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Four great playthings for your youngsters



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■ ONE OF THE more rewarding aspects for the active home work-shopper is building things for children.

The reward is two-fold: First, you get to share the joy that is triggered by the giving of toys such as those pictured on this page. The second is the smug satisfaction of being a "hero" (that only the builders of kids' furniture ever get to know).

On these pages we have rounded up four fun projects to keep you and your children busy. We built three of them in the PM workshop—and tested the prototype digger at length—before we photographed the projects for publication.

BOY-POWERED DIGGER

■ **THIS IS AN IDEAL** project for the craftsman who wants to build an exceptional toy for his youngster. The digger works beautifully and provides hours of fun and exercise for its proud young owner.

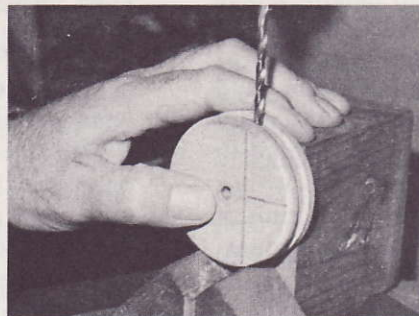
Utilizing a cable and sheave mechanism, the arm and boom are precisely operated with hand levers, while the attitude of the bucket for loading and dumping is controlled with a foot pedal. The young operator uses both hands and feet to operate the machine, which works fine in sand, sawdust, or snow.

making the sheaves

Start by making the boom mechanism and sheaves. Lay out and cut the six pulleys and sheaves from $\frac{3}{4}$ -in.-thick hardwood with a band saw. One easy way to mount the stock in the lathe for turning is to bore a $\frac{1}{4}$ -in. center hole in each blank and use a $\frac{1}{4}$ -20 machine screw turned into your tapered screw center after removing the existing screw. Turn the outside diameter of the sheave blank true, then turn a groove $\frac{3}{16}$ -in. wide by $\frac{1}{8}$ -in. deep for the cable. Round-over both edges of the sheave. Smooth up the face, leaving



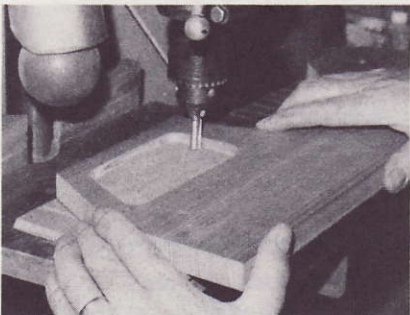
CABLE GROOVE in sheave is turned so it will accommodate two turns of cable.



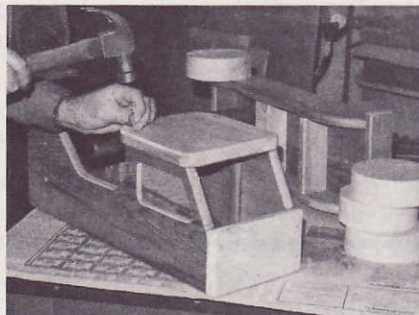
THROUGH-HOLES in sheaves are bored parallel to diameter.



BOOM AND ARM are assembled with axles and sheaves in place temporarily.



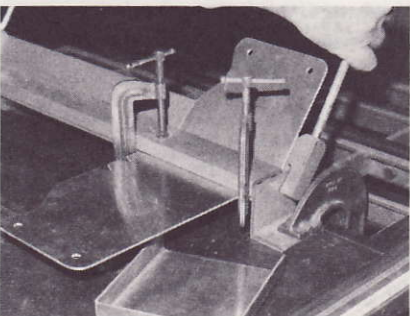
RECESSES ARE routed in truck sides to simulate windows.



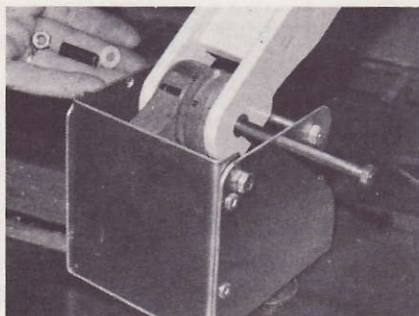
TRUCK is for outdoors so assemble with waterproof glue, finishing nails.



