Primary Industries throughout AUSTRALIA and NEW ZEALAND, can be used with outstanding success by unskilled labour.

The COWLEY AUTOMATIC LEVEL is the ideal instrument for setting out levels for contour cultivation, pasture furrows, absorption banks, dams, irrigation canals, drains, ditches, roads, and all building and construction work.

The effective range of the instrument using an 18 in. Target is from 6 ins. to 100 ft. For distances up to 300 ft. a larger Target is provided. All levelling usually done by more expensive instruments for distances within the requirements of the Primary Producer can be done with the Cowley Automatic Level, and because it is automatic in operation it does not require to be set up with accuracy.

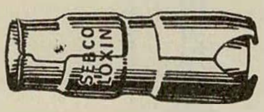
"SEBCO" MASONRY ANCHORS



SECURITY. "Sebco" anchors expand at the base, giving greatest grip at the bottom of the hole — as far away as possible from the surface of the masonry. The wedging action anchors the fitting with maximum security — the greater the load, the greater the expansion.

DURABILITY. "Sebco" anchors are all metal — they will last as long as the masonry.

NEATNESS. "Sebco" anchors require the smallest possible hole consistent with strength. Disfigurement of the masonry is avoided.



LOXIN

A LOXIN Shield will never yield. Carries greater loads, easier to install, securer than other methods. No grouting of bolts, drilling requirements cut in half, no lead or cement required, no waiting for material to set. When properly installed the LOXIN will develop the strength of machine bolts used. It can be inserted in either a loose or tight hole. In the case of a tight hole the shield can be tapped into place with a hammer. Under this condition it gives the best results.

Diam. Bolt	Shield Length	Shield Diam.	Working Load
¼	1¼	½	500 lbs.
5/16	2	⅝	600 lbs.
⅜	2	⅝	800 lbs.
½	2½	⅞	1500 lbs.
⅝	3	1	1800 lbs.
¾	3½	1⅛	2500 lbs.

PENETRENE

THE HANDY FLUID FOR METAL

Rusted bolts and nuts, tight set-screws and corroded metal parts call for the Penetrene treatment.

Mostly a few drops let run on the rusted surfaces will do the trick. Penetrene really penetrates into the most remote crevice. The most stubborn rusted screw or bolt will act like new after Penetrene soaks in.

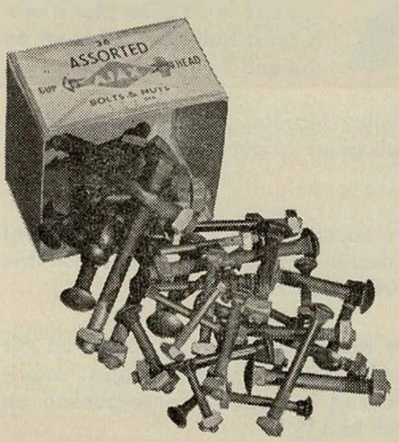
Also used with great success in stopping the squeaks of metal surfaces, springs, etc. Neutralises the effects of rust corrosion and carbon deposits on metals, machinery, motor vehicles. Will not pit or corrode any metal.

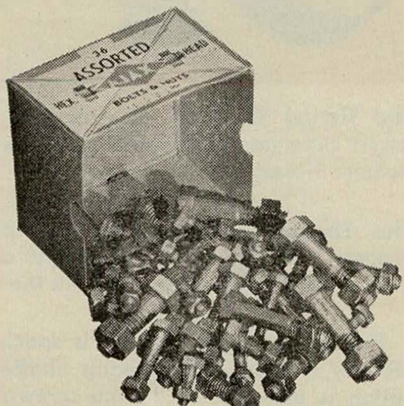
May be freely used for decarbonising cylinders, seized valves, heat bound bearings, etc.

Penetrene is non-acid and non-inflammable, and does not harm paint work. Available in 1 pint tins and larger.

AJAX BOLT AND NUT ASSORTMENT

Here are carefully selected assortments of 36 useful sizes which can save you time and trouble over and over again.





AJAX CUP HEAD BOLTS AND NUTS

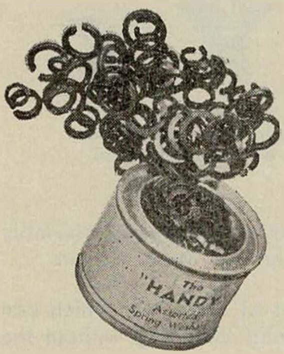
In Packets of 36

Sizes include — ¼ x 1½, 2, 2½, 3. 5/16 x 2, 2½, 3, 4. ⅜ x 2½, 3, 4, 5.

AJAX HEXAGON BOLTS AND NUTS

In Packets of 36

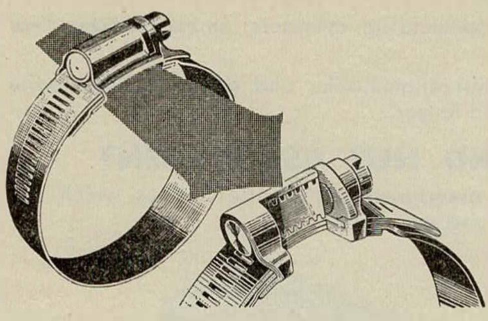
Size s include — ¼ x ¾, 1½, 5/16 x 1, 1½, 2. ⅜ x 1, 1½, 2. ½ x 1½, 2.



