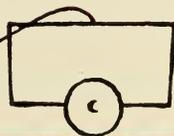




FARM SHOP EQUIPMENT

*Its Usefulness
on California Farms*



M. O'BRIEN

R. R. PARKS

FARM SHOP

Its Usefulness

Your farm shop should pay its own way . . . it will if it is planned to fit your operations.

It is not proposed that all construction, repair, or maintenance work be done in all farm shops . . . this would require more specialized equipment and skill than are usually available to the average farm operator.

However, many farmers find it advantageous to do a considerable part of their repair and maintenance work that does not require specialization. In so doing they are able to protect their investments in expensive buildings and equipment—cut the rate of depreciation (estimated to be from 3 to 10 per cent annually).

They are also able to modify new equipment to fit their specific

EQUIPMENT

on CALIFORNIA FARMS

needs—an important factor on California farms.

Too large or too elaborate a shop can be a liability. A good rule of thumb . . . the investment in shop and equipment should not exceed four per cent of the total investment in the land, buildings, and farm machinery.

It is often wiser to "farm out" major jobs of repair or busy-season jobs than it is to buy tools or machinery needed to do the work yourself.

This circular lists and illustrates some of the features that make for efficiency in planning, building, and operating a farm shop. It does not attempt to tell you how to do the work or how much you are justified in doing.

THE AUTHORS:

M. O'Brien is Assistant Professor of Agricultural Engineering and Assistant Agricultural Engineer in the Experiment Station, Davis.

R. R. Parks is Agriculturist, Agricultural Extension, and Extension Specialist, Department of Agricultural Engineering, Davis.

THE GENERAL LAYOUT

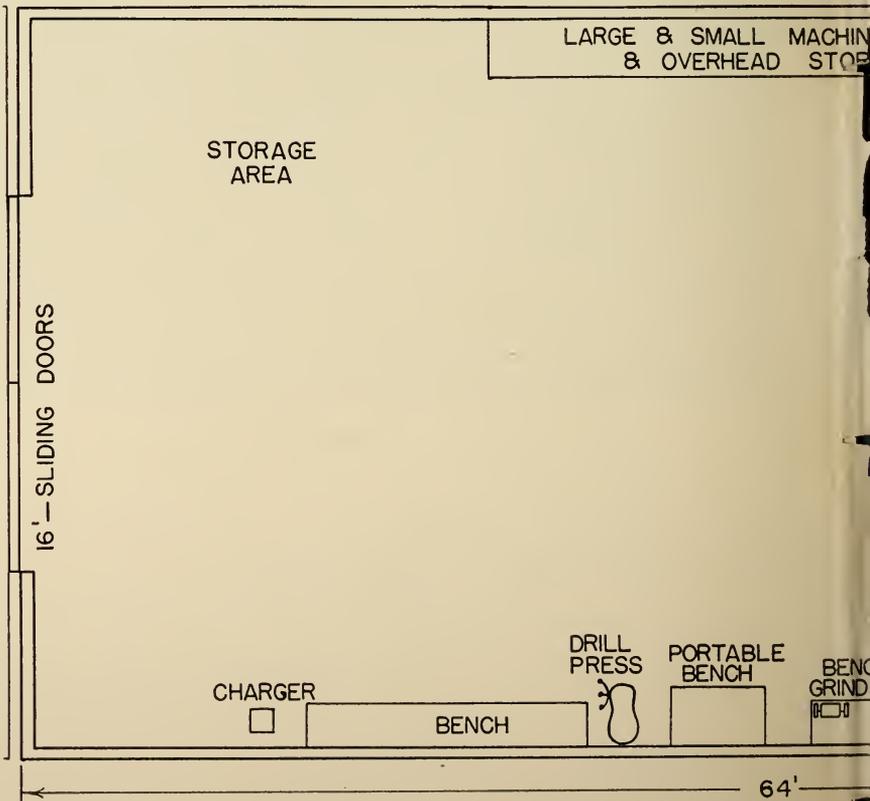
Your shop can be a separate building or part of a large storage shed. Either way, it should be big enough to handle expected jobs but not too big for efficiency. Most farm shops range from 24' x 36' to 50' x 100'. A common practice is to store trucks or other large equipment in the shop building when no shopwork is being done.

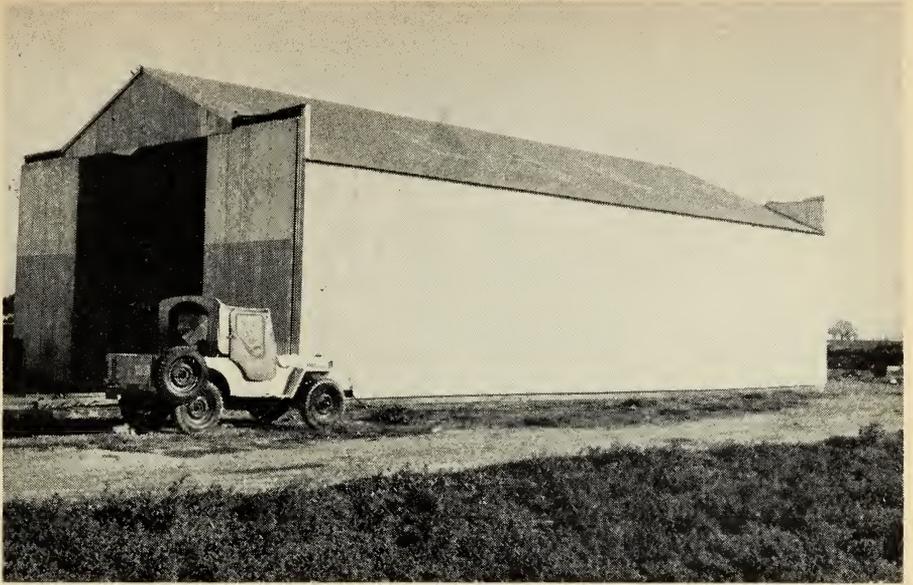
It is a good idea to locate the shop so that it is accessible from a central yard.

Here it is more convenient for work on bad days, evenings, and during off seasons so equipment can be put into good condition *before seasonal use begins*.

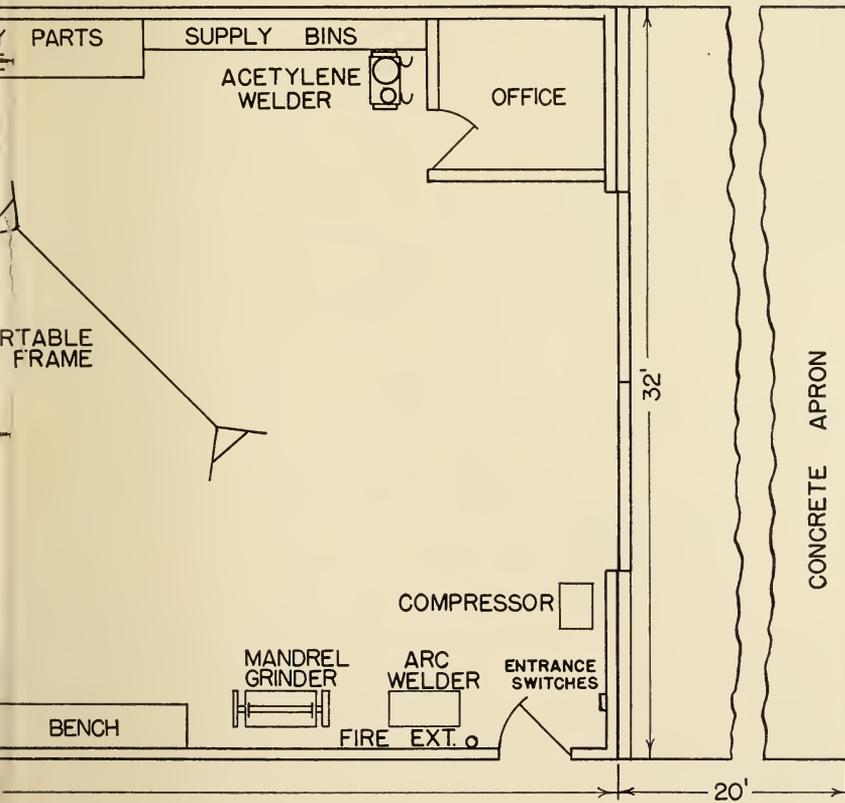
Since most of the shop equipment and storage bins will be arranged around two walls, the building need be only slightly larger than would be required for the storage of equipment. Using a truss-type roof support will allow more usable space inside.

Here is the floor plan of the shop pictured above. Efficient use of wall space permits maximum floor area for shopwork and storage of farm machinery.





This farm shop combines many desirable features that aid in the extensive shop activities carried on. On less extensive farms a similar layout might be employed on a smaller scale.



SOME HELPFUL DETAILS

A concrete apron is convenient for washing, mounting, steam cleaning, or painting equipment. The apron also makes it easier to expand the shop if needed, by adding a roof.



A concrete floor makes for ease in rolling heavy equipment in a limited space; is easy to keep clean; reduces accidents.

Anchors placed near each end of the floor are convenient for pulling and moving big equipment with block and tackle. The anchors can be recessed so they are flush with the floor.

Several parallel lines painted on the floor the standard width of row crops are helpful in adjusting machinery before it goes into the field. A shop rule can also be painted on the floor for rough measurements.



Doors should be 12' to 16' wide and 10' to 16' high. Exterior sliding doors or overhead doors are recommended because they leave maximum inside wall space.

The convenient location of small entrance doors will save using large doors except for movement of large equipment.

Machinery transports are handy for moving wide machines through shop doors.

Top: Water hose and gas pump are handy to the apron a reasonable (safe) distance from the shop. Center: Measurements of large doors are based on the largest piece of equipment that will enter. Bottom: small doors allow access to the shop for personnel, without opening the large doors.