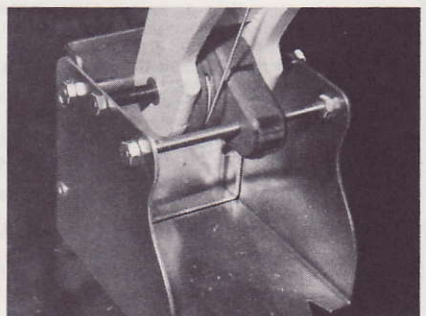
TIRE FACES and treads are turned on lathe; note dead center support.



ALUMINUM parts for the bucket were formed on small bending brake.



BUCKET PIVOTS on end of arm; spacers on rod keep bucket centered.



SHEAVE rotational positions and attitude relationship are critical.

the center slightly thicker than the edges for clearance. Sand and finish with varnish, then remove the stock from the lathe.

Enlarge the center hole on all sheaves to achieve a running fit on the 1/4-in. axles. To do it, use a 3/32-in. bit. Watching the bank of sheaves turning is part of the enjoyment that the young operator derives from using this toy.

Bore holes through the sheaves from groove to groove parallel with the diameter, *but offset slightly to miss the axle holes*. These holes should be 1/16 in. in the small and one of the medium sheaves, and 3/32 in. in the large and three of the medium sheaves. Bore the holes *across the grain* for strength. Drill and countersink for sheet-metal screws at right angles to the cable holes for locking the cable in the sheave where needed.

the boom arm

Cut the boom pieces from the 3/8-in. exterior plywood as shown. Tack the pieces together in groups of two. On your jointer (or with a hand plane) make an overall 1/4-in. taper on the width of both stacks. Lay out the 1/4-in. holes, spaced 16 in. on center. Scribe the rounded ends with a compass, then cut and sand the rounded ends of the stacks. Bore the 1/4-in. axle holes, then disassemble the stacks and round all edges of the boom and arm sides with a router and rounding-over bit.

Next, lay out and cut the operating handles. Cut a 3/8-in. dado slot in both handles to fit the plywood sides of the boom. Bottoms of the dados must be made at appropriate angles. The boom handle is glued to the 3/8-in. plywood at a 45° angle.

The arm-operating handle straddles the right-hand boom stringer with a 30° limit cut at the bottom of the slot.

If you are using a circular saw, clamp the handle to a scrap of plywood at the appropriate angle to kerf the slot. Round edges with a router, bore the 1/4-in. holes and glue the handle to the boom stringer. Using waterproof glue, fasten the largest wheel to the side of the arm-operating straddle lever.

Study photos and drawings and complete gluing operations before you assemble the boom, arm and bucket. Reinforce with 1/4-in. dowels.

Make the web for the boom and arm of 1-in. stock. Slot one web where the cables must cross, as shown. Assemble the boom and arm parts with waterproof glue and brads, with axles temporarily installed for alignment. Disassemble axles and paint boom/arm parts, then reassemble.

making truck sides

Stack two pieces of 3/4-in. stock and lay out, band saw and bore holes as shown on page 158. Round all edges with a router and rounding-over bit except the sides adjoining the roof and front grille, and inside the bottom edge. Rout 1/4-in.-deep recesses to simulate cab windows.

Assemble strengthening cleats to the bottom and sides, using waterproof glue and nails. Assemble in the same way the blocks for the pivot rod through the base and vertical cleats inside the truck sides at trunnion and cab. Rebore the 1/2-in. hole for the body pivot not quite through the block.