"HANDY" ASSORTED SPRING WASHERS

8 doz. per tin. Sizes from ¼" - 7/16".

CHENEY SUPER HOSE CLIPS



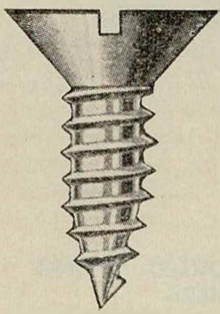
The Cheney Clip is standard equipment on the biggest and fastest civil and military aircraft. Moreover, the Cheney is used on a number of famous cars.

This apparently simple piece of metal can be just as efficient at the phenomenal speeds of a fighter plane as it is on a baby car, or even on the end of the garden hose.

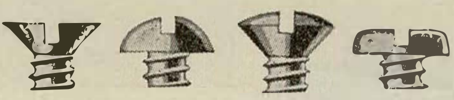
The Thrust Washer, an exclusive Cheney feature, permits the use of a larger diameter **hardened** screw, which gives a much more positive and deeper thread engagement.

The Threaded Band. The thread is specially machined by a patent process which ensures uniformity of depth and a perfectly concentric thread which meshes exactly with the hardened screw.

Finally, the whole fitment is specially rust-proofed by an approved Air Ministry method, and remains unaffected by atmospheric changes. Lubrication is unnecessary as the screw-retaining bridge is grease-packed on assembly. Available in 7 sizes from ½″ to 5½″.



P-K SHEET METAL SCREWS



C R O B

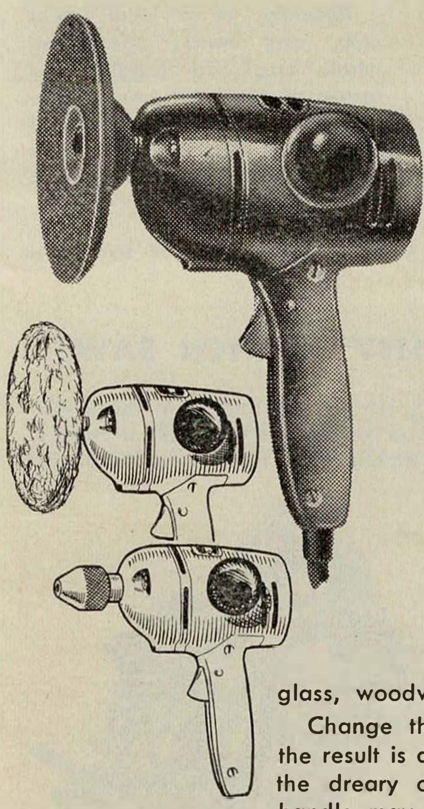
C — Countersunk Head. R — Round Head.
O — Raised Head. B — Binding Head.

The automobile trade, and all other industries in which speedy assembly of sheet metal is a feature, have standardised on P-K Metal Screws.

A hole is punched or drilled to take the point of the screw which can then be screwed right home, making a tight strong fastening without the need of units. The screw thread being specially hardened, cuts its own thread in the sheet, and so saves tapping. Several types in many sizes are available. Readers should send for particulars and prices from McPherson's Limited.

"DO-IT-YOURSELF" IS HERE TO STAY

Amateurs Marvel at Speedy High-Class Results



Following the wide acceptance in U.S.A. of the modern "Do-It Yourself" practice, wherein millions of ordinary people invest in electric tools to avoid costly jobs by experts in their homes, garages and workshops, it is now clear that Australians also have been quick to realise the advantages of doing it themselves.

One of the most useful tools now helping to popularise "D.-I.-Y." is the Black & Decker All Purpose Unit, shown at left. Only 3½ pounds in weight with a 240 volt motor giving 3,000 R.P.M., it is the basic unit for a host of time-saving operations. A key locked ¼ inch chuck permits it to drill up to quarter inch holes in mild steel and half inch holes in wood.

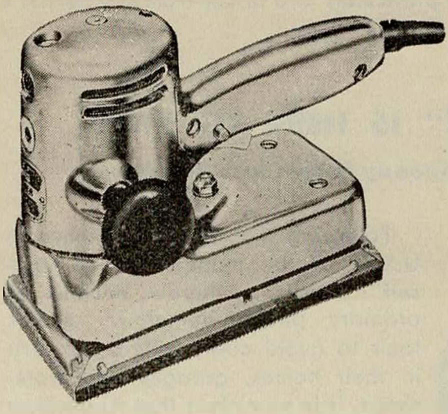
With a rubber disc replacing the chuck, lambswool mops may be used at high speed for polishing Duco, glass, woodwork and other high-gloss surfaces.

Change the lambswool for sanding discs and the result is a very efficient sander for speeding up the dreary operation of sanding. A detachable handle may be fitted either right or left side to facilitate control in tricky places.

A circular saw with efficient guards has now been produced for use on this All-Purpose Unit. Simply fit the saw spindle into chuck and the saw becomes another time-saver.

Melbourne — Sydney — Brisbane — Adelaide — Perth McPherson's Ltd.

FOR THE LARGER SANDING JOB



Often a man-size sanding job has to be faced up to, perhaps a boat, or a caravan, or an entire house painting job. This is the sort of job the Black & Decker No. 44 Sander (at left) is built for.

