Homemade Foot-Powered Generator

Materials

FRAME

Bicycle frame with:
- front[52*] and rear[4] forks
- pedals[53]
- pedal crank[54]
- chain[21]

The following lengths of 1″ angle iron (approximate, measure as you go)
- 5 2′ lengths[1 2 3 5]
- 2 10″ lengths[7a]
- 2 12″ lengths[7b]
- 2 6″ lengths[9]

DRIVE ASSEMBLY

- 4 ½″ bore self-centering pillow blocks[10 11 18 23]
- 4 ½″ bore bushings[13 19 22]
- 2 ½″ bore step sheaves (3 or 4 steps)[16 25]
- 1 ½″ bore 10- or 12- tooth sprocket (bicycle sprocket)[20]
- a ½″ 20-thread Jacob's chuck[15]
- V-belt (appropriate length)[26]
- a 12″ length of ½″ dia. steel stock (½″-20 right-hand thread on one end—1½″)[12]
- a 14″ length of ½″ dia. steel stock (½″-20 left-hand thread on one end—1½″)[17]
- 1 ½″-20 right-hand thread nut[14]
- 1 ½″-20 left-hand thread nut[51]
- 8 ¼″ nuts, bolts, and washers for the pillow blocks[55]
- extra chain links (if needed)
- flywheel—½″ bore (optional)[24]
- toe clips (optional)

IDLER

One-piece grinder shaft assembly[27] complete with:
- bronze bushings[30]
- 8″ length steel stock same dia. of bushings[29]
- 2″ dia. pulley to fit shaft[31]

large gate hinge[28]
#62 spring[32]

TABLE

- a 3′ length of ¾″ steel stock[33]
- a 16″ × 11″ × ¾″ hardwood board[40]
- the following lengths of ¾″ ID steel tubing
  - 1 6″ length [34]
  - 2 3″ lengths[38]

*Numbers refer to parts labeled on photographs.

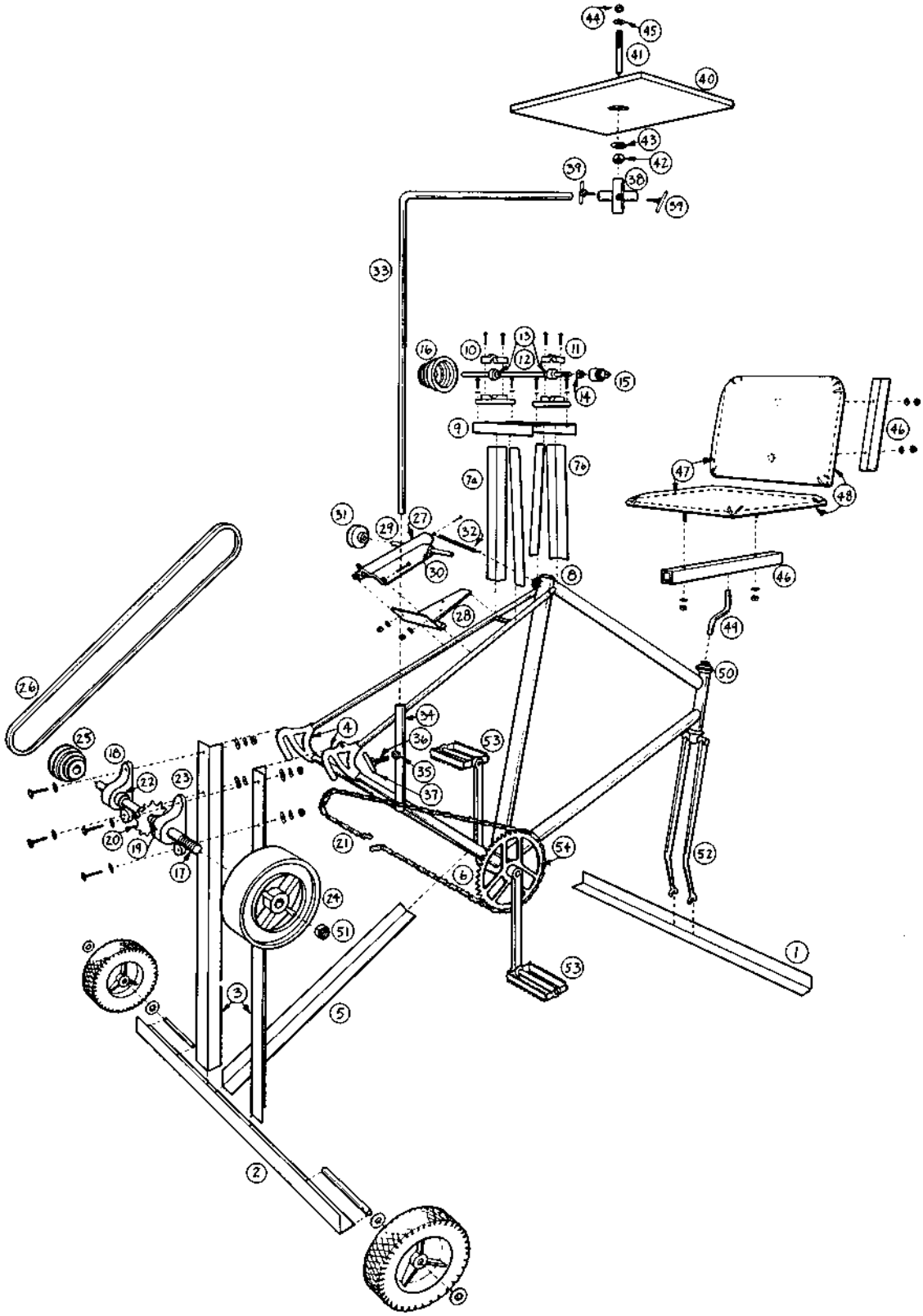

Figure 3-25 Exploded view of homemade Energy Cycle

a 6″ length of ¾″ steel stock threaded 1½″ on one end[41]
3 ⅜″ nuts[35]
3 ⅜″ bolts[36]
3 2½″ lengths of ¼″ steel stock[37]
2 ¾″ nuts[44 42]
2 ¾″ washers [43 45]

SEAT

2 12″ lengths of 1¼″ square metal tubing[46]
2 12″ × 15″ × ¼″ pieces of plywood[47]
2 12″ × 15″ × ¼″ foam rubber[48]
2 15″ × 18″ pieces of vinyl cloth
1 8″ length of ⅞″ dia. steel shaft[49]

Building Instructions (Based generally on the present model of the Energy Cycle foot-powered generator)

Use these general guidelines of this model to adapt to the materials you have available. Read the instructions thoroughly, following the photographs before proceeding with construction. Be sure you understand the directions before starting and take time to improve the design to best suit your situation and materials.

Tools for building this unit should be found in many common workshops. To assemble the frame you will need to use either welding equipment or an acetylene outfit. That is the part of construction requiring some expertise. Other tools include a hacksaw, drill, wrenches, allen wrenches, clamps, file, and pliers.

The basic frame of the cycle should be easy to scrounge. Any old bike frame will do. You won't need wheels, tires, or handlebars but be sure to find a frame including the front and rear forks, pedals, crank, and chain. All new frame support pieces will be fashioned from 1-inch angle iron.

Cut a 2-foot length[1*] of angle iron and tack weld it horizontally to the bottom of the front fork[52] of the bicycle to form the back end of the Energy Cycle. (Do not be confused. In building the cycle, the bike frame is turned around so that the back of the bicycle becomes the front of the unit.) Build a T-frame support for the front end from one 2-foot length[2] of angle iron (to rest on the floor) and two vertical pieces.[3] Welded to the horizontal support and the back fork[4] of the bicycle, the vertical pieces should be long enough to keep the pedals at least 4 inches off the floor. For extra support, weld a piece of angle iron[5] between the front horizontal support and the crank section[6] of the frame.