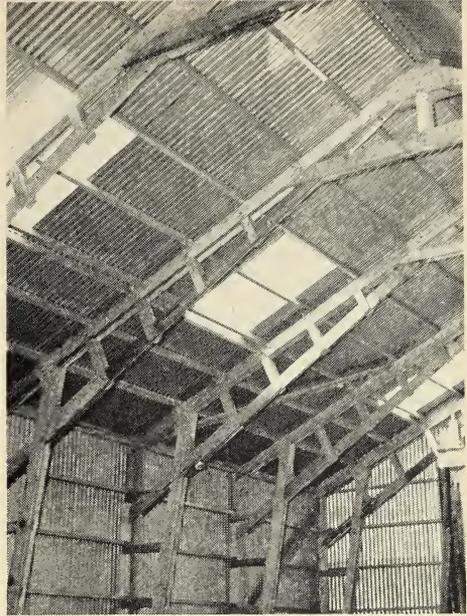


Windows may be made of translucent fiberglass and spaced at intervals in the roof to provide light to all parts of the shop during the daytime. Most shopwork requires good lighting, so plenty of windows are recommended.

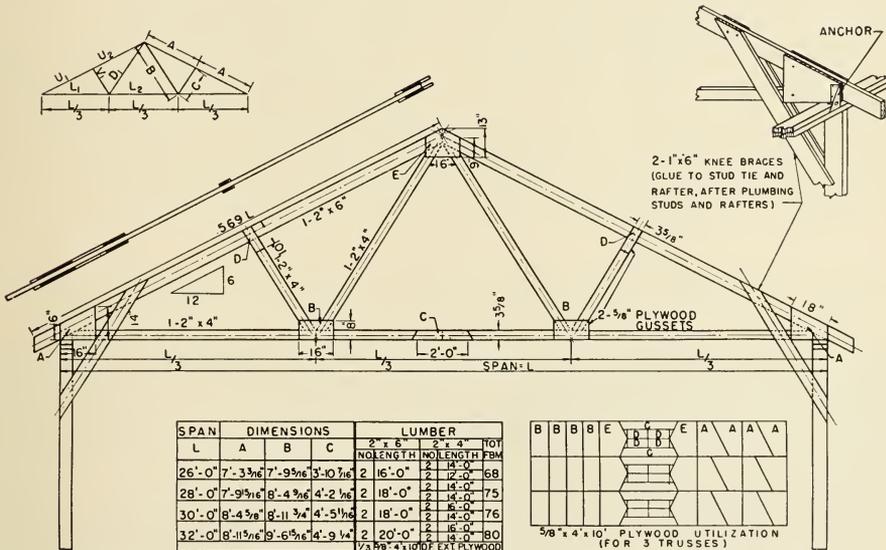
Roof windows will also reduce vandalism and theft of machinery.

Artificial lighting will be required for work on dark days and at night. An overhead outlet for each 200 square feet of floor area is recommended.

In addition, locate floodlights over each 10-foot length of work bench and a light over each piece of permanent equipment.

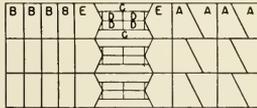


Uniform lighting from windows in the roof. Note truss-type roof supports allowing for maximum use of floor space.



SPAN L	DIMENSIONS			LUMBER	
	A	B	C	2" x 6" NO LENGTH	2" x 4" NO LENGTH FBM
26'-0"	7'-3 3/8"	7'-9 5/8"	3'-10 1/8"	2	16'-0" 68
28'-0"	7'-9 5/8"	8'-4 3/8"	4'-2 1/8"	2	18'-0" 75
30'-0"	8'-4 3/8"	8'-11 3/4"	4'-5 1/8"	2	18'-0" 76
32'-0"	8'-11 3/8"	9'-6 3/8"	4'-9 1/4"	2	20'-0" 80
				1/3	58'-3 1/2" EXT PLYWOOD

DESIGNED FOR DEAD LOAD & LIVE LOAD = 45 #/sq ft WHICH WILL CARRY ORDINARY METAL ROOF ON 2 x 4 NAILING STRIPS SPACED 16" O.C. WITH NO ADDITIONAL RAFTERS BETWEEN THE 6' SPACING OF TRUSSES FOR TIGHT ROOF DECK, SPACE 1' PLAIN RAFTER BETWEEN EACH TRUSS TO STIFFEN 1" SHEATHING



5/8" x 4" x 10' PLYWOOD UTILIZATION (FOR 3 TRUSSES)

USE CASEIN GLUE ON ALL JOINTS. NAIL GUSSETS WITH 7D BOX NAILS TO HOLD GUSSETS WHILE GLUE SETS. USE 1" METAL ANCHOR AT EACH TRUSS TO PLATE CONNECTION.

This type of roof truss can be made on any smooth surface and eliminates need for space-stealing posts in the center of the floor.

FOR COMFORT . . .

Since much of the shopwork will be done during the winter, provide heat in the shop. An oil space-heater equipped with a fan will be convenient.

Smoke and gases can be removed by an exhaust fan and a flexible tube.

A ventilating fan will make the shop more comfortable during the summer.



A return-stack orchard heater made portable by the use of casters may be used to heat a shop during wintertime.

AND CONVENIENCE

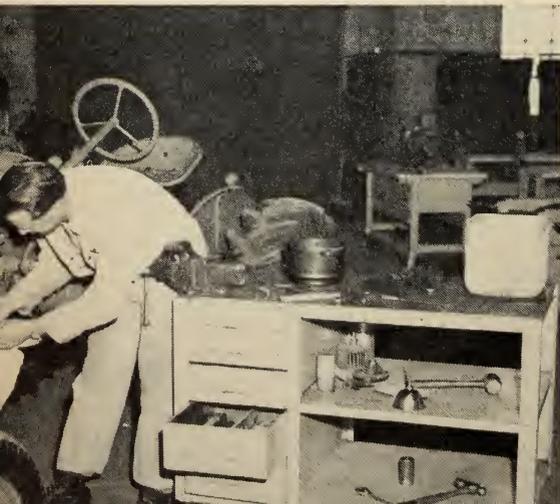
When planning the wiring installation, provide service outlets for each piece of equipment. Use 3-wire service cords—one a ground wire. Consider future needs and leave outlet boxes for equipment you plan to add.

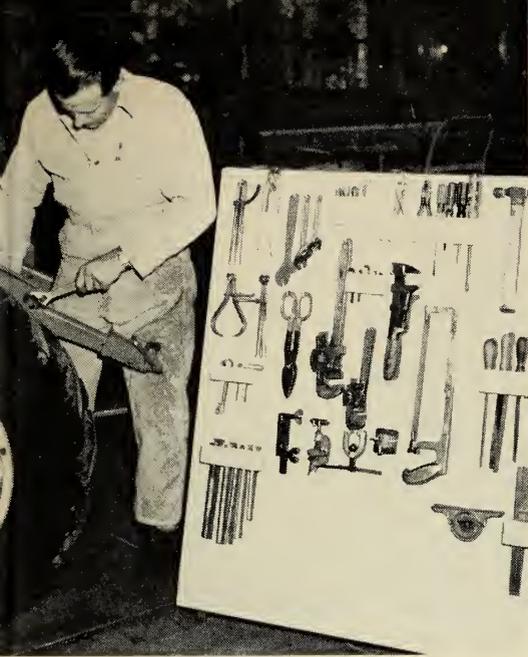
Locate 115-volt outlets for each 10-foot interval of wall. Three-wire, 230-volt, single-phase service should also be pro-

vided. In most cases you will want at least 60-ampere entrances and entrance wires not smaller than No. 4.

Work tables and benches. It helps to have at least two work benches in the shop. You can use one of the benches for both wood and metal work. It should be 8' to 12' long, 23" wide, and 36" to 38" high. The front 11½" should be a

Left: A small, castered, portable bench is handy for holding repair equipment, parts, and tools. Right: This sturdy bench can be rolled around the shop or over rough ground for repair jobs outside.





Tools mounted on a castered rack may be moved to the area where needed. This rack is made of $\frac{5}{8}$ " plywood.

smooth working surface made preferably of 2-inch hardwood planking finished with several coats of floor seal or a good quality of deck enamel. The back $11\frac{1}{2}$ " can be of 2-inch Douglas fir, for example, with a similar finish. You will find that a swivel-type, 4-inch-jaw machinist's vise with smooth-type jaw covers accommodates wood work and also can be used for

metal working jobs when the jaw covers are removed.

The other table for metal work can be of identical size. However, you may want both the 2-inch planks to be of Douglas fir. It helps to place an angle iron along the front edge and cover the remainder of the bench top with sheet metal $\frac{1}{8}$ " to $\frac{3}{16}$ " in thickness. The heavy sheet metal protects the bench top from damage and provides a smooth clean working surface needed in metal working. It is a good idea to mount a heavy-duty, 6" machinist's vise on this bench.

Benches that are approximately 2 feet wide can be supported through the use of triangle brackets attached to the wall studs of the building. This will allow a clear space under the bench for a roll-away storage rack for metal or lumber. The brackets for the bench and the roll-away storage rack can be made entirely of welded construction. The bench angle braces should be 8" above the floor to allow greater capacity on the storage rack. The storage rack (of welded steel pipe or angle iron construction, in order to fit easily under the bench) should be 2' shorter, 4" narrower, and the height 5" less than that of the bench. Mounting the rack on 3-inch casters allows adequate foot space while working at the

Left: This type of "pigeon hole" storage bin is handy for keeping general shop supplies. Right: These large bins and shelves provide storage for bulky machinery and parts used in repair work.



bench yet makes it convenient for the stored material to be moved out in the shop.

Portable bench. If justified, it is convenient to have a small portable bench approximately 4' long, 2½' wide, and 34" high. The frame of this bench is made entirely of welded construction, with an angle iron frame to which two 12-inch diameter wheels are attached to one end, and two angle iron legs to the other. The top is constructed from three 2" × 10" surfaced planks to which is bolted an angle iron rim and a 3½-inch, swivel-type machinist's vise. A bottom shelf provides storage for supplies or tools.