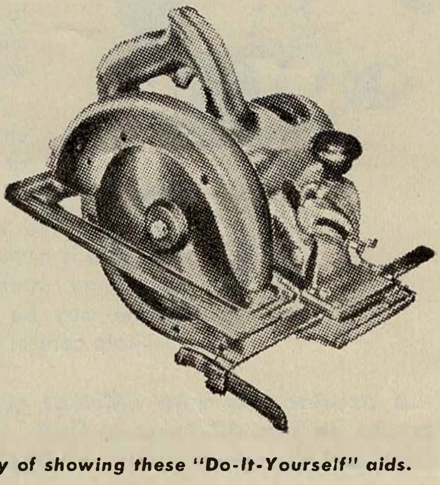
Recently, at a local yacht club, one owner spent the whole week-end sanding the inside of his boat. Meantime, alongside, another owner did a similar job on a similar craft in TWO HOURS with a Black & Decker 44 Sander.

Ten times faster than hand, it has a sanding surface 3 ⅝ ins. by 9 ins., and weighs 5 ½ lbs.

BLACK & DECKER "UTILITY" 8 INCH SAWS

What fun is there is sawing, sawing, sawing by hand? To those who first try an electric portable saw there is no going back to the old drudgery. It's easier, it's thrilling to speed through timber and it finishes the job almost as it's begun.

Designed for the amateur and the householder; this means that safety is the first consideration in design and construction. Ease of control and effective sawing have also contributed to the tremendous popularity of this miracle tool. Blade diameter is 8 ¼ ins., giving a cut of 2 13/16 ins. deep. A depth and bevel attachment, also a Rip Fence are supplied with the saw.

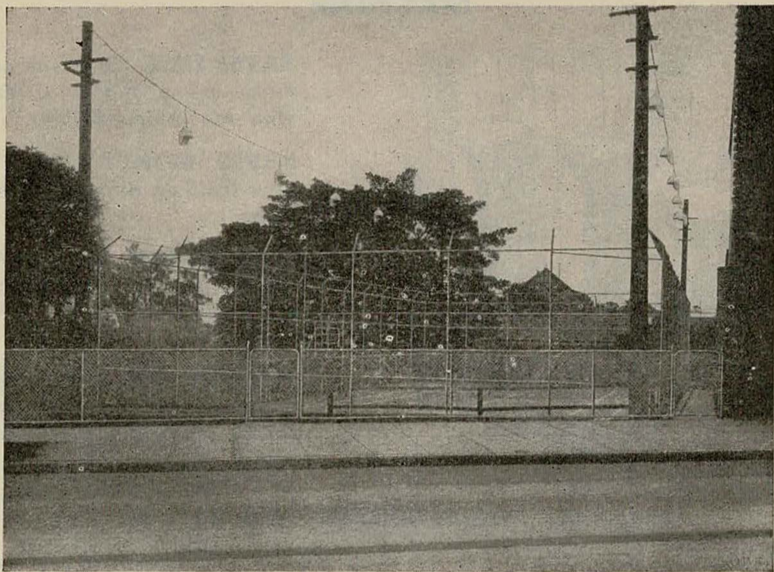


Price of this time saver is only part of the cost saved on a long job.

McPherson's Limited make a specialty of showing these "Do-It-Yourself" aids.

McPherson's Ltd. **Melbourne — Sydney — Brisbane — Adelaide — Perth**

"DOWNEE" PRESSED STEEL RAIL FITTINGS

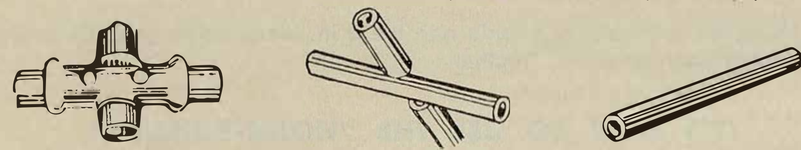


Ideal for Tennis Courts, Poultry and Stock Enclosures, Pipe Railings, Machine Guards, &c., "Downee" does away with old-fashioned and unsatisfactory methods. Manufactured from special steel, all galvanised finish, made to gas and water pipe sizes, complete with galvanised bolts and nuts.

Suitable for Permanent Outdoor Use

Fire Proof — white ant proof — and always looks attractive and efficient.

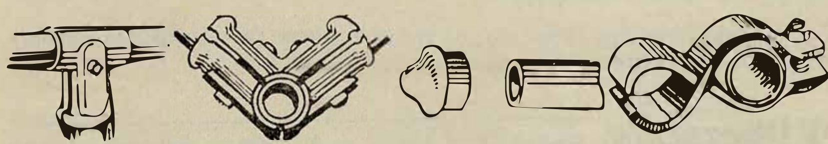
No skill is required to construct. A spanner is the only tool required.



Take a tube, use two more, add a "Downee" fitting, multiply as required.

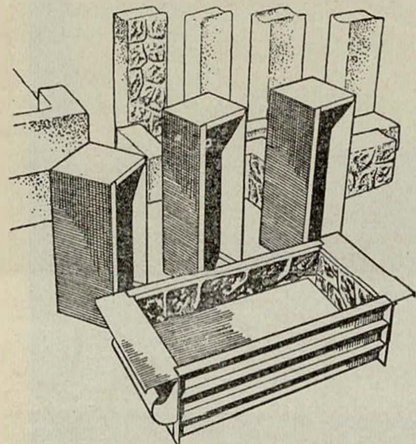
A wired enclosure may be completed in a fraction of the time required to make one using timber.