Next, you will build a power-head support where the seat used to be. Cut four lengths[7] of angle iron to extend vertically from the front fork to a height 38 inches off the floor. Position one post on either side of the front fork, close to the former bicycle seat connection.[8] A platform[9] to support two pillow blocks will rest on top of the four vertical posts; therefore, the width of the pillow blocks will determine the position of the second set of posts (3 or 4 inches forward on the frame). Clamp, making sure all four posts are level, and weld.

Cut two 6-inch lengths[9] of angle iron and weld one horizontally on top of each set of support posts[7] to form the platform. Mark and drill holes and bolt two ½-inch self-centering pillow blocks[10,11] in place. Next, insert the threaded end (right-handed thread 1½ inches up shaft) of a ½-inch × 12-inch

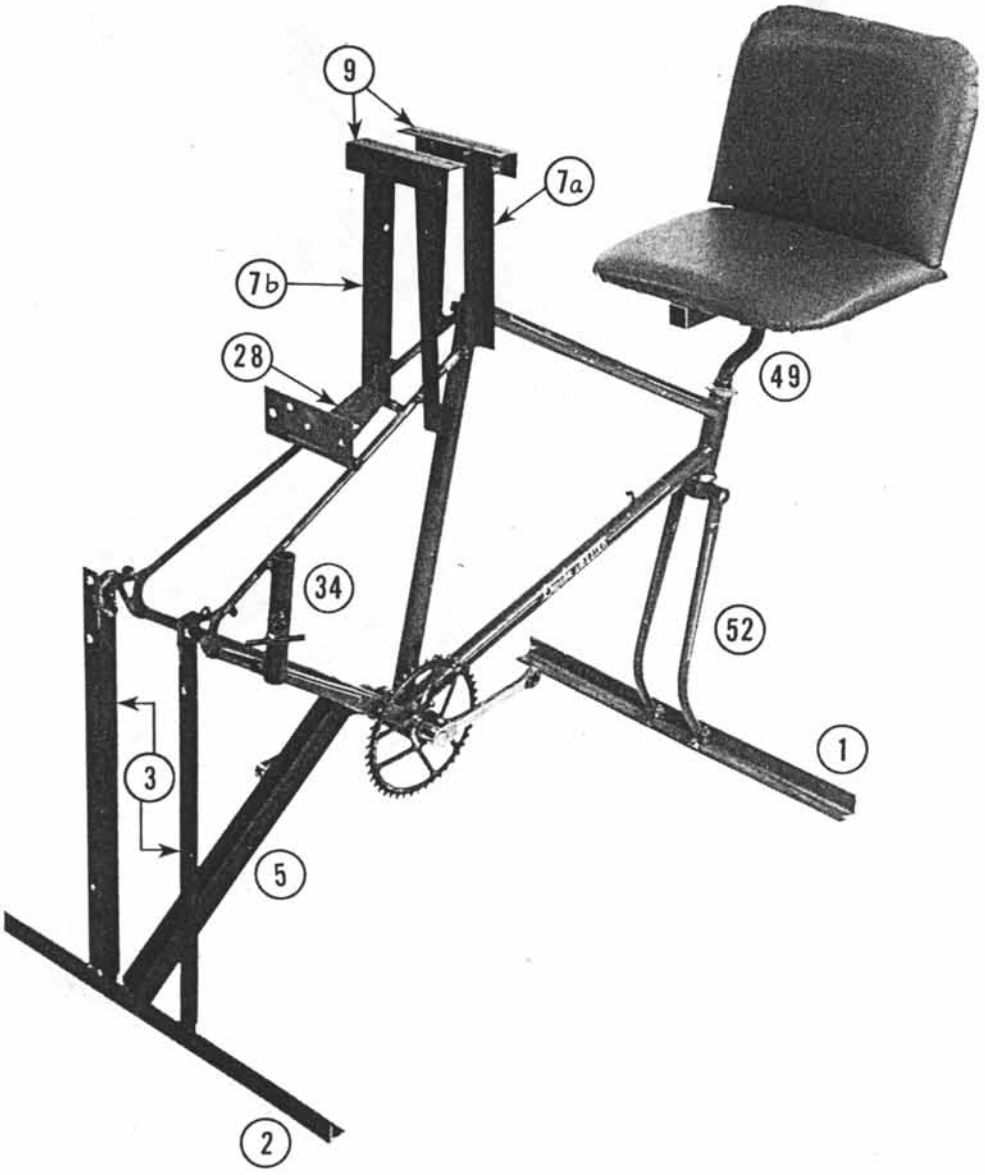

Figure 3-26 Basic frame with seat, power-head support, hinge for idler, table support tubing, and pedal crank

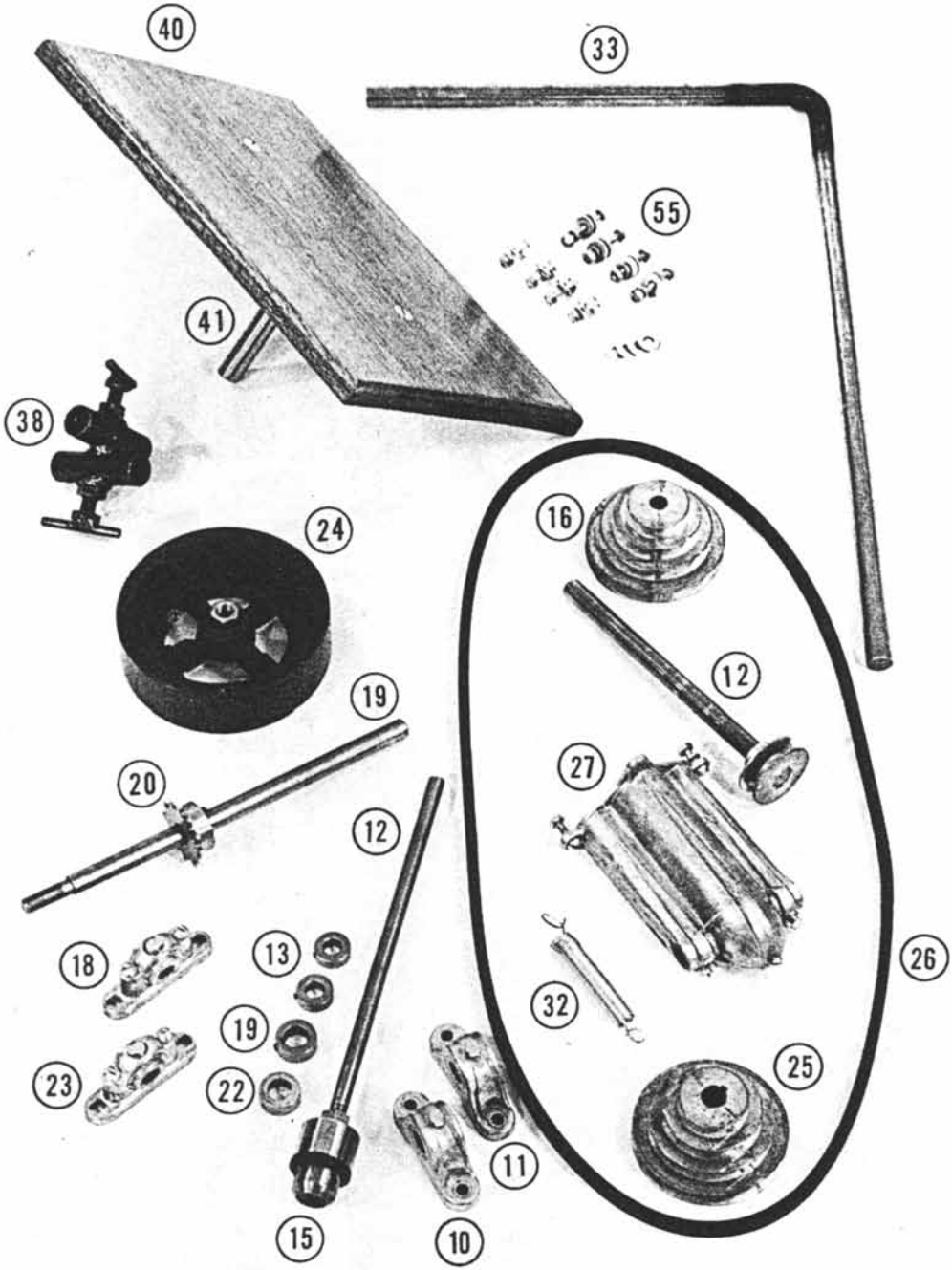

Figure 3-27 To help keep costs down, it should be easy to scrounge many of these parts.