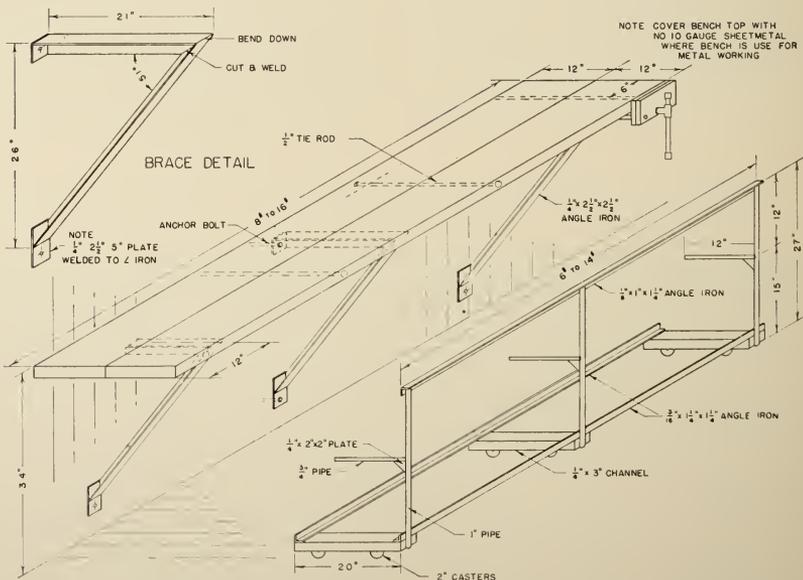
Tool racks and parts bins. It is important that tools, supplies, and spare parts be kept in bins or racks. This saves time in locating the right tool or supply item.

If you place certain tools on castered racks they can easily be moved to different areas in the shop. It is usually convenient to place other tools on a wall panel over the work bench. These can be

enclosed as cabinets which can, if necessary, be locked. Orange colored silhouettes painted on a light background shows when tools are missing and helps in getting a tool back in its proper location.

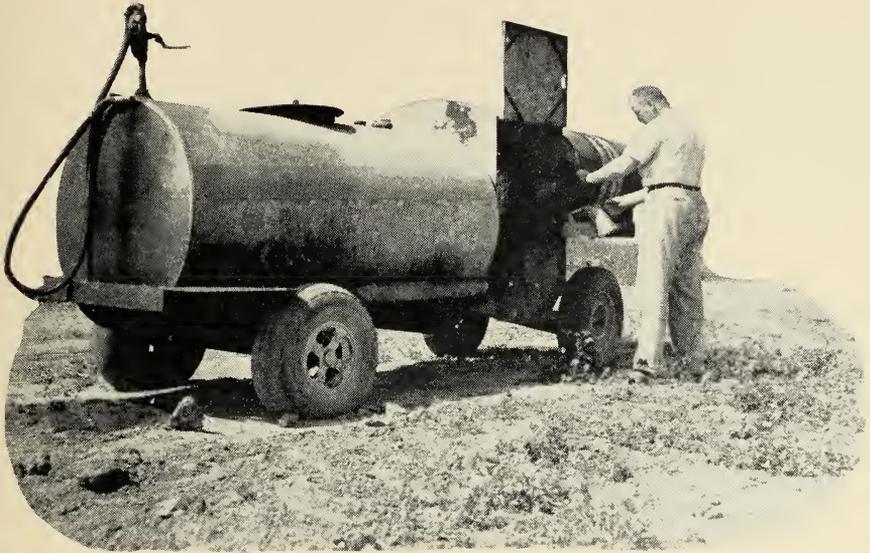
On most farms it is well to provide storage space for commonly used machinery parts, bolts, pine fittings, V-belts, chains, and similar items. Nails, screws, staples, bolts and other small items are needed regularly. Machinery parts bins should vary in size from 30" deep, 48" wide, and 24" high for large parts, to 18" deep, 30" long, and 15" high for smaller items. The bin fronts should be constructed for ease in removing parts and will need labels for parts identification. Bins must also provide for orderly storage of many small items. It is suggested that the rack vary from 15" deep at the bottom to about 8" at the top. Each of the shelves should have partitions arranged according to the items to be stored.

A measuring rule tacked to the storage rack will be handy.



A wall bench supported by brackets gives room for a castered storage rack underneath. The woodworking vise is replaced with a machinist's vise when the bench is used for metal work.

FUEL AND OIL STORAGE



This service wagon can be moved from the farm to the field and is handy for both machine service and as a tank-refill truck.

The cheapest and quickest method of providing storage for fuel and oil supplies is an aboveground tank with gravity flow to vehicles being serviced. However, such a tank should be protected from the sun and equipment with a pressure ventilating cap to reduce loss by evaporation. It should also be placed well away from buildings to reduce the hazard of fire from spillage.

An underground tank with pump has several advantages over the aboveground storage method—less danger, less evaporation—but is more expensive to install.

Diesel fuel can best be stored in a “trap wagon” with 500 to 750 gallons

capacity. Oil and small quantities of gasoline can also be left in a cabinet with this portable storage unit.

Oil, like paint, should be stored in a place that is separate from the shop. While the danger from fires starting in such a storage area is not great, when such fires do start they are extremely difficult to get under control with the fire fighting apparatus usually found around a farm.

Keep any gasoline (in small quantities) that may be needed in the shop in safety cans.

To minimize the danger from fire, and do a better job, wash motor parts in solvent or kerosene.

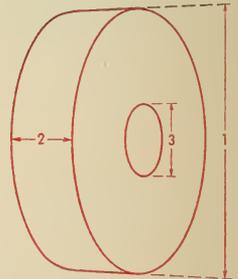
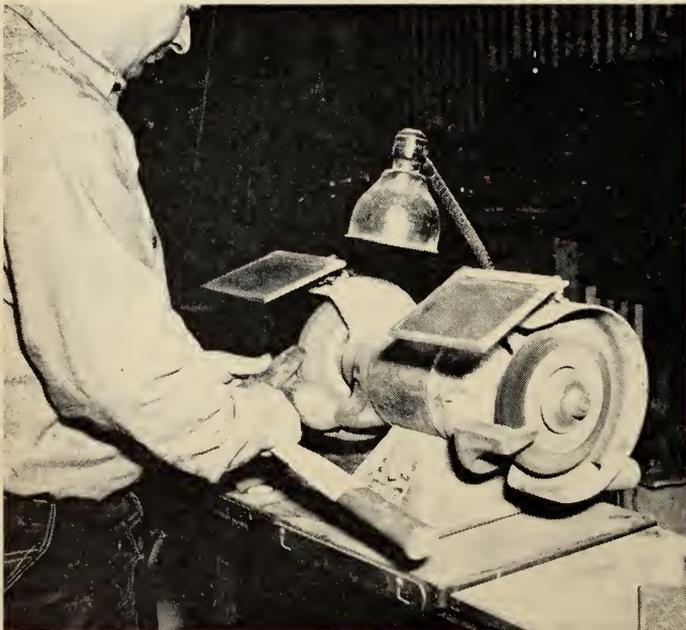
Bench grinder

This is a compact, self-contained unit that is handy for sharpening tools and doing light grinding jobs. One of the wheels may be replaced with a wire brush for buffing and cleaning metal.

When grinders are not equipped with illuminated, shatterproof shields, safety goggles and a shaded light should be provided for the protection of the operator.

Minimum specifications

Bench Grinder— $\frac{1}{2}$ hp—3450 rpm; 115 or 230 volts; sealed ball bearings; 7" \times 1" \times $\frac{5}{8}$ " bore wheels with guards; tool rests and safety illuminated eye shields. Illuminated, shatter-proof shields direct the light onto the grinding wheel and work, and protect the operator's eyes from any particles thrown from the grinding wheel.



Bench grinder equipped with light and eye shields is handy for many sharpening and small grinding jobs.

Mandrel-type grinder

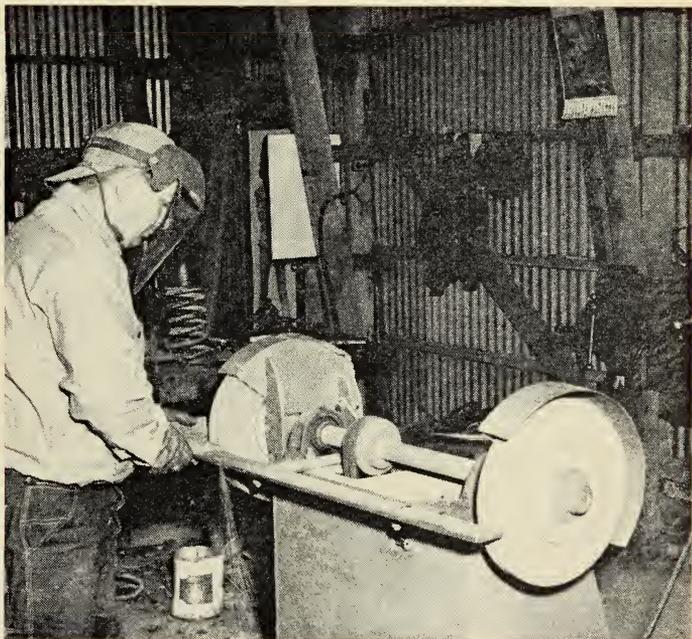
This consists of a mandrel fitted with grinding wheels, guards, V-belt drive sheaves, mounting bearings, and an underslung motor. This grinder is particularly adapted for heavy work and the wheels are more accessible for work such as sickle grinding. You will probably want a coarse wheel for fast rough cutting, and a medium or fine wheel for more accurate work.