Made for ¾" to 2" piping and full particulars are available on application to McPherson's Limited.



Clips or Tees. **Corner Fittings.** **Knobs.** **Gate Hinges.**

"AJAX" HOME BUILDER CEMENT BLOCK MACHINE



SAVES TIME. One man can make many blocks a day with one "Home-Builder."

SAVES MONEY. Cost of your building materials is cut down.

EASY TO USE. No skill required. Anyone can turn out good blocks with little trouble.

AVOIDS DELAYS. The materials you need are simply cement, sand and gravel.

What the "HOME-BUILDER" will do . . .

It will turn out uniform size building blocks, with geometrically true faces, and square corners:

18 in.	long,	6 in.	wide,	4 in.	thick,	with	plain	face.
18 in.	,,	6 in.	,,	3 in.	,,	,,	,,	,,
18 in.	,,	6 in.	,,	4 in.	,,	,,	rock	,,
18 in.	,,	6 in.	,,	3 in.	,,	,,	,,	,,

Corner Blocks:

18 in. and 9 in. lengths from corner, 3 in. or 4 in. thickness, with plain or rock face.

Using the 4 in. blocks outside and the 3 in. block inside give full cavity insulation from damp and weather.

IT'S EASY TO USE THE "HOME-BUILDER"

1. Set up the machine with end-pieces (frogs) and packing piece to make the size block you require.

2. Fill up with the cement mix (see separate notes on the correct methods of mixing), and ram down. Fill up again, give a few hard blows with your shovel, and smooth off the top.

3. Turn the machine over on to a level piece of ground, preferably sprinkled with sand.

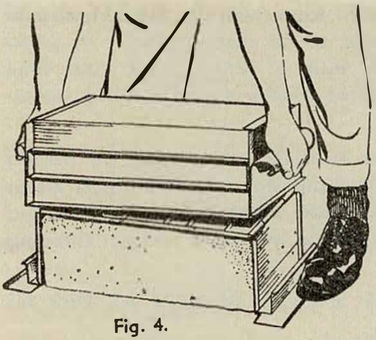


Fig. 4.

At left:

4. Keeping one foot on each of the holding flanges, lift up the outside casing.

Below:

5. Slightly open out the hinged section of the inner frame to lift it clear of the block.

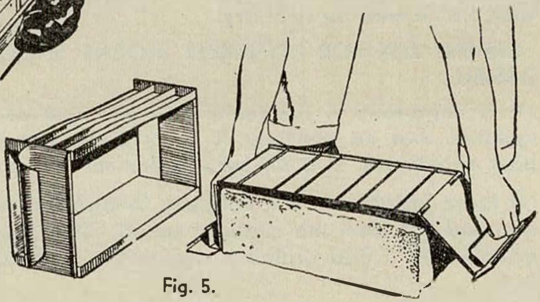


Fig. 5.

6. Replace inner frame and packing piece ready for next block.

7. Allow the block to dry and harden for about 12 hours; then cure the blocks by keeping them damp for 7 days, by occasional spraying or covering with damp bags. This will greatly increase the strength of the blocks.

MIXING THE CEMENT

The underlying principle of good concrete making is that every particle of sand shall be thoroughly coated with cement — hence a thorough mixing of the two ingredients in a dry state is firstly necessary, and if any gravel or broken stone be included, every piece of such must have its coating of the sand and cement mixture.

The following proportions may be taken as a guide:—

Very fine sand and cement	4 to 1
Medium sand and cement	5 to 1
Good sharp sand, fairly coarse, and cement . .	6 to 1
Good sharp coarse sand, and cement	7 to 1
Gravel, sand and cement	5, 3 and 1

Mixtures in these proportions, well tamped, will give a good block. The sharper and cleaner the sand, the better the result; but it must be remembered that the mixing should be thorough. Use one brand of cement and the same kind of sand, or sand and gravel throughout your building — for the outside walls particularly — to ensure uniformity in colour of blocks.

Should there be more than 10 per cent of loam with the sand, it should be washed until the water used shows little or no discoloration. A good building block can, however, be made with a sandy loam and lime (hydraulic) in proportion of 4 to 1, but these blocks would require waterproofing if used for outside walls.

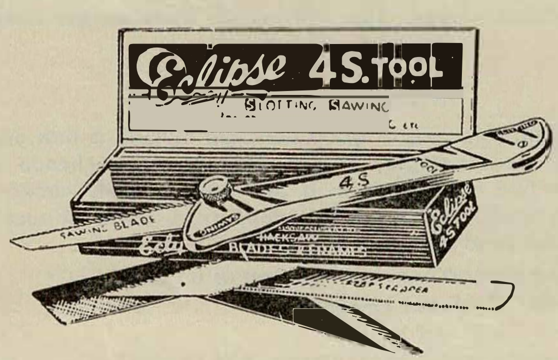
For colouring the blocks, if desired, a mineral colour may be added during first dry mixing. After dry mixing is complete, sufficient clean water may then be sprinkled on the mixture, so that, when thoroughly worked up again, it will retain its shape when pressed in the hand without showing water, i.e., it must be semi-dry.

CEMENT MIX FOR CONCRETE BLOCKS SHOULD BE KEPT AS DRY AS POSSIBLE.

It is important to remember that the size of the batch should be so regulated that no concrete is used which has been wet for more than about 45 minutes, as it will take its first set in that time.