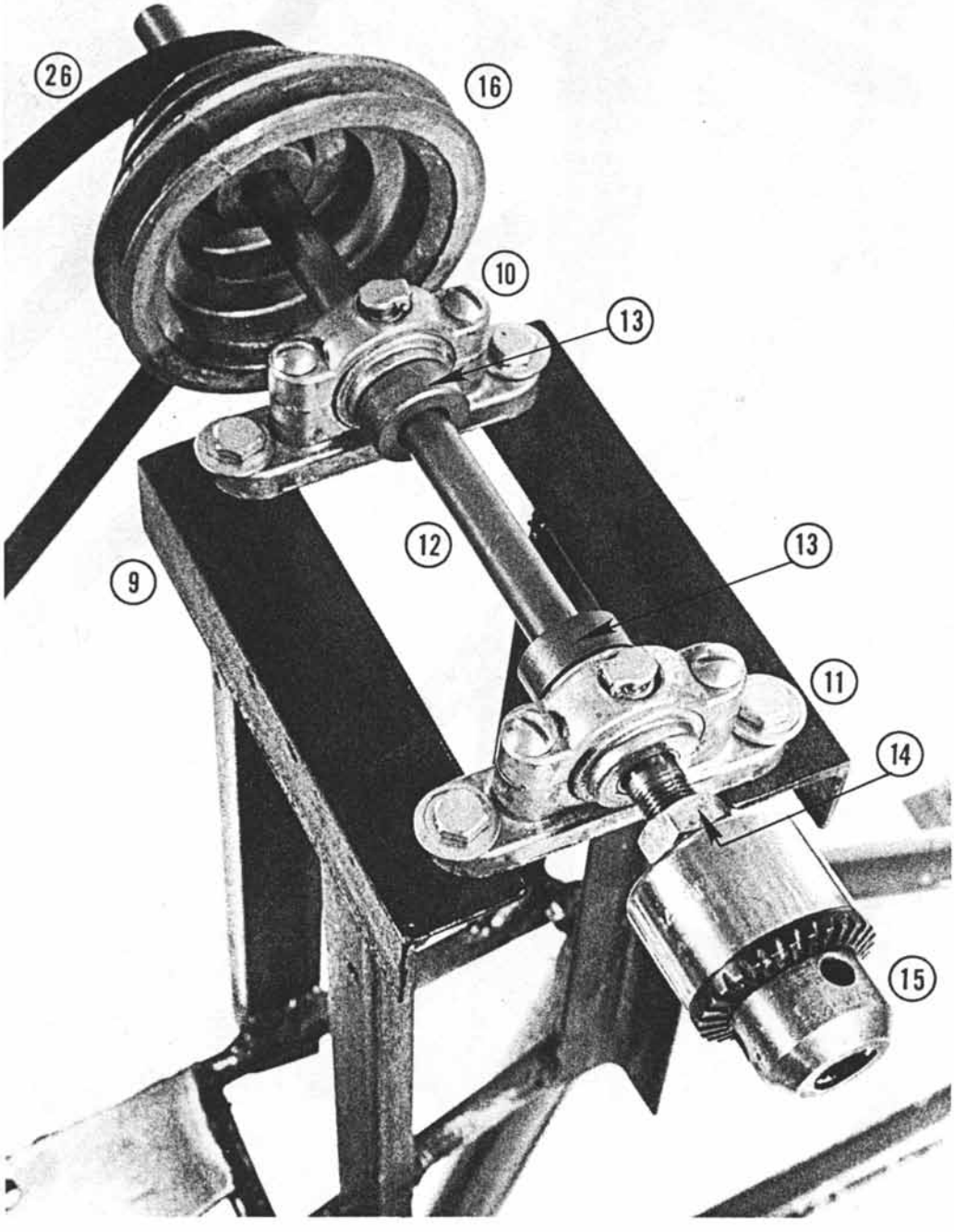

Figure 3-28 Power head: self-centering pillow blocks support an axle which transfers power from the V-belt to the chuck.