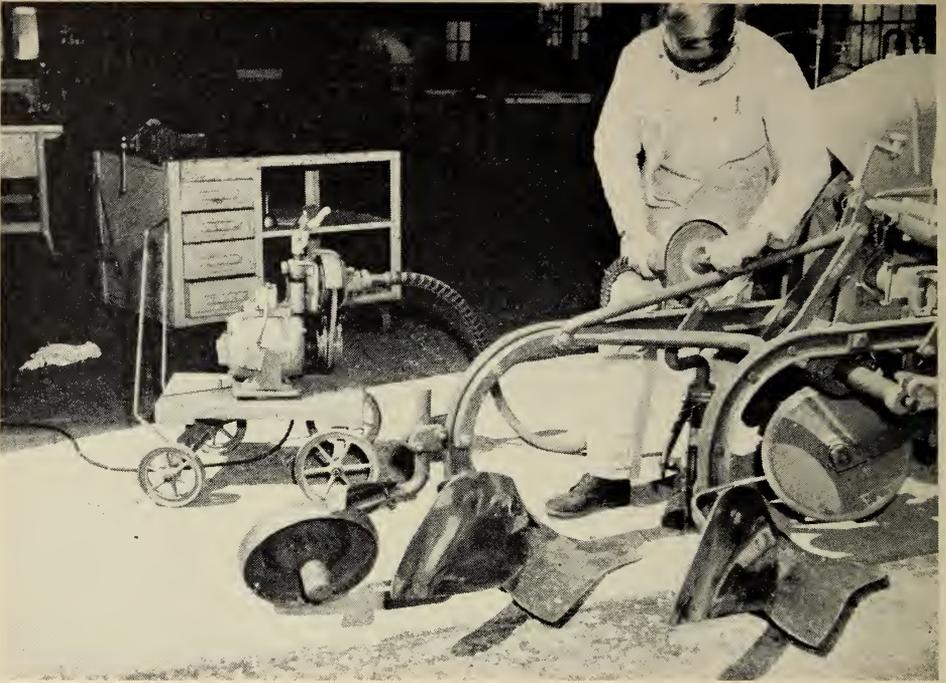
Minimum specifications

Mandrel Grinder—1 hp—1750 rpm; 230 volts; sealed ball bearing motor. 1¼" mandrel—twin 5" "B" section V-belt sheaves for the motor and twin 4" "B" section V-belt sheaves for the mandrel. Two "B" section V-belts. Two 1¼", self aligning pillow block ball bearings. 10" × 1½" × 1" grinding wheels.

NOTE: Where three dimensions of a grinding wheel are given they indicate 1) diameter of the wheel; 2) width of wheel; 3) diameter of bore (see drawing at left).

The mandrel-type grinder is for heavier duty work with more free area around the wheels. Note face shield.





This flexible-shaft grinder is veeing a coultter mount in preparation for welding.

Portable electric grinder

A portable grinder is a very desirable tool. Such a unit can be used for wire brushing, buffing, and polishing metal surfaces. It will also remove rust, scale,

paint, and grind off rivets and bolts. It is helpful to use this grinder in "veeing" metal in preparation for welding and for smoothing welded surfaces.

Minimum specifications

Portable Grinder—wheel size $5'' \times \frac{3}{4}'' \times \frac{1}{2}''$ bore; Universal motor; no load speed; 5250 rpm; sealed ball bearings; steel guard; cast aluminum body. Weight, 15 pounds. A flexible shaft grinder is also satisfactory for this type work.

CAUTION: Most grinding wheels do their best cutting when their surface speed is a mile (5,280 feet) a minute. Extreme care should be taken to see that grinders do not exceed recommended operating speeds (usually printed on the wheel).

To calculate the surface speed of a grinding wheel multiply the diameter by $3\frac{1}{8}$ to get the circumference, then by the r.p.m. (revolutions per minute) and divide by 12 to get the surface speed in feet per minute.

For example: an 8 inch grinding wheel is running at 2600 r.p.m. What is its surface speed? Eight times $3\frac{1}{8}$ is 25 (inches in circumference) 25 times 2600 is 65,000 inches or about 5400 feet or a little over one mile a minute.

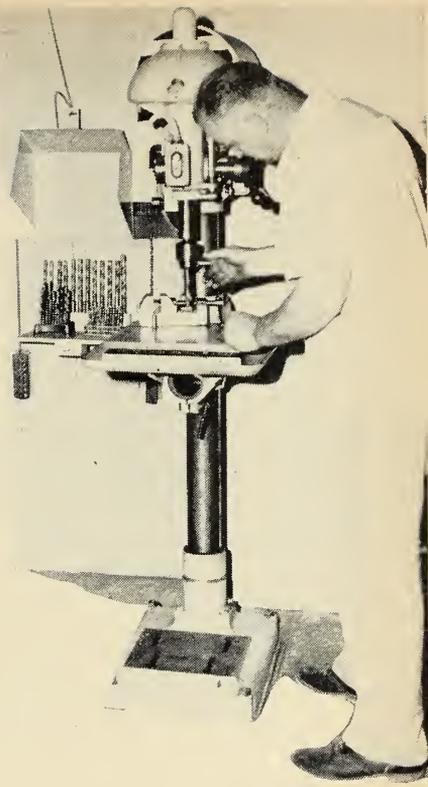
Drill press

A drill press large enough to handle holes up to 1" diameter is often desirable for machinery repair and construction jobs. Bench or floor models are available in sizes ranging from 9" to 20". A 17-inch drill press will best meet most of your farm shop needs. (The measurement refers to the maximum diameter of a circle in which a hole may be drilled in the center.) A 3-jaw key chuck with a capacity for 1/2-inch, straight shank bits is standard equipment on most drills.

For the jobs where there is need for drilling holes larger than 1/2", a No. 2 Morse taper spindle will handle the larger drill. The 3-jaw chuck will be fitted on a Morse taper shank to handle straight shank drills to 1/2", and drills from 1/2" to 1" will have No. 2 Morse taper shanks. A 1/2-inch round shank drill in sizes from 1/2" to 1" will fit a 1/2-inch chuck, but this type is not as desirable as the Morse taper because of the excessive stress on the chuck.

High-speed drills range from 700 to 4200 rpm while slow-speed drills range from 400 to 2200 rpm. The speed is controlled by the V-belt pulley sizes. The slow-speed drill is more adaptable to farm shop use.

A drill press vise is recommended as an accessory for the drill press. The vise holds material rigid for drilling work without the danger of slipping and injuring the operator or breaking a drill.



This 17-inch drill press drills holes up to 1" in diameter. The drill press vise is essential for accurate work and for preventing the metal from turning and injuring the operator.

Minimum specifications

Floor Type Drill Press—Size 17-inch—5-inch spindle travel with spring return and depth gauge; slow speed (400 to 2200 rpm), with No. 2 Morse taper spindle and 3-jaw key chuck; chuck capacity 0 to 1/2". Sealed ball bearing; 6 splines in spindle and sleeve; 3/4 hp capacitor motor with protective switch and wiring with ground connections.

Portable electric drill

For convenience, two portable electric drills are suggested for most farm shops—a lightweight, light-duty drill where constant use is necessary, and a heavier drill for heavier work. Either or

both of these drills may be hand held and used wherever a power outlet is available. The heavier one particularly may be mounted on a stand and used as a bench drill.

Minimum specifications

One-half-inch Standard Duty Drill—Universal motor, capacity to $\frac{5}{8}$ " in steel, hardwood up to 1"; 400 to 500 rpm, no load; grease sealed bearings; cast aluminum body; 3-jaw key chuck.

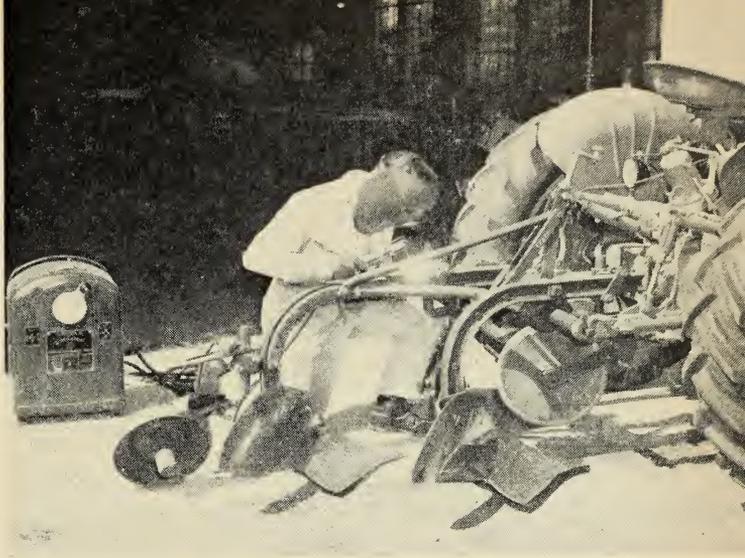
One-quarter-inch Standard Drill—Universal motor, capacity up to $\frac{1}{4}$ " in steel and $\frac{1}{2}$ " in hardwood; 2000 rpm, no load; grease-sealed bearings; cast aluminum body; 3-jaw key chuck. This drill is convenient for use in drilling lightweight steel, nonferrous metal, and wood. The $\frac{1}{4}$ -inch standard drill usually weighs about 5 pounds and the $\frac{1}{2}$ -inch standard drill about 20 pounds. You can buy wood auger bits with sizes up to 1" that may be used with the $\frac{5}{8}$ -inch drill for bolting wood.



A portable electric drill may be used anywhere within reach of an electrical outlet.

Arc welder

An AC arc welder that can be used outside the shop in good weather is convenient.



Either of two types of arc welders may be satisfactory for use on a farm—the AC or DC type.

The AC welder is particularly adapted to use in the shop where AC power is available. Its absence of moving parts reduces upkeep costs to a minimum and it has been found that the average power cost to run an AC welder is from \$4 to \$6 a year or about 9¢ per hour of intermittent use. Arc electrodes are relatively inexpensive when purchased in standard packages.

The new limited input AC farm welder will meet most requirements for farm use. A large-capacity welder is probably not necessary because 90 per cent of the welding in the farm shop is done at 150 amperes or less.

The DC welder is gasoline engine-driven and can be easily made portable for use on heavy equipment in the field. It is much more expensive, however, than the AC welder.

The inert gas arc welders are not particularly recommended for use on farms.

Minimum specifications AC welder

Either 180 or 250-ampere limited-output AC arc welder to operate from 230-volt, single-phase line served by a 5 KVA or larger transformer. Welder complete with 10' of primary cable, 25' welding and ground cable; insulated electrode holder; ground clamp; wall receptacle; head shield or helmet with No. 10 lens.