If these instructions are carefully followed, a perfect building block can be turned out from the material mixed. Two hundred of these blocks are equivalent to 1,000 ordinary clay bricks, and will build a wall 10 ft. by 10 ft.

TWELVE TOOLS IN ONE



THE "ECLIPSE" 4S TOOL is a handy tool designed for use on a hundred and one jobs in engineering, electrical, plumbing, garage, and general maintenance work. It consists of a specially designed metal holder and twelve separate tools all contained in an attractive metal case. The holder is double-ended and so designed that the tools can be fitted either "in line" or at an angle to give clearance for the fingers; the knurled screw secures the tools firmly. The twelve tools are made from high grade steel, specially heat treated to give the best performance and the longest life.

The tool can be used in line or at an angle.

The 4S tool consists of:

3 Slitting blades with 24 teeth per inch, in 23, 21 and 18 gauge.
4 Sawing blades (23 gauge) with 32 teeth per inch.
1 Slotting blade (18 gauge) ground for mica cutting and thread cleaning.
1 Flat scraper.
1 Slitting knife.
1 Screwdriver.
1 Second cut file.

SAWING BLADES

Indispensable for short stroke work, such as cutting in awkward corners, cutting slots in sheet metal, wood, etc. They are toughened on the back to reduce breakages and tapered for use where there is little clearance.

FLAT SCRAPER

Specially hardened and tempered for keen cutting, the front edge being slightly convex for accurate work. This blade is a handy tool for decarbonising purposes.

SCREWDRIVER BLADE

A useful component of the outfit. It is specially heat treated for durability and long life.

SECOND CUT FILE

Supplied with one safe edge, the file is suitable for general purpose work and invaluable for jobs for which a full size file cannot be used.

SLOTTING BLADE

So designed that one edge may be used on the push stroke and the other on the draw stroke. It can also be used for clearing damaged screw heads, slotting broken studs or, instead of warding or safe edge-files, for press tool and jig work.

SLITTING KNIFE

Ground with a bevel edge on one side only so that cutting is done with the greatest ease.

MICA CUTTER AND THREAD CLEANER

An 18 gauge slotting blade specially ground to a "V" edge for correctly undercutting the mica of the commutators of D.C. dynamos or motors. It is also extremely useful for clearing the threads of old and worn set screws and bolts.

USEFUL WEIGHT TABLES

APPROXIMATE WEIGHT OF PURE MANILLA ROPE

Circumference in.	800 ft. coil lbs.	100 ft. lbs.	Circumference in.	800 ft. coil lbs.	100 ft. lbs.
½	14	1 ¾	3	208	26
¾	20	2 ½	3 ¼	224	28
1	28	3 ½	3 ½	272	34
1 ⅛	32	4	3 ¾	312	39
1 ¼	40	5	4	352	44
1 ½	54	6 ¾	4 ½	440	55
1 ¾	64	8	5	560	70
2	98	12 ¼	5 ½	728	91
2 ¼	108	13 ½	6	840	105
2 ½	140	17 ½	6 ½	976	122
2 ¾	158	19 ¾	7	1120	140

WEIGHT OF WIRE ROPE

Circumference	Diameter	Weight in lbs. per fathom: Patent Steel Hoisting Ropes	B.B. Wire Rigging	Flexible Hawsers	Circumference	Diameter	Weight in lbs. per fathom: Patent Steel Hoisting Ropes	B.B. Wire Rigging	Flexible Hawsers
6	1 ⅞	34 ¾	32	30	2 ¾	⅞	7	7	5
5 ½	1 ¾	29	26	26	2 ½	13/16	6	6	4
5	1 ⅝	24	22	21	2 ½	11/16	5	5	3
4 ¾	1 ½	21 ¾	20	17	2	⅝	4	4	2 ½
4 ¼	1 ⅜	17 ½	16	12 ½	1 ¾	9/16	3	3	2
4	1 ¼	15 ½	14	11	1 ½	½	2	2	1 ½
3 ½	1 ⅛	12	11	8	1 ¼	7/16	1 ½	1 ½	1 ⅛
3	1	8 ¾	8	6	1	5/16	1	1	¾

WEIGHT OF WIRE NETTING

Per Roll of 50 Yards, 24 in. Wide

Mesh	Gauge	Weight	Mesh	Gauge	Weight	Mesh	Gauge	Weight
½″	22	42	1″	17	73	1 ⅝″	16	60
½″	20	65	1 ¼″	19	35	2″	19	23
½″	19	74	1 ¼″	18	45	2″	18	30
⅝″	22	32	1 ¼″	17	61	2″	17	39
⅝″	20	52	1 ¼″	16	77	2″	16	51
⅝″	19	61	1 ½″	19	30	3″	19	16
¾″	20	43	1 ½″	18	39	3″	18	21
¾″	19	54	1 ½″	17	51	3″	17	28
¾″	18	71	1 ½″	16	65	3″	16	36
1″	20	34	1 ⅝″	19	28	3″	15	46
1″	19	41	1 ⅝″	18	35	3″	14	60
1″	18	50	1 ⅝″	17	47			

ADVANTAGES OF ALUMINIUM CORRUGATED SHEET FOR ROOFS, WALLS, ETC.

DURABLE. Its freedom from corrosion and rust combined with its high resistance to industrial fumes ensures long life.

LIGHT. Costs are reduced through the lightness of the metal which makes handling and erection easier and gives substantially lower transport costs.