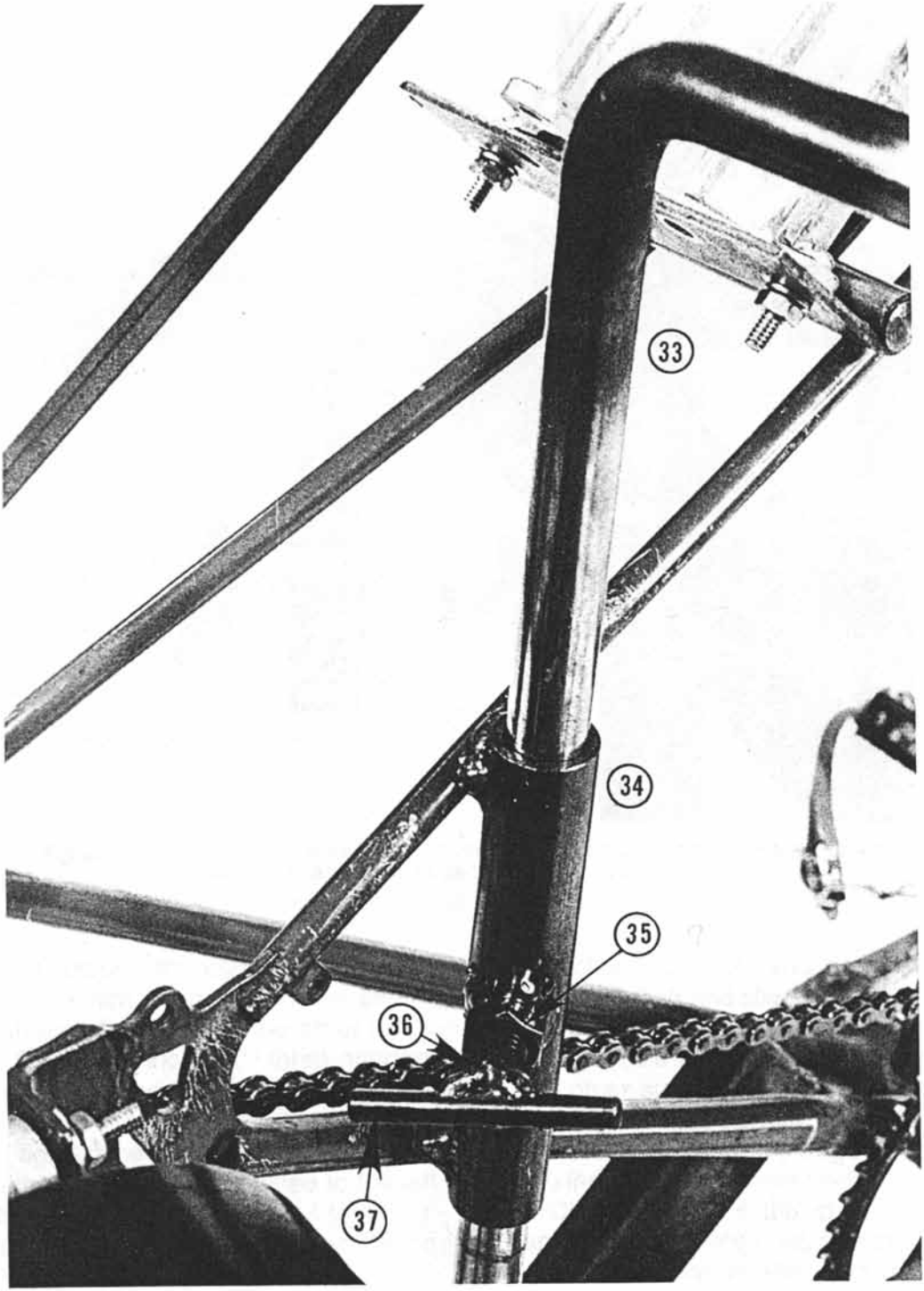

Figure 3-29 The table support bar is supported by a 6-inch length of tubing and locked in place by a hand-tightened "T-bolt."

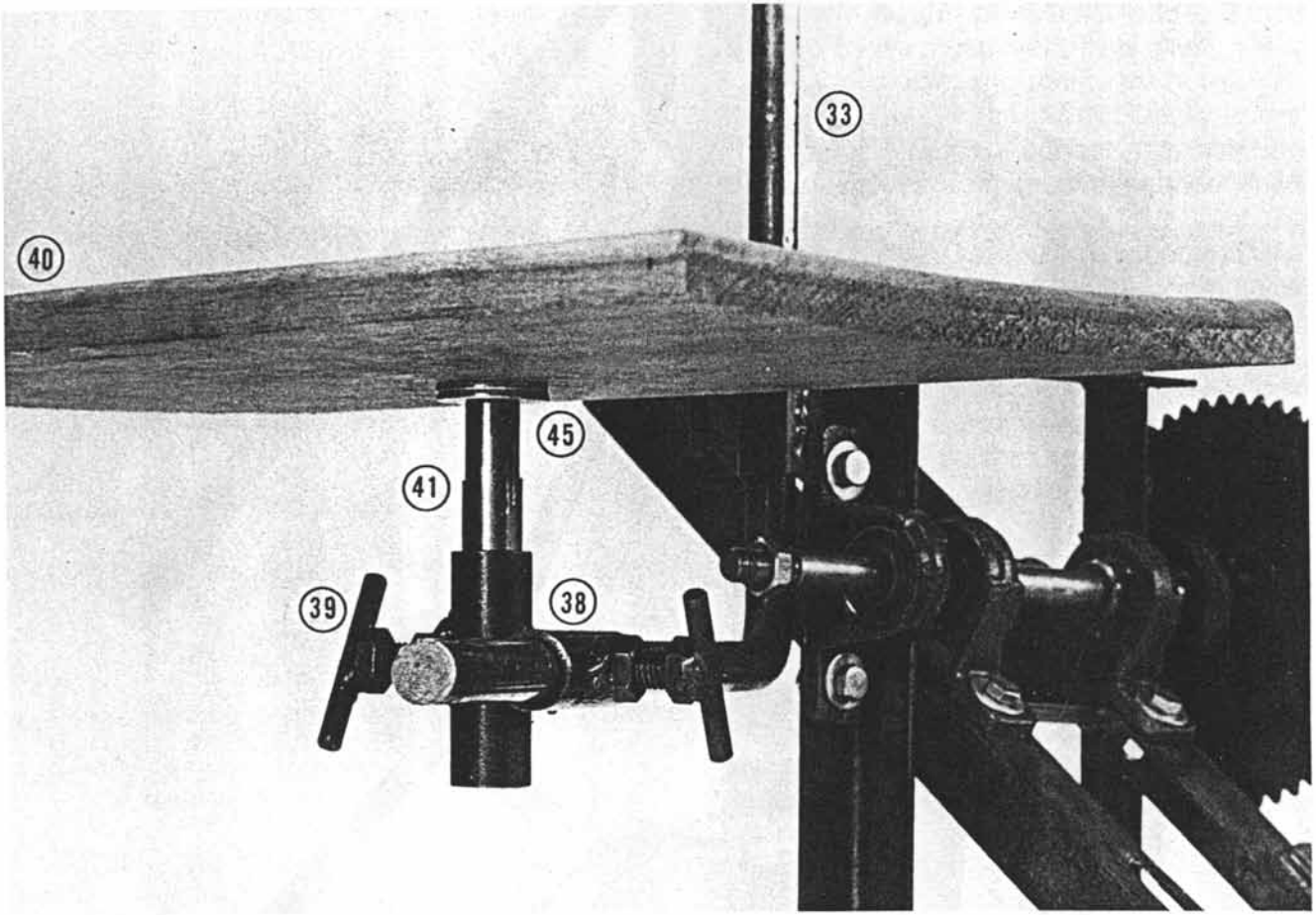

Figure 3-30 The table, which can be moved to most positions, offers a universal means of attaching various tools to the cycle.

steel shaft through the right pillow block.[10] Place two ½-inch bushings on the shaft[12] and push the shaft through the other pillow block.[11] Screw a ½-inch nut[14] three-quarters of the way onto the thread and screw the Jacob's chuck[15] onto the shaft until firmly wedged against the nut. Slide the shaft to the right so that the chuck is as close to the left pillow block[11] as possible without touching. Place a step sheave[16] on the right end of the shaft. Do not secure the fittings yet.

At the front of the cycle, at the top of the T-frame support, drill holes for and bolt the two pillow blocks in place. Insert the threaded end of a 14-inch shaft[17] through the right pillow block.[18] In order, place a bushing,[19] sprocket,[20] chain,[21] and another bushing[22] onto the shaft and slide the shaft through the other pillow block.[23] The threaded end is for a removable flywheel[24] and the right end for the other step sheave.[25] If the top sheave[16] has been mounted with the small pulley on the inside, be sure the large sheave[25] is on the inside on the bottom shaft.[17]

Check to see if the chain fits the new sprocket.[20] If it does not, remove the master link (slightly larger link) and either add or remove links until the chain is taut. With the chain in place, pedal forward a few revolutions so the front sprocket[20] can align itself. Then align all the bushings [13, 19, 22] and sheaves [16, 25] and file "flats" onto the shafts