It is desirable to consult the power company supplying you before buying an arc welder.

Additional welding accessories and supplies: Arc electrodes— $\frac{3}{32}$ ", $\frac{1}{8}$ ", $\frac{5}{32}$ " mild steel electrodes of American Welding Society type E6013. Machineable and nonmachineable electrodes for welding cast and malleable cast; hard surfacing electrodes; metal alloy powder or paste for hard surfacing.

Carbon arc torch with additional $\frac{1}{4}$ ", $\frac{5}{16}$ ", and $\frac{3}{8}$ " diameter copper-coated, soft center carbons makes possible bronze welding, heating for light forging and soldering.

Miscellaneous supplies: extra cover glasses and lens; clamps and welding jig; peening hammer; chipping hammer; carbon plate and carbon rod; leather gloves; copper plate "back-up" strip.

Power saws

Portable electric, table, and radial arm are the three types of saws now in general use. The portable electric is best adapted for on-the-job use. It is also relatively inexpensive and may be used for a wide variety of jobs. The table saw is usually preferred by those doing a large amount of wood construction work. The radial arm saw is preferred by some, particularly carpenters and contractors as a cut-off saw, but is usually considered expensive for limited farm use.

Portable Electric Saw. Consider carefully the weight and capacity of this saw before it is purchased. A lighter weight saw is preferred, but if it is to be most useful it should cut at least $1\frac{5}{8}$ " when

set at a 45° angle. Special attention should be given to the type of guard that is provided; those guards which pivot around the saw arbor and rotate back over the saw have proved to be satisfactory for all-round use.

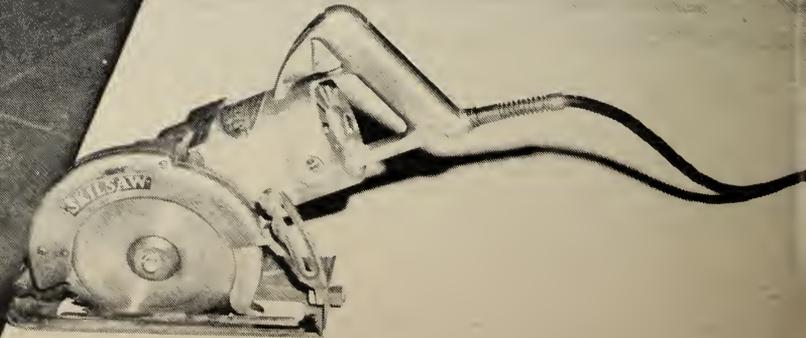
Table Saw. A wide choice is available in this type. A tilting arbor is preferred since the table of the saw remains in a horizontal position and the saw blade tilts. A 10-inch blade and a 1 hp motor are required if the saw is to have extensive use. An 8-inch saw with $\frac{1}{2}$ hp drive will serve for limited use. The saw with combination blades or the new safety saw blade have been found best for all types of work.

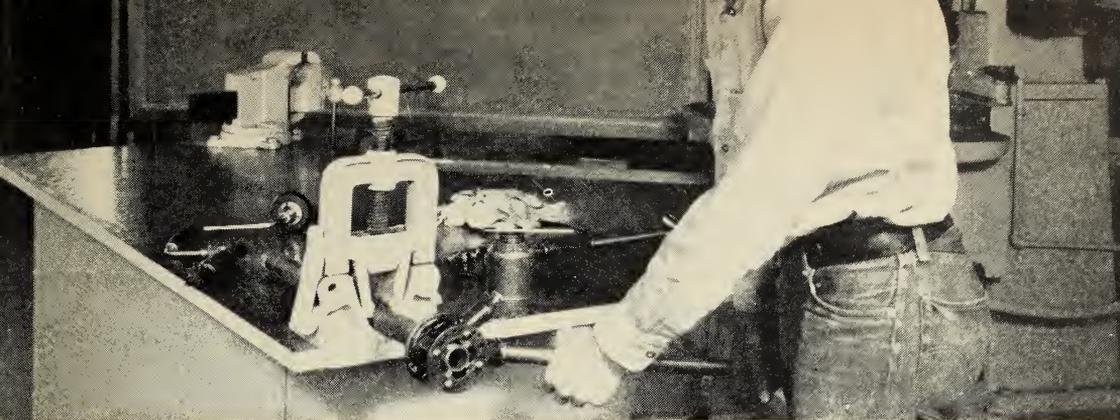
Minimum specifications

Portable Electric Saw— $7\frac{1}{4}$ -inch blade; maximum vertical cut $2\frac{3}{8}$ "; 45° -cut, $1\frac{3}{4}$ "; Universal motor. Free speed of blade 3200 rpm; automatic telescoping guard; weight 15 pounds.

Tilting Arbor Saw—10-inch blade that tilts 45° ; adjustable rip fence; miter gauge; guard; 1 or $1\frac{1}{2}$ hp, sealed ball-bearing, 115- or 230-volt repulsion induction motor; sealed ball-bearing arbor; V-belt drive; maximum capacity about $3\frac{1}{4}$ ".

A portable electric saw speeds up construction. One with a $7\frac{1}{4}$ " blade will meet most farm needs.





Both machinists' and pipe vises are convenient where material is to be held securely.

Vises

A vise probably receives more use and more abuse than any other piece of shop equipment. The vital part of any vise is a replaceable steel jaw. A rigid jaw is necessary in order to hold work securely. However, the vise is almost worthless, if worn jaws cannot be replaced. The common types of vises are rigid, swivel base,

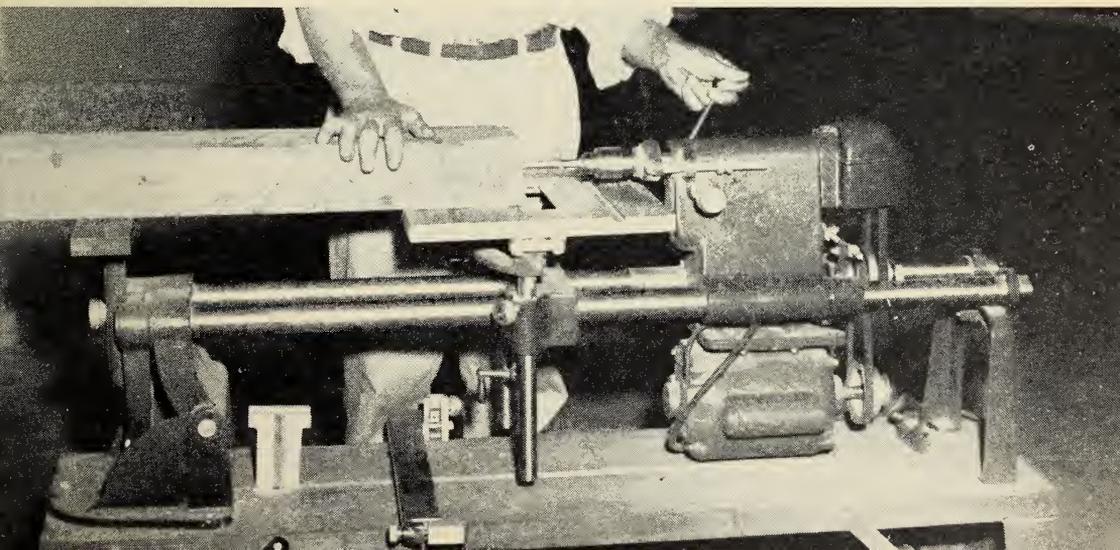
pipe, and combination pipe. The vise size is designated by the width of jaw; opening capacity is $1\frac{1}{2}$ that of the jaw width. When using a vise it is desirable to pound against the rigid jaw. You can place aluminum or wood covers over the vise jaws to prevent marring of close fitting machine or equipment parts.

Multi-purpose power tools

A multi-purpose power tool has the advantages of being adapted to use in limited space. Most equipment of this kind can be used for about five basic operations—circular saw, vertical drill

press, horizontal drill press, wood lathe, and disc sander. A limited amount of time is required to convert the equipment from one use to the other and a single motor serves for all operations.

A multi-purpose power tool combines several basic tools in one; saves shop space but takes time to set up.

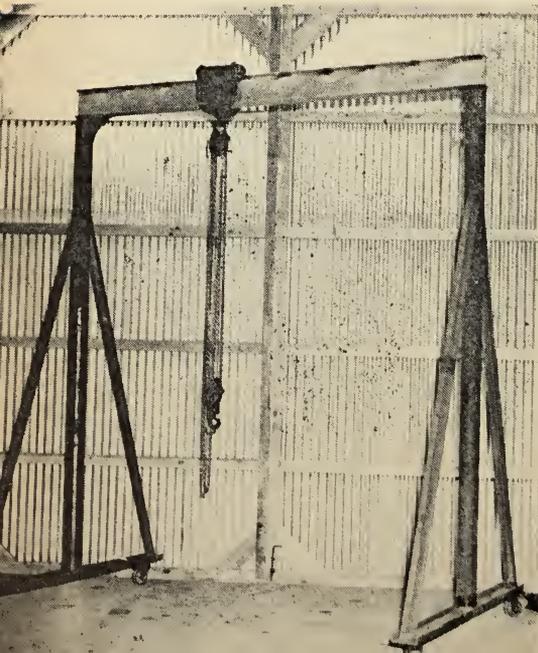


Cranes and hoists

The lifting of truck and tractor engines and heavy farm machinery requires special hoist equipment. The portable floor crane is usually preferred over the hoist operated from a trolley because it is more versatile. It is also usually less expensive when you consider the added Cost of strengthening the roof trusses to carry the weight of the hoist. You may use a hydraulic cylinder, a geared chain hoist, or a winch to provide the lifting power. The crane should be readily portable, have a minimum safe lifting capacity of at least 2 tons, and a minimum lifting height of about 8'. (This lift should be measured from the floor to the hook when it is at the highest point.) Satisfactory A-frames or floor cranes may be constructed in your shop.