INEXPENSIVE. Owing to its durability it gives a lower cost per year of service than galvanised steel and other corrugated roofing materials.

EASY TO MAINTAIN. Painting is not necessary. Repair and maintenance are negligible.

STRONG. It is not brittle or subject to damage during and after erection and its strength is an important factor in industrial safety by eliminating the risk of workmen falling through apparently solid roofs.

BRIGHTER FOR INTERIORS. The high reflectivity of aluminium makes it an important factor in improving lighting efficiency inside buildings.

THERMALLY EFFICIENT. The high reflectivity and low emissivity ensures a maintenance of relatively even temperatures for internal working conditions.

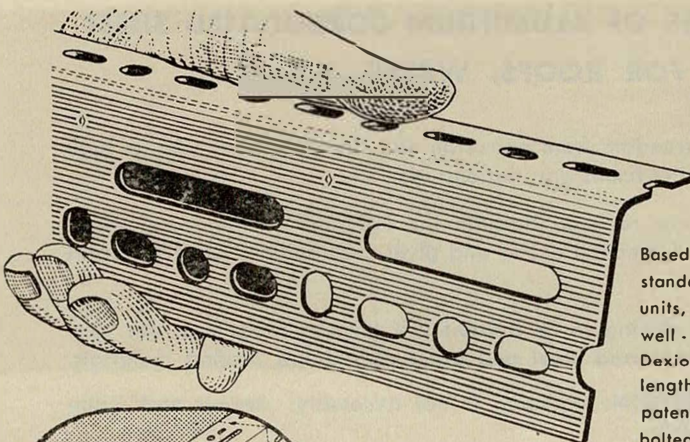
ATTRACTIVE. It remains clean in appearance and its freedom from rust ensures an attractive appearance throughout its life since it weathers evenly.

NON-TOXIC. The non-toxic qualities of aluminium enhance its value in agricultural areas where roofs are used as catchments for drinking water.

NON-INFLAMMABLE. As aluminium is not normally coated with paint or other inflammable protectives, it gives increased protection from fire for factories and warehouses, and also for produce and stock in agricultural areas.

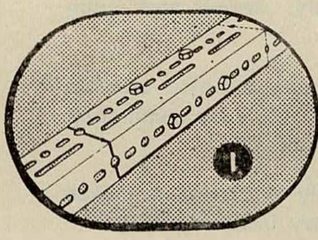
Two types of sheet are available, with a nominal width of 26", Corrugated Roofing in 24 gauge with eight 3" corrugations in 6, 7, 8, 9, and 10 feet lengths, and Mansard pattern sheets for walls or roofs in 24 gauge with five 6" corrugations in 6, 8, 9, and 10 feet lengths.

Special nails and diamond shape roofing washers are also made for this material.



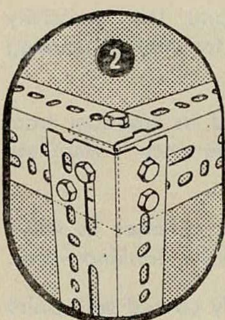
DEXION ANGLE

Based on the principle of standard constructional units, as for example the well-known "Meccono," Dexion simply consists of lengths of special slotted patented angle which are bolted together to build up all manner of extremely useful things. Dexion Angle is an amazingly useful and economical material for building all kinds of structures: Frameworks of small buildings and erections, Fencing, Machine Guards, Belt Guards, Storage Racks, Work Benches, Stands for small machines, Guard Rails, Staging for erection and repairs, Jigs, Trolleys, Bins, Shelves, etc.



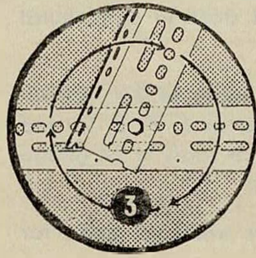
TRANSVERSE SLOTS

You can overlap and splice the NEW Dexion 225. Thus you can build up long, rigidly bolted lengths. Use up short lengths which may have accumulated — no waste! Nest one section neatly inside another when you need greater strength.



RIGID CORNER

The three-way corner, plain or inter-locked, gives outstanding rigidity. The round holes give positive location, and the bolt works in bearing in all directions.



ROUND HOLES

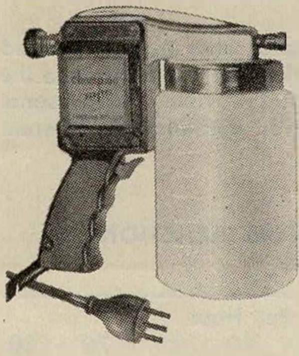
These ⅜" holes allow joints in which the bolts are in bearing in all directions — positive bracing on right-angled triangles with sides of the proportion 3-4-5 or 5-12-13. With special ⅜" fitted bolts, accurate pin-joints in full bearing are possible.

Ask for fully illustrated descriptive pamphlet dealing with the advantages of Dexion.

McPherson's Ltd.

Melbourne — Sydney — Brisbane — Adelaide — Perth

COMPRESSORLESS SPRAY PAINTING!

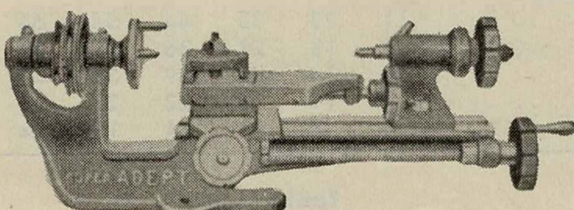


The Champion Super Electric Spray Gun is revolutionary in that it operates without the use of compressed air.