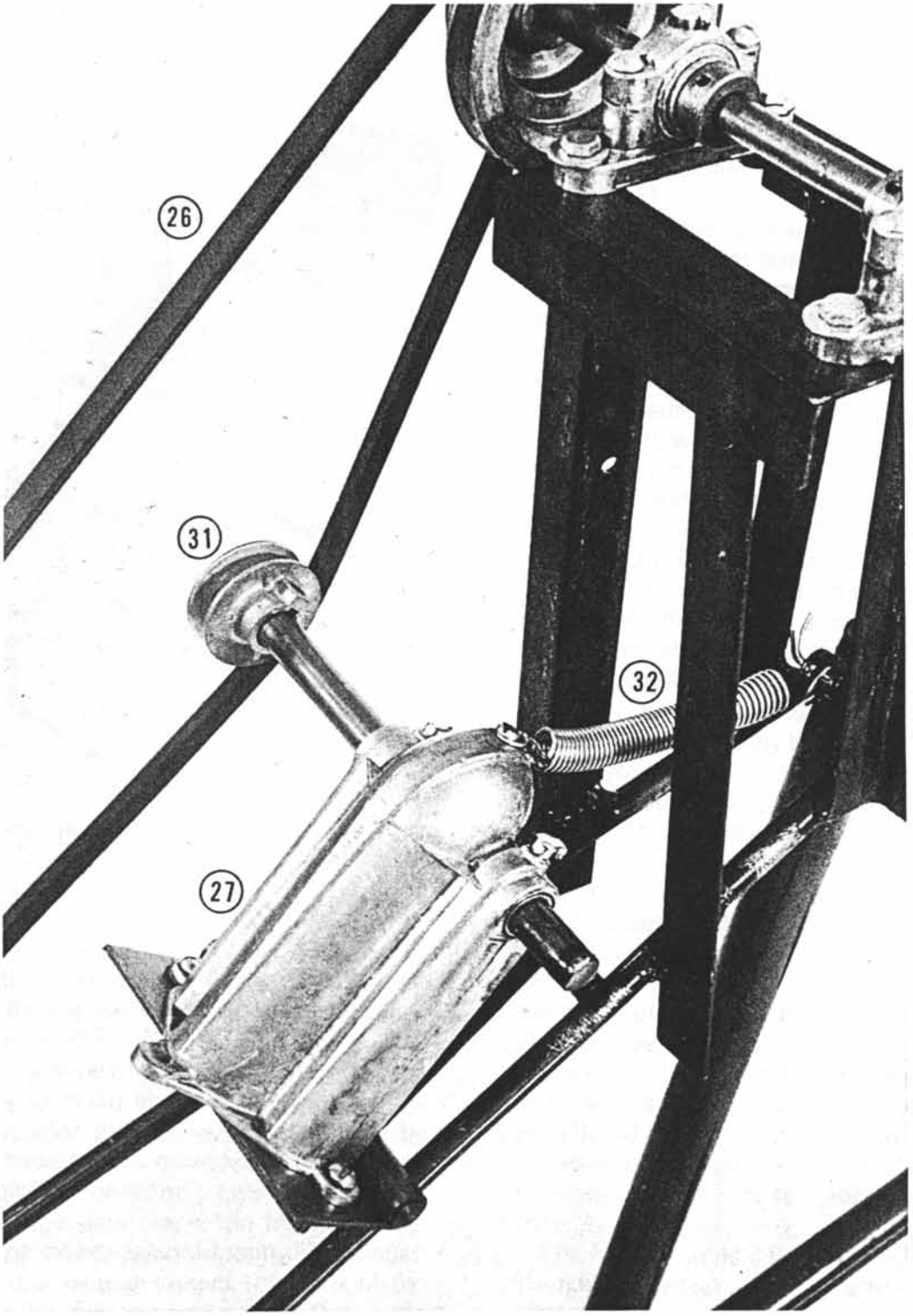

Figure 3-31 Research and Development personnel adapted a one-piece grinder shaft assembly to perform the task of an idler—a mechanism to remove slack from the V-belt.

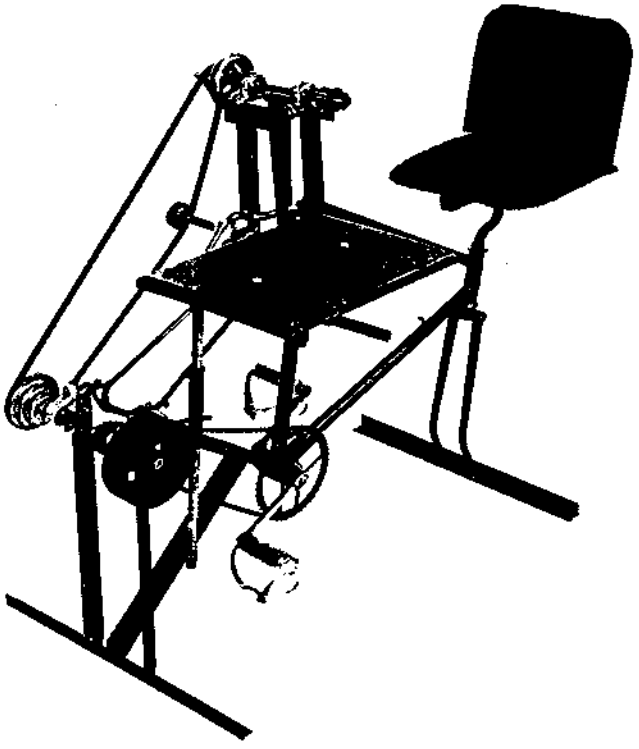

Figure 3-32 Homemade Energy Cycle built by Rodale R & D for less than $60

where the allen screws line up so they will have a flat surface to tighten to. Oil all pillow blocks.[10, 11, 18, 23]

Select a V-belt[26] to fit loosely on the step sheaves to make changing gears a simple task. An idler to remove the slack can be easily made from a one-piece grinder shaft assembly[27] mounted on a gate hinge.[28] First, weld a large gate hinge[28] to the frame just below the power-head support. The hinged end should extend toward the front of the bike and be able to open a full 180 degrees on a horizontal axis. Bolt the one end of the assembly to the flexible part of the hinge and insert an 8-inch shaft[29] through the bronze bushings[30] at the other end. Add a 2-inch pulley[31] to the right end of the shaft, file a "flat" on one side, and secure the pulley with the allen screw in the pulley. Finally, run a #62 spring[32] from the former seat hole[8] on the frame to the free end of the grinder shaft assembly.[27]

The adjustable table will be supported by a ¾-inch, 3-foot steel bar[33] with a right angle bend 14 inches from one end. To bend the bar, secure it in a vise and hold a torch 14 inches from one end. Let it get good and hot. When it turns a dull, red color, bend by exercising pressure on the other end by hand—remember to wear gloves!

Cut a 6-inch length of ¾-inch steel tubing[34] to support and guide the table bar[33] you just bent. Weld a ⅜-inch nut[35] to the side of the tube[34] and drill and tap threads through the tubing, guided by the nut, so that a bolt[36] can be screwed through the side of the tubing to secure the table support bar in place. As an option you may want to weld a 2½-inch piece of ¼-inch shaft[37] across the bolt's head to form a "T-bolt" for easy tightening by hand.

Now you're ready to weld the tubing to the frame. Place it far enough forward on the frame to be out of the pedaler's way. The T-bolt should face away from the bicycle, to be readily accessible for quick adjustments. Use a square to align the tubing on a vertical axis. Any misalignment will be amplified by the long table extension. File all burrs from the inside of the tubing to allow the table support bar maximum mobility.

Construct two more bar supports from 3-inch lengths[38] of tubing and weld them together at a 90-degree skew. Slide one onto the table bar support. The other will support the table. Build T-bolts[39] for the bar supports.[38]

We found that a 16 × 11-inch piece of ¾-inch hardwood made a nice table top.[40] Thread a 6-inch length of ¾-inch steel rod 1½[41] inches.