Chain Hoists are most popular in farm shops. There are three types of chain hoists in use today, each offering a varied range of mechanical efficiency and price and each filling the needs of a particular set of conditions.

A portable A-frame and chain hoist is a safe way to do the heavy lifting jobs around the shop.



The Differential Hoist is the least efficient, as well as the least expensive of the three. Keeping the loads suspended by means of friction in the parts of the hoist, it offers a work efficiency of only 35 per cent (i.e., for the work you do in operating the hoist 35% or about $\frac{1}{3}$ is useful in load lifting). It has capacities to 2 tons.

The Screw-Geared Hoist costs more than the differential, but makes up for the added cost by giving a work efficiency of 40 per cent. Although it requires less operating effort, it still holds its loads in suspension by use of the friction principle and has capacities to 5 tons.

The Spur-Geared Hoist offers the greatest advance in hand-hoisting mechanism. Holding its loads in suspension by an automatic brake, it is capable of a work efficiency of 85 per cent and has capacities to 40 tons. Thus, though the cost of the spur-geared hoist is the greatest of the three, you may find where use is frequent that it is actually the most economical.

Safety blocks are recommended for use under any equipment that is being worked under or around. The blocks should always be used in such a way that they support the weight across their shortest dimension.

Use this table to select the correct size of I-beam for a hoist of any given capacity.



Recommended I-Beam Sizes for Various Spans and Hoist Capacities

Span in feet	1-ton Hoist			1½-ton Hoist			2-ton Hoist		
	Depth of beam	Width of flange	Wt. per foot of beam	Depth of beam	Width of flange	Wt. per foot of beam	Depth of beam	Width of flange	Wt. per foot of beam
	inches	inches	pounds	inches	inches	pounds	inches	inches	pounds
30	7	3.66	15.3	8	4.08	20.5	10	4.66	25.4
28	7	3.66	15.3	8	4.00	18.4	10	4.66	25.4
26	7	3.66	15.3	8	4.00	18.4	8	4.26	25.4
24	6	3.44	14.8	8	4.00	18.4	8	4.17	23.0
22	6	3.33	12.5	7	3.76	17.5	8	4.00	18.4
20	6	3.33	12.5	7	3.66	15.3	8	4.00	18.4
18	6	3.33	12.5	7	3.66	15.3	8	4.00	18.4
16	5	3.14	12.3	6	3.44	14.8	7	3.66	15.3
14	5	3.00	10.0	6	3.33	12.5	7	3.66	15.3
12	5	3.00	10.0	6	3.33	12.5	6	3.44	14.8
10	4	2.80	9.5	5	3.14	12.3	6	3.33	12.5
8	4	2.66	7.7	5	3.00	10.0	5	3.14	12.3

YOU MAY NEED THESE . . .

Air compressor

The air compressor has four major uses around the farm: Inflation of tires; pressure greasing; cleaning equipment; and spraying paint, wood preservatives, and insecticides. It is desirable to purchase equipment that is readily portable, but skids, rubber tires, or carrying arms may be mounted on stationary equipment to make it portable.

Minimum specifications

Tank-Mounted Air Compressor— $\frac{1}{3}$ -hp; repulsion induction motor, or gasoline engine; single-stage compressor; pressure gauge; 20-gallon tank; displacement 2 cubic feet per minute; output pressure 150 psi. Weight approximately 150 pounds.

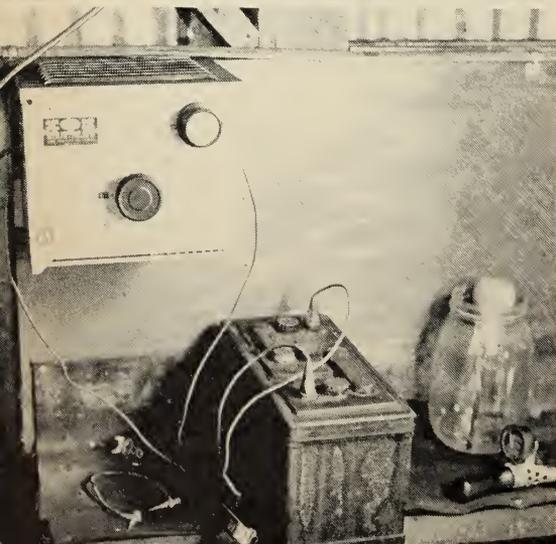
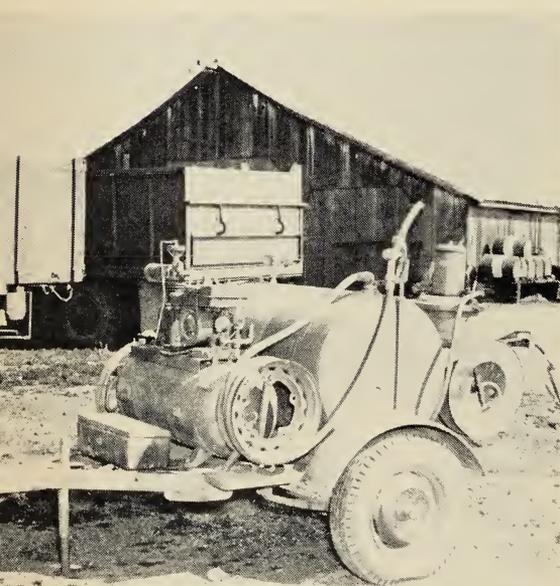
Battery charger

If you have four to six tractors or trucks with battery electrical systems a battery charger that operates on 110 volts will be a good investment. It will serve to keep batteries charged and prevent loss of time, and to charge batteries of equipment that receives only periodic use.

Ordinarily a battery that is low can be charged overnight but it is a good idea to have an extra battery to prevent unnecessary delays. A jug of distilled water will facilitate servicing batteries.

Be sure to connect the correct terminals when you install a battery in equipment. When connecting a battery to the charger be sure the + charger lead is connected to the positive terminal of the battery. The positive terminal can be checked by one of the following: It is the largest; it is marked +; if the battery has the trademark on only one side the positive terminal is on that side.

Top: A portable air compressor is handy in both field and shop. This one is mounted with fuel and oil supply. Bottom: A battery charger of medium capacity will meet most farm needs.



Jacks

On any farm there is always a place where a hydraulic jack of adequate capacity is desirable for heavy lifting jobs as well as for straightening and aligning machinery parts. Capacities of hydraulic jacks vary from 1½ to 100 tons.

Anvil

A good, heavy, rigid anvil will take care of many bending and straightening jobs. It also provides a flat surface for pounding. It is desirable to have a 150-pound, steel faced anvil mounted on a base so that the face will be thumb tip height.

"C" Clamps

You will find that a selection of several sizes of "C" clamps in the shop will aid materially in holding construction work in place and will serve as rigid clamps to prevent distortion while welding. The recommended range of capacity is from 4" to 10".

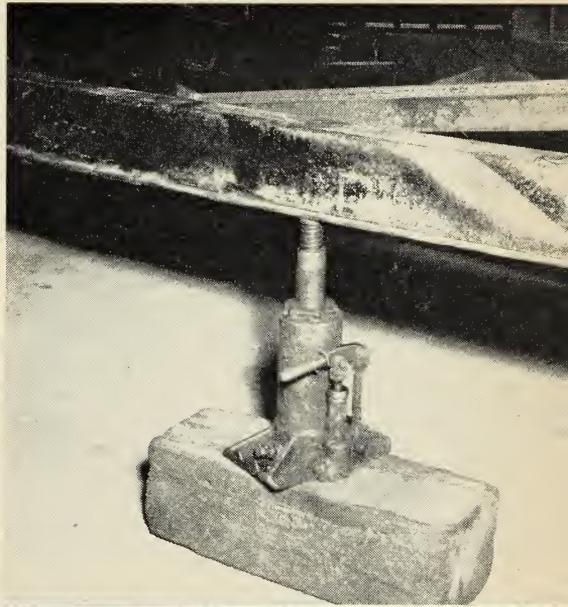
Metal lathe

A metal lathe can be justified in a farm shop only when there is a definite need for it and when a skilled operator is available. Metal lathes are rather costly. Few farm mechanics can justify lathe use in the farm shop.

Record files—a "must"

A desk and file for keeping records, parts catalogs, plans, and operators' manuals is very desirable. The file should be made of metal, so that filed material is protected from rodents.

A continuing record of repairs and improvements needed about the farm provides slack season and rainy day jobs. Notations should be made of needed improvements or repairs when they are first observed. It is also a good idea to keep a record of repair parts equipment, and supplies that are needed. This provides a ready reference that can be taken along on regular trips to town thus saving many hours.



Top: A hydraulic jack can do the heavy lifting and will serve as a press for bending or straightening. Bottom: Plan sheets, catalogs, or operating manuals should be filed.

Oxy-acetylene welding and cutting equipment

If you have three or more tractors with complementary machinery; *and* if you or one of your helpers has the skill to operate it, then oxy-acetylene welding and cutting equipment is probably justified on your farm.

The equipment may be used for cutting, heating, brazing, and hard-facing (application of hard-facing alloys on knives, disks, shovels, and other wearing surfaces of tillage equipment).

Where there is much cutting to be done, the only convenient method is by means of a cutting torch.

Farmers may own their own oxygen and acetylene cylinders or they can use those loaned by gas companies. Since most farmers use a limited amount of oxygen and acetylene in their shops, they have to be concerned with demurrage charges made on the loaned cylinders. The usual charge on the loaned cylinder

has been from 2 to 3 cents per day per cylinder, after a 30-day loan period.

The companies that supply oxygen and acetylene prefer that farmers purchase cylinders. This eliminates demurrage, the cost of billing for demurrage and the cost of accounting for cylinders. In times of cylinder shortage you will be able to get oxygen and acetylene if you have your own cylinders to exchange.