Operates by simply plugging into the power point, nozzle pressure of 120-135 lb. to the square inch. It sprays with equal ease lacquers, varnishes, synthetic resins, enamels, oil paints, disinfecting liquids, water paints, primers, building and impregnation materials, oils and liquid greases, fire resistant agents, polishes, etc.

The principle is that of an oscillating electro-magnet, and therefore has no rotating parts, which guarantees circuit safety in operation.

JUNIOR BENCH LATHE



A real working lathe, less than 12 in. long; simple yet complete with essentials; and priced to suit every Hobbyist, Home Mechanic and Car Owner. 1 5/8 in. centres. 6 in. between centres. Overall length, 11 1/4 in.

Screw Tail Stock, lead screw, compound slide rest, as illustrated, or with Sliding instead of Screw Tail Stock. Fitted to treadle, or small motor, these wonderful little lathes will solve many of the Tool User's difficulties.

3-Jaw Chuck to suit.

FOR CAR DRIVERS

STOPPING DISTANCES: MENTAL REACTION AND MECHANICAL EFFICIENCY

There are two actions in stopping a car — that of what might be termed the mental reaction to an emergency, and the distance travelled once the brakes are applied. Set out below are distances travelled for personal reaction at various speeds (Table 1), and brake efficiency at different speeds, four-wheel brakes (Table 2).

Table 1

DISTANCE TRAVELLED FOR PERSONAL REACTION AT VARIOUS SPEEDS

Time Reaction	Miles Per Hour							
	10	20	30	40	50	60	70	80
Poor	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.
2 seconds	29	59	88	117	147	176	205	275
1 ½ seconds	22	44	66	88	110	132	154	196
1 ¼ seconds	18	36	55	73	91	110	128	167
Good								
1 second	14	29	44	58	73	88	102	137
⅞ second	13	25	38	52	65	77	91	104
Very Good								
¾ second	11	22	33	44	55	66	77	88
⅝ second	9	18	27	36	45	54	63	72
½ second	7	14	22	29	36	44	51	58
⅜ second	5	11	16	22	27	33	38	44
¼ second	3	7	11	14	17	22	25	29

Table 2

BRAKE EFFICIENCY AT DIFFERENT SPEEDS

Four Wheel Brakes

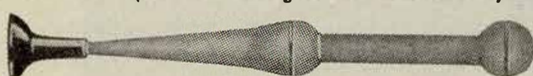
Speed	Distance Travelled	Speed	Distance Travelled
10 m.p.h.	4 feet	40 m.p.h.	78 feet
15 m.p.h.	10 feet	45 m.p.h.	100 feet
20 m.p.h.	19 feet	50 m.p.h.	120 feet
25 m.p.h.	30 feet	55 m.p.h.	146 feet
30 m.p.h.	44 feet	60 m.p.h.	172 feet
35 m.p.h.	60 feet		

Another interesting table of distance travelled in feet per second at various speeds per hour is included. After all, most serious accidents due to speed happen in a second or a fraction of a second, and we set out to the nearest foot the following figures:—

Miles per Hour		Feet per Second	Miles per Hour		Feet per Second
20	=	29	55	=	81
25	=	37	60	=	88
30	=	44	65	=	96
35	=	51	70	=	103
40	=	59	75	=	110
45	=	66	80	=	118
50	=	73			

It is a simple procedure to convert miles per hour into feet per second. Add one half of your miles per hour and you have it. The result is correct within two per cent. Twenty miles an hour is 30 feet per second. Thirty miles an hour is 45 feet a second, 50 miles an hour is 75 feet per second, and a second is as long as it takes to say distinctly "one second." Always drive by thinking of your speed in feet per second instead of miles per hour. It will make you a more careful, a more polite and a much better and safer driver.

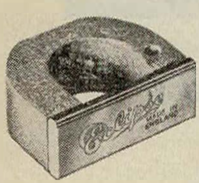
(With acknowledgment to National Safety Council of Australia.)



HAND TYPE SUCTION GRINDERS

No. 541.—Large suction Grinders with smooth, non-slip frictionless handles for all large head engine valves having no slots. Length, 11 in.
No. 542.—Small suction Grinders for all small engine valves, particularly adaptable to Ford 8-10 h.p., Morris, Singer, etc. Length, 10 in.

"ECLIPSE" POCKET MAGNET



The "Eclipse" Pocket Magnet in Alnico is primarily an engineer's pocket inspection magnet. Owing to its great power for its small size, it is also useful for retrieving nuts, bolts, etc., on the end of a string or wire, from inaccessible places in the garage, workshop, warehouse, laboratory, office, etc.
Overall Height — 1". Distance between poles — ¼".
Section — 5/16" x 5/16". Weight — 1 oz.
Supplied with plated keeper.