Screw a ¾-inch nut[42] onto the rod, add a washer,[43] and insert the shaft through a ¾-

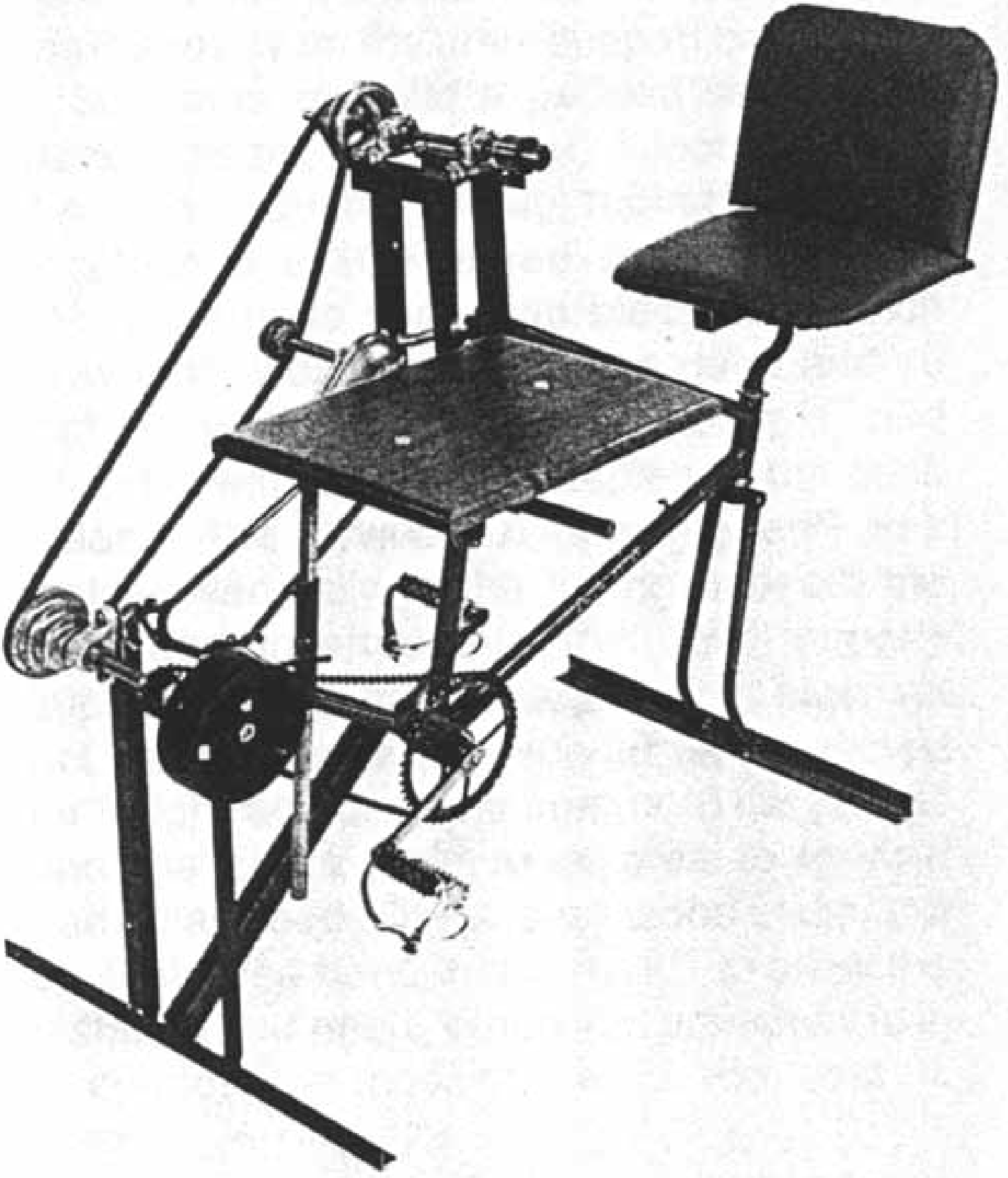

Figure 3-32 Homemade Energy Cycle built by Rodale R & D for less than $60

inch hole in the table. Countersink a thin nut[44] and washer[45] when securing the shaft on the other side of the table. Now you are ready to slip the shaft into the support tubing[38] already on the table support bar.[33]

Scrounge or build a padded seat with a back support. We used two 1-foot lengths of 1¼-inch square metal tubing[46] welded together at a 100-degree angle to support our homemade seat. Two pieces of ¼-inch plywood[47] were cut 12 inches deep and 15 inches wide, padded with foam,[48] and covered with vinyl cloth stapled to the back sides of the plywood. A ⅞-inch shaft[49] was welded vertically to the tubing beneath the seat and inserted into the hole formerly supporting the handlebars.[50] This seat will not be adjustable and should be measured for height and distance from both the pedals and the chuck-table work area to fit your particular needs. If the seat is too close, put an S-shaped bend in the shaft[49] to allow the distance you need. When you are sure it is in a comfortable position, weld the seat in place.

You may find it helpful on some jobs to have toe clips for the pedals. Pick these up at your local bike shop. The flywheel[24] is another option. A lawn mower graveyard is a good place to scrounge one of these. You may not find it helpful for every job, so we suggest bolting[51] it on instead of welding to keep it removable.

Always think safety when using your cycle. The flexibility of the idler should help you avoid pinching your fingers when changing gears. We strongly suggest building guards for the pulleys so your fingers don't get caught in the V-belt.[26] Safe Pedaling!

Rear-wheel Bicycle Adapter

Materials

MAIN FRAME

The following lengths of angle iron:

- 2 40" lengths[24]
- 1 5" length[25]
- 2 4¾" lengths[26]
- 2 7½" lengths[2]
- 2 18" lengths[3]

2 self-centering pillow blocks[16]

BICYCLE MOUNTS

The following lengths of angle iron:

- 2 14" lengths[6]
- 2 8" lengths[7]
- 2 7" lengths[8]
- 4 1½" lengths[9]

2 turnbuckles (one end loop, other hook)[10]

POWER ARM

The following lengths of angle iron:

- 2 18" lengths
- 1 5" length
- 1 4½" length

4 self-centering pillow blocks [13 15]
1 10" length of steel stock[12]
1 11" length of steel stock[12]
1 6" dia. wheel[20]
4 bushings (optional, if pillow blocks without lodging screws)
2 54-tooth sprockets, #35[17]
2 12-tooth sprockets, #35[17]
length of #35 chain[22]
1 heavy-duty spring[23]

TABLE (see other set of plans)

- 1 3-foot length of ¾" steel stock[33]
- 1 16" × 11" × ¾" hardwood board[40]
- 3 3" lengths of ¾" ID steel tubing[34 38]
- 1 6" length of ¾" steel stock threaded 1½" on one end nuts, bolts, washers[41]
- 3 2½" lengths of ¼" steel stock[37]

Building Instructions

This design adapts any ordinary bicycle to a rear-wheel power takeoff to harness the power-of-the-pedal. For less than $45.00, you should be able to build this simple

mounting frame to use your bicycle one minute for grinding grain and the next minute to ride to the store.

Except for a welding or an acetylene outfit, tools needed to build this unit are commonly found around most workshops—drill, hacksaw, file, and allen and common wrenches. Refer to the materials list and photographs regularly for clarity but use this model merely as an example. Let your imagination improve on our design to best fit your specific needs and available materials.