From 3/4-in. stock, cut out the grille, front bumper, two chassis skirts, two skirt spreaders

MATERIALS LIST—BOY-POWERED DIGGER

Key	No.	Size and description (use)	Key	No.	Size and description (use)	Key	No.	Size and description (use)
A	4	1 3/4 x 5"-dia. hardwood (wheels)	N	1	3/4 x 2 x 4" hardwood (bucket yoke)	DD	2	5/16"-i.d. x 1 1/16" metal or plastic tube (spacers)
B	1	2 x 2 1/2 x 5 1/2" hardwood (pivot block)	O	1	3/4 x 4 x 7" pine or hardwood (grille)	EE	1	1/2"-i.d., 3"-o.d. leather washer
C	1	1 1/2 x 5 1/2 x 20" hardwood (truck base)	P1	2	3/4 x 1 1/2 x 5" pine (cleats)	FF	5	1/8"-dia. cold rivets
D	1	1 1/2 x 5 1/2 x 21" hardwood (chassis base)	P2	2	3/4 x 1 1/2 x 6" pine (cleats)	GG	4	5/16"-i.d. flat washers
E	1	1 1/2 x 2 x 5 1/2" hardwood (chassis pivot block)	Q	2	3/4 x 2 x 6" pine (chassis cleats)	HH	1	3/8" pushnut
F1	1	1 x 2 x 10" hardwood (boom lever)	R	4	3/4 x 2 1/2"-dia. hardwood (sheave)	II	4	5/16" pushnuts
F2	1	1 x 2 x 10" hardwood (arm lever)	S	1	3/4 x 3"-dia. hardwood (sheave)	JJ	4	1/4" pushnuts
G	1	1 x 2 3/4 x 5" hardwood (foot pedal)	T	1	3/4 x 2"-dia. hardwood (sheave)	KK	1	1/4-20 hex nut
H	1	1 x 7 1/2 x 8" hardwood (seat)	U	2	3/8 x 2 1/2 x 18 3/8" plywood (boom side)	LL	1	8d finish nail cut to 1" (pedal pin)
I	1	1 x 1 3/4 x 8" pine or hardwood (bumper)	V	1	3/8 x 2 1/4 x 18 1/8" plywood (arm side)	MM	1	1/4"-dia. x 4" steel rod (lockpin)
J	2	3/4 x 7 1/2 x 20" pine or hardwood (truck sides)	W	1	3/32 x 3 1/4 x 13 1/2" aluminum (bucket)	NN	1	1/16" steel airplane cable (20 ft.)
K	2	3/4 x 3 1/2 x 21" pine or hardwood (chassis sides)	W1	1	3/32 x 3 1/4 x 5 1/2" aluminum (bucket back)	OO	2	Turnbuckles
L	1	3/4 x 2 1/4 x 13 3/8" pine or hardwood (boom web)	X	1	1/2"-dia. x 5" steel rod (truck pivot)	PP	4	Double-hole swedges
M	1	3/4 x 1 1/2 x 13 1/8" pine or hardwood (arm web)	Y	1	3/8"-dia. x 5" steel rod (pedal pivot)	QQ	6	No. 6 x 1/2" sheet-metal screws
			Z	2	5/16"-dia. x 11 1/2" steel rod (axles)	RR	2	1/2" screw eyes
			AA	1	1/3"-dia. x 1 1/2" steel rod (boom pivot)	SS	1	16" sash chain with snap hook
			BB	1	1/4"-dia. x 3 1/2" steel rod (arm pivot)	TT		No. 8 x 1/2" rh screws
			CC	3	1/4"-dia. x 5" threaded steel rods (bucket and pivot spreaders)	UU		4-40 x 1/2" rh screws and washers

and foot pedal. The seat should be of 1-in. hardwood with the grain running across the truck. Round all corners and edges where appropriate, and assemble parts with waterproof glue and finishing nails. Imitation lights and grille ornaments were added on the prototype.

the wheels and bucket

Band saw four 5-in. blanks from 2-in. stock. For turning, glue sandpaper to a wood faceplate to act as a friction drive. Place a blank against the sandpaper and bring up the dead center to engage the compass detent at the center of the blank. Turn the tire and face of the wheel, then bore the $\frac{5}{16}$ -in. axle hole. Paint the tires black, the wheels as you prefer.