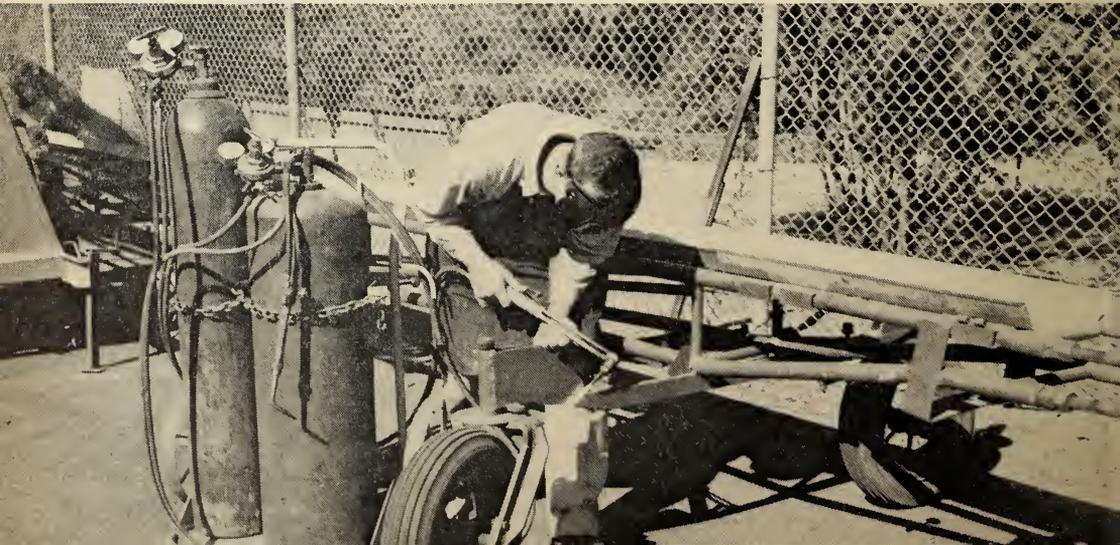
The sizes of oxygen cylinders vary from 80 to 230 cubic feet and the acetylene cylinders from 70 to 275 cubic feet. The cost of gas per cubic foot is slightly higher in the small cylinder than in the large ones.

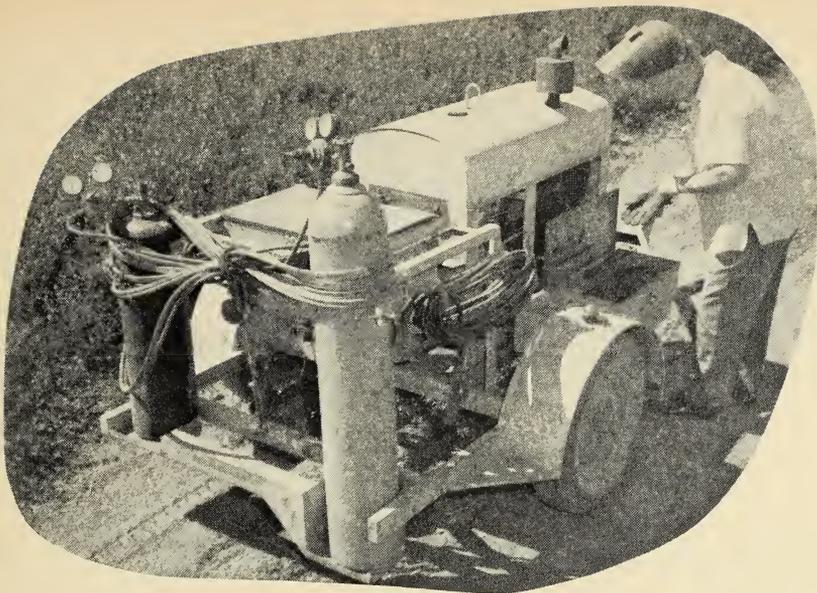
Under normal use a 230 cubic foot cylinder of oxygen will last the same amount of time as a 133 cubic foot cylinder of acetylene. When a considerable amount of cutting is done the oxygen will be used at a much faster rate.

Minimum specifications

Welding torch or blowpipe with mixer (not always separate), and No. 0, 1, 3, 5 and 8 welding tips; cutting attachment with sizes 1 and 2 nozzles, gouging nozzle for gouging out grooves and welds and one heating tip, providing the equipment is to

Oxy-acetylene welding and cutting equipment can be operated from tanks having varying capacities.





Portable oxy-acetylene welding and cutting equipment can be used in the shop or taken to the field when needed.

be used for heating metal. Oxygen and acetylene regulators; 15 feet of $\frac{3}{16}$ -inch twin hose with connection; set of tip cleaners, friction lighter; welding goggles or No. 5 green cellulose acetate shield; and 6-way wrench. Oxygen and acetylene cylinders are optional. Cylinder trucks may be made in your farm shop.

Forge

The forge is practically outdated in most farm shops; oxy-acetylene heating torches and carbon arc torches for arc welders are now generally being used to heat metal. If you do a large amount of hot-metal work, however, the forge is one of the least expensive methods of heating iron or steel. It is also valuable for preheating material before welding

with arc or oxy-acetylene equipment.

Some farmers purchase a geared blower, piping, and fire bowl, and make the hearth, hood, and legs out of steel or masonry. The blower should have at least a 12" fan with high-speed spindle and ball bearings. If the forge is purchased complete one of adequate size should be obtained.

Minimum specifications

10-gauge steel hearth, 30" x 36"; 30" high; high-speed blower with 12" fan.

FOR EFFICIENCY . . .

The arrangement of the tools and equipment in the shop is largely a matter of personal choice, but a carefully arranged shop contributes to convenience and to the amount of work that can be accomplished.

Work benches should be located near or against the walls of the shop. The large shop equipment should also be located near the walls. An effort should be made to locate tools and equipment

used in the same type of work in the same general area. Castored tool racks save time and energy. If drawers are used for storage of hand tools they should be shallow.

It is often a problem to find suitable iron or steel for construction on repair jobs. A partial solution is to collect the material and sort into rods, flat iron, angle iron and channel iron. This can then be set into horizontal racks or verti-

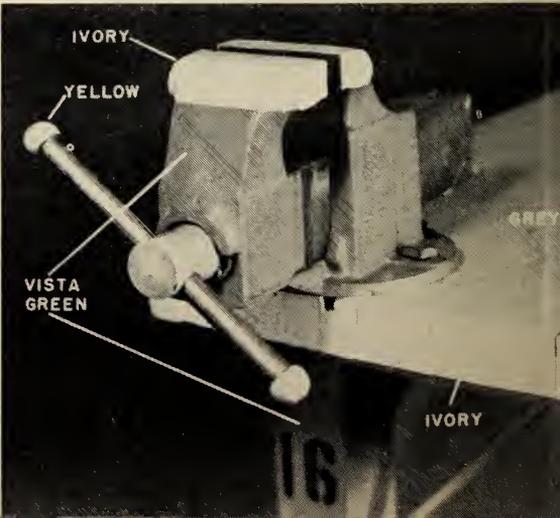
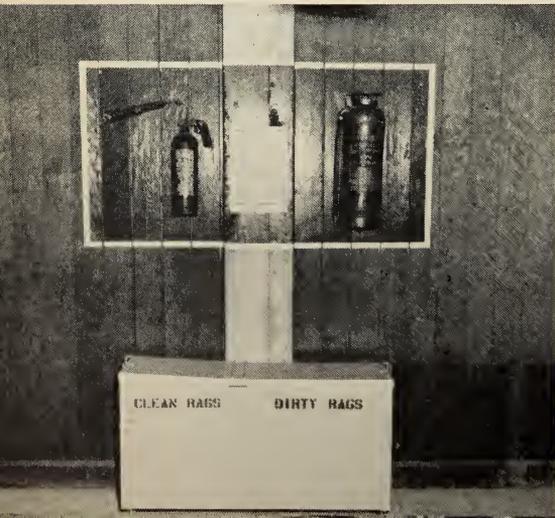
A CLEAN, ORDERLY SHOP IS

AND SAFETY

Fire extinguishers of the appropriate type should be placed on a "fire engine" red panel in accessible areas *near where the greatest fire hazard exists*. A soda acid, foam, or loaded stream type extinguisher, or plain water should be used on Class A fires (rubbish, wood, textiles, etc.). Class B fires (paints, oils,

etc.) require blanketing type extinguishers, such as vaporizing liquid, foam, dry powder, carbon dioxide, or loaded stream. Fires in electric motors and other electrical appliances—Class C fires—require nonconductive dry powder, carbon dioxide gas, or vaporizing liquid extinguishers.

Fire extinguishers should be placed near areas in which fire hazards are greatest and be easily accessible. Color and cleanliness add to safety and pleasant working conditions.



cal racks that slope 15 degrees, making selections easy. The time it takes to keep material stored is easily saved when collecting material for a construction or repair job.

A discarded milk can cut off at the shoulder, or a 15 gallon barrel with handles welded to the side serves as a fireproof "junk" collector.

It is best to store lumber on horizontal racks; some may be stored on racks in

the shop at sufficient height to give head room under the rack. Steel may be stored either vertically or horizontally. Storage on portable racks under the benches is satisfactory for either lumber or metal.

The air compressor and welders should be portable—at least about the shop. The drill press and grinders should be located so that moderately long pieces may be handled without obstruction around the equipment.

U S U A L L Y A S A F E S H O P

Color. The National Safety Council has accepted a *safety* color code as a standard for agriculture. These colors improve visibility and point out danger spots about the shop. The safety colors are *caution blue*, *safety green*, *alert orange*, *danger red* and *high visibility yellow*. They are usually available where paint is sold. A gloss enamel for both wood and metal gives excellent results. The use of light-colored paint will improve vision and make working conditions more pleasant. The following colors are recommended for painting your shop equipment:

Caution Blue
(medium dark)

Power and light panels—Base of switches and convenience outlets—tags designating out of order.

Ivory

Edges of benches—Edge of tool and machine tables and vice jaws.

Safety Green
(pea green)

First aid and safety equipment—Body and base of all machines and equipment.