BANGOR SLIDING DOOR TRACK AND FITTINGS

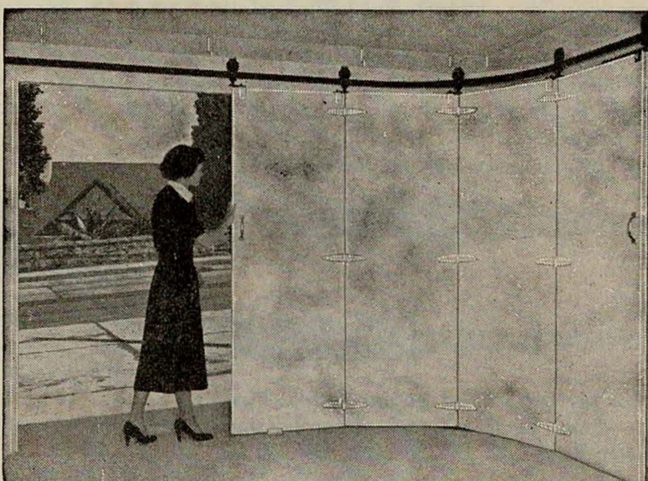
"ROUND THE CORNER" OPEN RAIL

Set 285 — 3 Door

Specially designed for private garages and to suit an opening 8′ wide with up to a 14″ nib from the return wall. Headroom required, 7½″.

Sets are supplied complete with track, hangers, hinges, floor guides, door stop and Service Door Clip and necessary bolts, nuts and screws.

The simplified action of Bangor "Round the Corner" ensures that each section of door slides easily along its course until it fits snugly against the side wall of the garage.

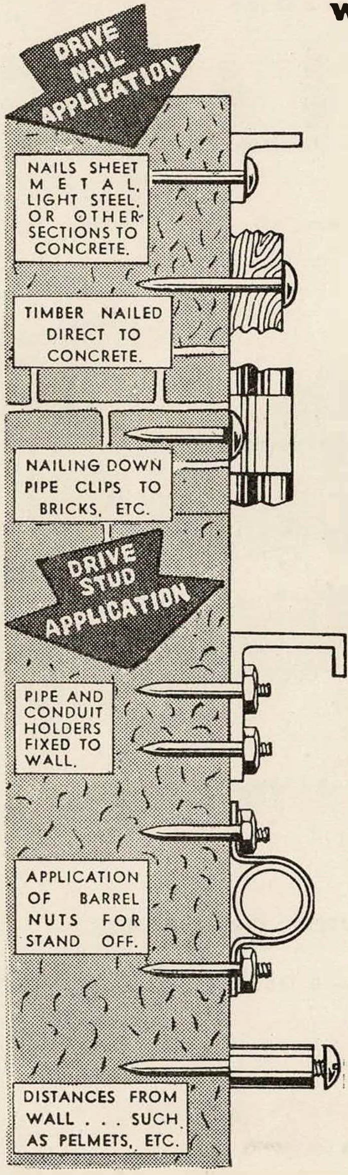


"ROUND THE CORNER" OPEN RAIL

Set 290 — 4 Door

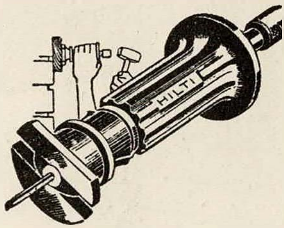
For an opening 8′ wide with up to 14″ nib. Each leaf should not exceed 60 lbs. in weight. These sets provide a most inexpensive means of hanging garage doors.

Nail into steel or concrete
with this handtool



- **No mess.**
- **No plugging.**
- **No danger.**
- **No preparation.**
- **No drilling.**
- **No power needed.**

HILTI
Hand Drive Nailing Tool



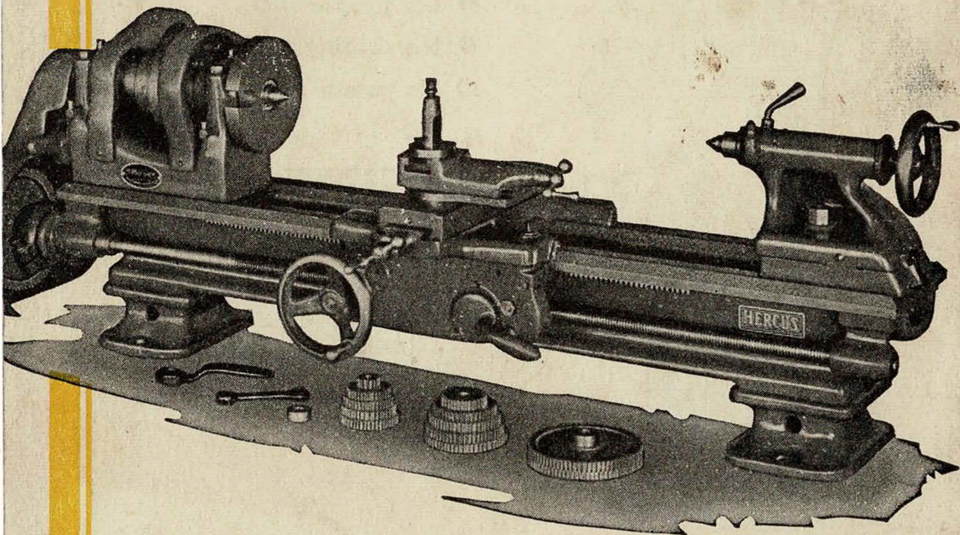
STANDARD MODEL DM6 (illustrated)

Is a universal tool for driving either nails or studs, and is a general tradesman's tool; there are also available different models specifically for nailing only or studding only; and completing the range is a simple handyman's tool.

PRICES ON REQUEST

SEND FOR THIS FREE BOOKLET

An Introduction TO THE SMALL LATHE



ELEMENTARY INSTRUCTIONS on SMALL SCREW-CUTTING LATHES

●

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