Aluminum sheet $\frac{3}{32}$ -in. thick is available at scrap-metal yards or duct-fabrication shops. Lay out bucket parts according to the drawing. Cutting can be done on a band saw as aluminum is softer than the woodcutting blade.

Drill $\frac{1}{4}$ -in. holes for the yoke rods. Bending is done on a small brake clamped to the circular-saw table. You could do a suitable job with a machinist's vise and hammer. Make the bends and assemble the back to the bucket with cold rivets.

Assemble the bucket to the yoke with two $\frac{1}{4}$ -in. rods threaded at both ends. The front rod has nuts on the inside of the bucket and on outside faces to prevent collapsing and spreading. Bucket sides at the front rod must be slightly sprung to install the front rod with internal nuts in place.

Assemble the yoke to the end of the arm with $\frac{1}{4}$ -in. rod threaded at both ends, a tube spacer and washer on each side of the yoke, and nuts on the outside at rod ends. Mushroom rod ends slightly to keep nuts tight. Assemble the arm and boom with $\frac{1}{4}$ -in. rod and pushnuts. Assemble the boom to trunnions on the truck with $\frac{1}{4}$ -in. rod, pushnuts, washers and spacers.

installing the foot pedal

Make the foot pedal $2\frac{3}{4}$ in. wide by 5 in. long from hardwood stock 1 in. thick. The pedal controls the attitude of the bucket. Even when boom and arm levers move, a consistent position of the pedal holds the position of the bucket. Changing the bucket attitude responds well to movement of the pedal.

Drill the pedal through its width for the $\frac{3}{8}$ -in. rod that will pass through the lower part of the truck trunnions and accept the hardwood pedal on one end. Tap the rod into the pedal flush with the edge, then pin it with an 8d finishing nail in a

hole drilled through pedal and rod. Looking toward the rear from the front, pass the rod through the right trunnion and slip on a $2\frac{1}{2}$ -in.-dia. sheave. Pass rod end through the left trunnion and install a pushnut. Do not pin sheave to the rod until the cable is run.

Determine cable lengths by running string through and around the sheaves. Looking aft, the shorter cable on the right connects the sheave glued to the operating lever with that glued to the arm, operating the arm. The longer cable interconnects the four sheaves on the left—pinned sheave on the foot-pedal rod, two idlers at ends of the boom and small sheave glued to the bucket yoke. This controls the bucket attitude. Use string as guides to cut cable lengths.

Airplane cable of $\frac{1}{16}$ -in. diameter should be found at an industrial hardware store. Pull cable loosely around the sheaves and through locking holes, and adjust sheaves by rotating them to allow proper turning leeway. Start at lowest sheaves, leaving 10 or 12 in. of cable loose for turnbuckle attachment under boom.

Tighten lockscrews (sheet-metal screws with points ground flat) at these lower sheaves before final routing of the cable. Attach cable ends to the turnbuckles with double-hole swedges (crimp-on cable clamps) appropriate for $\frac{1}{16}$ -in. cable (an industrial hardware store should have them). Here, a swedging tool was made with holes drilled in a flat bar, and a hacksaw cut made through the centers of the holes.

Check and adjust sheave rotational positions for leeway in movement and cable tightness before you tighten the lock screw on the outboard sheave. If cable holes in any sheaves are too large, insert one or two short pieces of cable in the hole. Adjust arm lever to arm position before locking it. Repeat the procedure for the bucket-control cable from foot pedal. Holes in idler sheaves must be large enough for two thicknesses of cable. Attach swedged loops to turnbuckles, tighten cables.

finish assembly

With parts prepainted and truck-boom assembly completed, pivot the truck body to the chassis. Cut a pivot pin from $\frac{1}{2}$ -in.-dia. steel rod, to a length just short of the depth of both holes plus the washer. A waxed leather disc was used on the prototype; metal discs will serve as thrust washers. A small chain anchored by a screw under the roof has an end snap hook to engage a screw eye on the boom. It acts as a snubber to lock the boom in traveling position.