Alert Orange
(yellow-orange)

Inside of gear, belt or other guards or doors where danger lurks. Parts of machines or equipment that might crush, cut, shock or otherwise injure. Faces of convenience outlets and switches.

Danger Red
("fire engine")

Location of fire fighting equipment, danger, stop and gasoline.

High-Visibility Yellow
(canary yellow)

All operating handles, levers, adjusting nuts and controls. Protruding parts, low beams, and obstructions are marked with alternating yellow and black strips usually diagonal.

A CHECK LIST



The following is a suggested list of tools which you might wish to consider in equipping your farm shop.

Your selection of tools depends on the activities you plan to undertake. Some prefer to do complete overhaul jobs on power units, tractors and machinery; others expect to do only the simpler maintenance tasks. It is not possible to give a complete list of tools for all purposes, because special tools are needed for certain machines.

The tool lists that follow are classified into major work areas. It is granted that the tools may be used in areas other than the ones in which they are listed.

Farm Structures and Utilities

Number	Name of Tool	Description
1	nail hammer	16 oz. curved claw
1	ripping hammer	20 oz. straight claw
1	broad hatchet	4" cut
1	combination square	12" grooved blade
1	carpenter's square	body 24", tongue 16" blued, with rafter or framing table
1	steel tape	50' metallic
1	steel tape	10'
1	carpenter's level	24" plumb and level, hardwood or aluminum
1	wing dividers	10 inch
1	jack plane	length 14½", 2" cutter
1	cross cut or panel saw	26", 8 point, skew-back
1	rip saw	26", 5½ point, skew-back
1	nest of saws	4 blades—keyhole, compass, plumbers, nail
1	brace	10" sweep, ratchet
1 set	wood auger bits	¼" to 1" by 16ths with tang or ½" round shank for power drill
1	expansion bit	2 cutters, ⅞" to 3"
1	hand drill	capacity to ⅜"
1 set	drill bits with stand	high speed steel, ¼₁₆" to ½" by 32nds
1	countersink	⅝", rose
3	screw driver bits	¼", ⅝₁₆", ⅜"
1 set	wood chisels	socket ¼", ½", ¾", 1"
2	pipe clamp fixtures	fits ¾" pipe
4	"C"-clamps	4", 6", 8", 10"
4	hand screw drivers	4", 6", 8", 10"
1	woodworker's vise	4" × 10" or 4" × 7" jaws
2	wrecking bars	¾" × 30" and ⅝" × 18"
1	combination oil stone	1" × 2" × 7" coarse and fine
1	auger bit file	
1	grinding wheel dresser hooded	
3	nail sets	¼₁₆", ⅜₃₂", ⅛"
1	wood file or rasp	12", half round
8	file handles	sizes 1 to 4
1	file card	1½" × 5"
2	screw drivers	electrician's 3" and 6"
1	lineman's side cutting pliers	7" insulated
1	long nose pliers	6"
1	oblique cutting pliers	6"
1	American standard wire gauge (A.W.G.)	sizes 0 to 36
1	convertible wye level and transit	10 power, 10" telescope

1	rod and target	9' graduated in feet and tenths of feet
1	steel tape	100' with reel graduated in feet and inches or tenths of feet
1	soil auger	2" diam. 40" long (may be shop made)
3	round point shovel	10" × 13" long handle
1	brick trowel	10" blade
1	concrete trowel	12" flexible blade
1	concrete edger	2 $\frac{3}{4}$ " × 6"
1	concrete float	wood, $\frac{3}{4}$ " × 5" × 14" shop made
2	balls chalk line	100 ft. each
1 set	masonry drills	fluted, carbide tipped $\frac{1}{4}$ ", $\frac{3}{8}$ ", $\frac{1}{2}$ "
1	square pointed shovel	10" × 13", short handle
1	pipe vise	capacity $\frac{1}{8}$ " to 2"
1	pipe stocks and dies	$\frac{1}{4}$ ", $\frac{3}{8}$ ", $\frac{1}{2}$ ", $\frac{3}{4}$ ", 1"
1	pipe burring reamer	capacity $\frac{1}{4}$ " to 2" spiral flutes
3	pipe wrenches	10", 14", 18"
1	flaring tool (copper tubing)	9 sizes $\frac{1}{8}$ " to $\frac{3}{4}$ " O.D.
1	tube cutter and reamer	capacity $\frac{3}{16}$ " to $\frac{3}{4}$ " O.D.
1	putty knife	1 $\frac{1}{2}$ " × 3 $\frac{3}{4}$ " elastic
4	paint brushes	2", 2 $\frac{1}{2}$ ", 3", 4"
1	paint gun	external mix, 1 quart

Metal Work

Number	Name of Tool	Description
1	anvil	100 or 150 lbs., $\frac{1}{2}$ " steel face
1	cold cutter	1 $\frac{3}{8}$ ", 16" handle
1	blacksmith's sledge	4 lbs., cross peen
1	sledge	8 lb.
1	machinist's vise	6" jaws
1	machinist's vise	3" jaws, swivel base
1	blacksmith's hammer	2 $\frac{1}{2}$ pounds
1	straight peen hammer	1 $\frac{1}{2}$ pounds
2	ball peen hammers	1 and 2 pounds
1	bolt cutter	capacity $\frac{1}{2}$ " steel
3	cold chisels	$\frac{1}{2}$ ", $\frac{5}{8}$ ", $\frac{3}{4}$ "
3	center punches	$\frac{3}{8}$ ", $\frac{7}{16}$ ", $\frac{1}{2}$ "
1	hack saw frame	adjustable 8" to 12"
2	files	10", mill bastard
1	file	12", double cut flat bastard
3	files	$\frac{5}{16}$ ", $\frac{3}{8}$ ", $\frac{1}{2}$ " round bastard
1 set	twist drills—with stand	high speed steel, $\frac{1}{16}$ " to $\frac{1}{2}$ " by 32nds, straight shank
5	twist drills	high speed steel, taper or $\frac{1}{2}$ " round shank depending on chuck, sizes $\frac{9}{16}$ ", $\frac{5}{8}$ ", $\frac{3}{4}$ ", $\frac{7}{8}$ ", 1"
1 set	combination screw-plate	taps and dies N.C. and N.F. 8 sizes each from $\frac{1}{4}$ " to $\frac{3}{4}$ "—2" or 2 $\frac{3}{4}$ " collet (6 sizes $\frac{1}{4}$ " to $\frac{5}{8}$ " N.C. used most.)
1	drill press vise	2 $\frac{3}{4}$ " × 7 $\frac{1}{4}$ "
1 set	Phillips screw drivers	
1	wire brush	2 $\frac{1}{2}$ " × 8"
1	electric soldering iron	200 to 300 watts
1	tinner's snips	combination 13", 3" cut
1	aviation snips	10", straight and combination

Farm Machinery and Power

Number	Name of Tool	Description
1	starter punch	½" body, ⅜" point
3	pin punches	⅛", ⅜", ¼"
2	long taper punches	½" × 9, ⅝" × 12"
1	guard and sickle anvil with rivet set	
1	wheel and gear puller	medium duty, interchangeable jaws
1	service light	40' cord
1	socket wrench set ½" drive	12 point, 17 sockets ⅜" to 1¼" with 7 attachments
1 set	combination box and open-end wrenches	12 sizes, ⅜" to 1¼"
6	open-end adjustable	6", 8", 10", 12", 15", 18"
1 set	Allen wrenches	set, sizes ⅜" to ¾"
2	"vise-grip" type wrenches	7" and 10"
1 set	tappet wrenches	set of 6, ⅞" to 1⅜"
1	slip joint plier	10"
1	cotter key pliers	6½" diagonal
1	lever grease gun	1 lb. capacity, high pressure
1	piston type oil can	½ pt.
2	oilers	¾ pt., welded seams
1 set	thickness gauges	nine leaves .0015 to .015
1	outside caliper	6"
1	inside caliper	6"
1	valve spring compressor	Universal
3	bearing scrapers	cutting edge 1½", 2½", 3½"
1	ring compressor	
1	spark plug socket set	½" to ⅞" by 16ths
1	water pump pliers	capacity ⅜" to 1⅝"
1	carbon scraper	flexible
1	tension or torque wrench	½ square drive, range 0 to 100 foot lbs.
1 set	extractors (Ezy-outs)	¼", ⅜", ½", ⅝"
1	battery hydrometer	
1 set	knockout wheel pullers	⅝" to 1⅞"
2	pipe taps	⅛" and ¼"
1	speed indicator	
1	jack	hydraulic, heavy floor, capacity 8 tons
1	battery strap	

Shop Safety and First Aid

Number	Name of Item	Description
1	first aid kit	bandages, gauze "Band-aids," adhesives, antiseptic, burn dressing, scissors, tweezers
2	face shield	6" clear cellulose acetate spring flex overhead band
1	fire extinguisher	Foam—2½ gallons (will freeze)
1	fire extinguisher	Vaporizing liquid, 1½ quarts
2	fire extinguishers	CO ₂ , 5 lbs. charge
1	shop broom	4" × 18" head, stiff bristle

A selection of paints in "Safety" colors.

In order that the information in our publications may be more intelligible it is sometimes necessary to use trade names of products or equipment rather than complicated descriptive or chemical identifications. In so doing it is unavoidable in some cases that similar products which are on the market under other trade names may not be cited. No endorsement of named products is intended nor is criticism implied of similar products which are not mentioned.

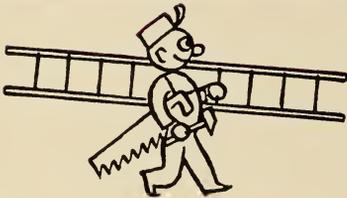
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PLAN



for your needs...

NOT TOO BIG NOR TOO SMALL



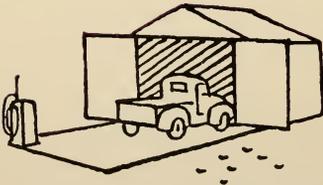
THE TOOLS YOU NEED

for efficiency...

for safety...



AVOID ACCIDENTS AND FIRES



in your farm shop