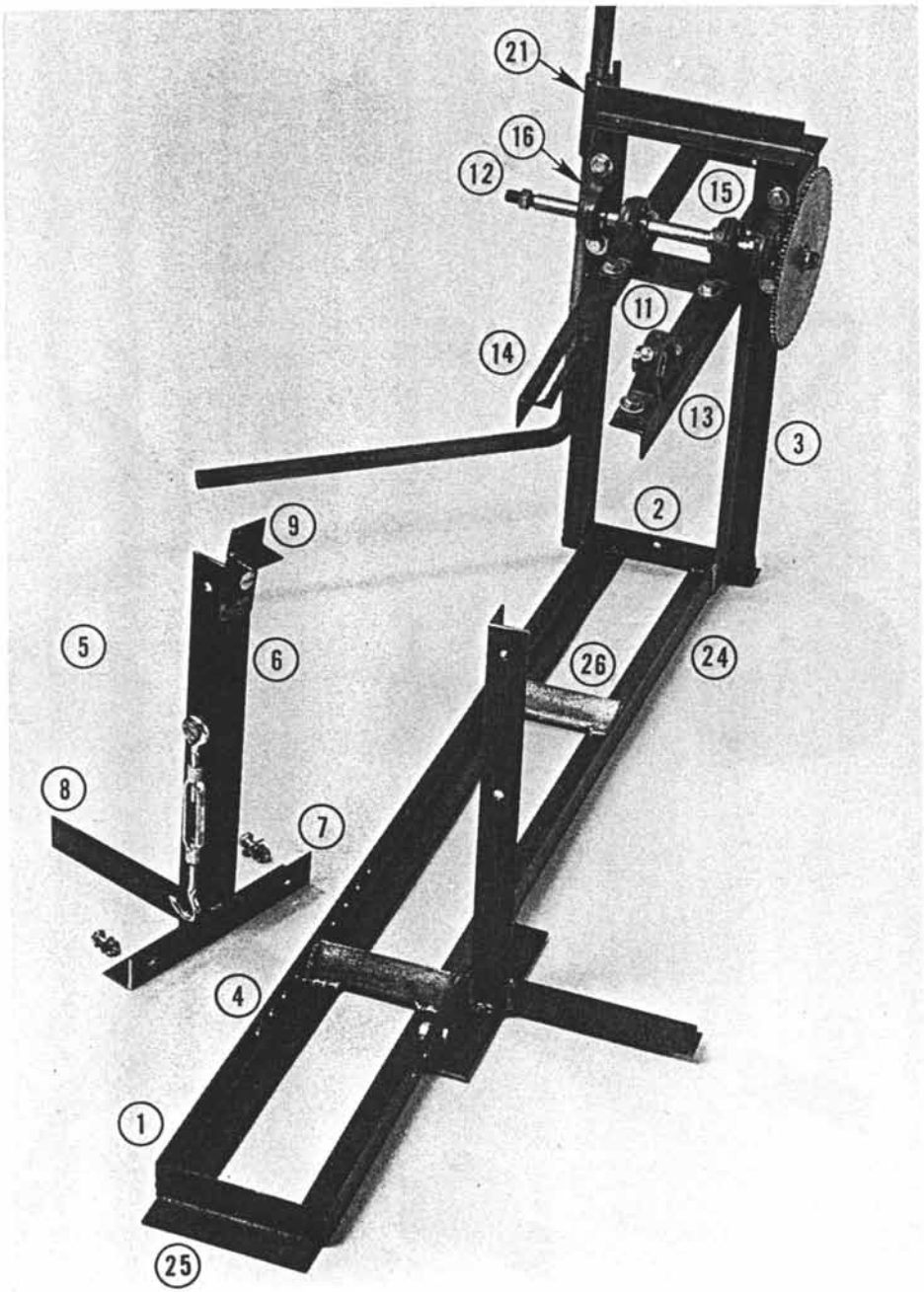

Figure 3-33 The rear-wheel adapter model consists of three components: floor frame and rear uprights, bicycle frame mounts, and spring-loaded power arm.

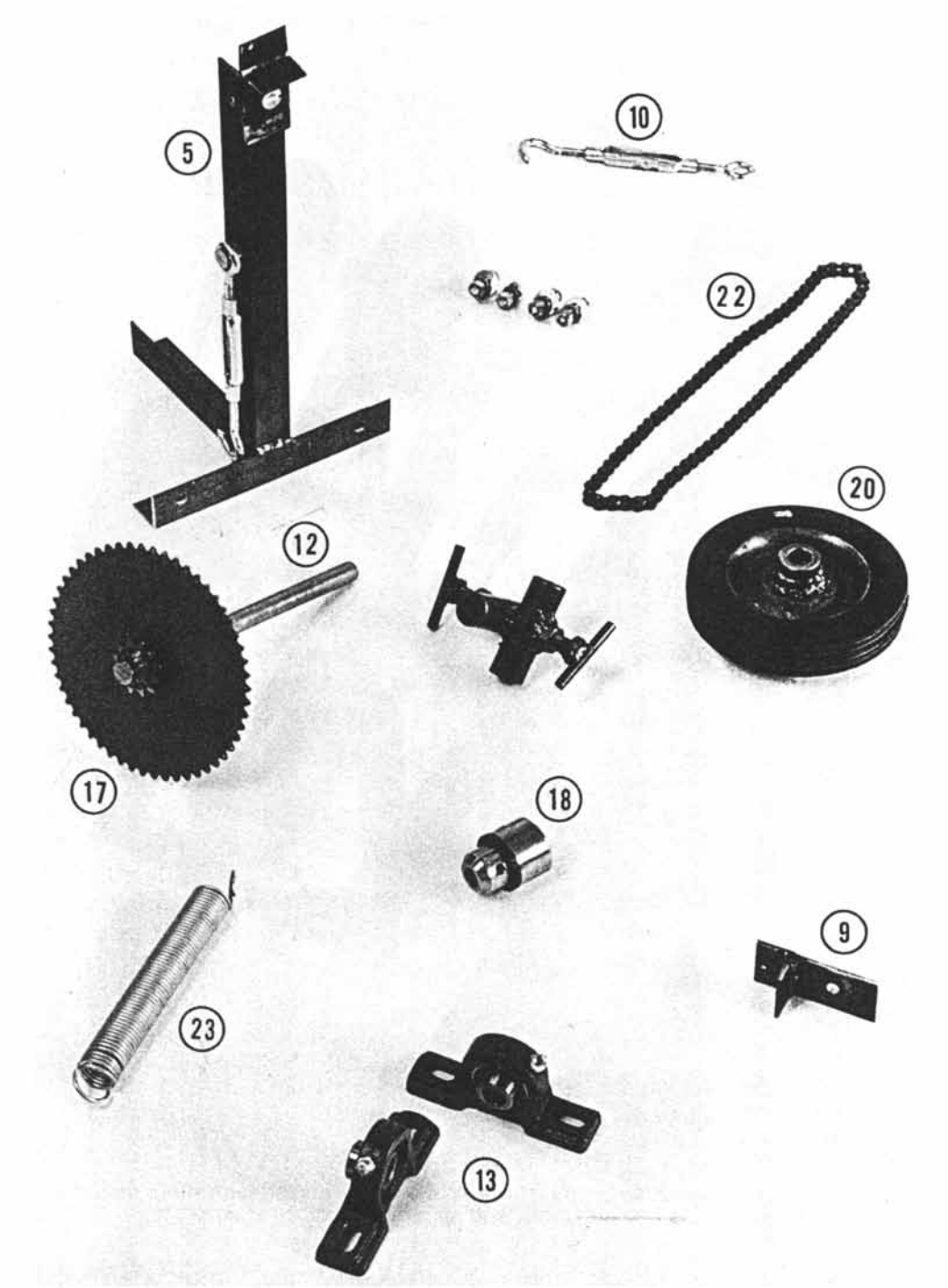

Figure 3-34 A few simple fabricated parts and some basic hardware make up the rear-wheel power adapter.

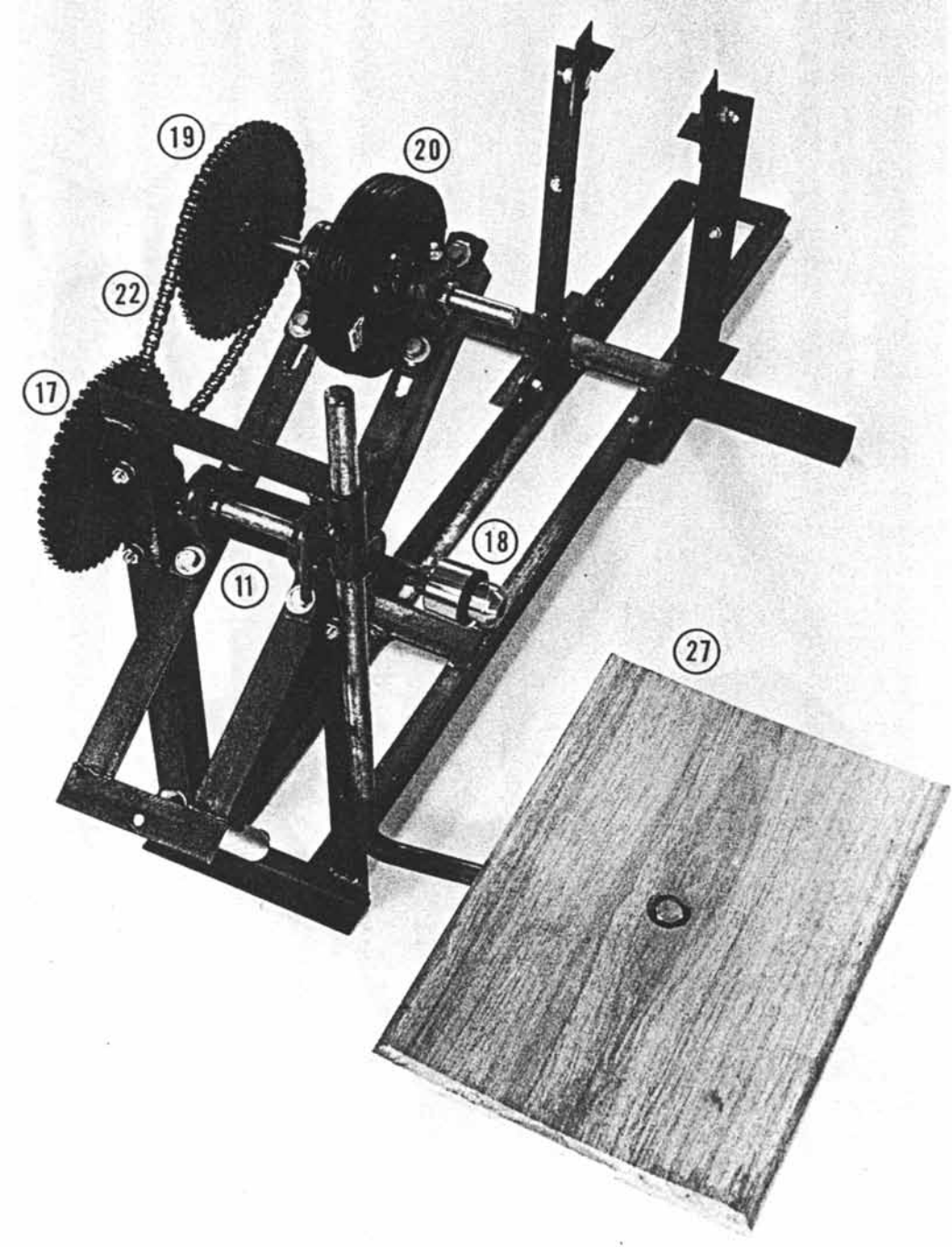

Figure 3-35 Attached to a five-speed bicycle, this prototype spun the chuck at a rate of over 5,000 rpm's.

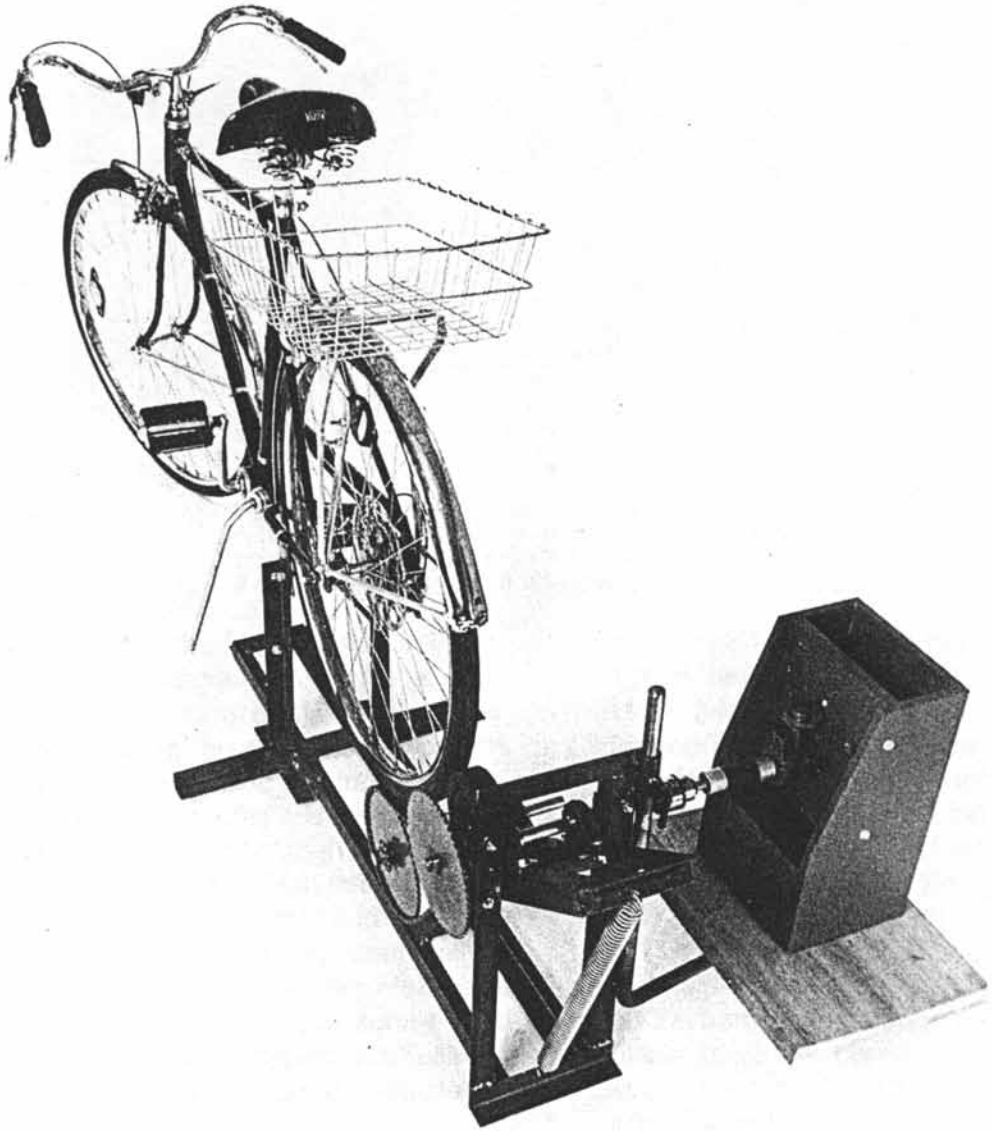

Figure 3-36 Bicycle rests on the two frame mounts and is secured in place with two turnbuckles. A converted electric grain mill sits on the adjustable table and its drive shaft is clamped inside the chuck.

Construction of the frame is the first step. Using 1¼-inch angle iron, build a floor frame[1] 40 inches long and 5 inches wide. The rear spacing brace[2] should be 7½ inches long to lap outside the frame to support two 18-inch uprights.[3] Before welding, drill ten ¼-inch holes[4] through the sides of the 40-inch[24] pieces at 1-inch intervals starting 7 inches from the front end. *Caution:* Everything must be aligned symmetrically in this model for parallel positioning. Make sure the holes are aligned directly across from their mates. The bike frame mounts[5] will bolt through these holes and can be adjusted to fit different sizes of bicycles.

To build each bicycle frame mount[5] you will need a 14-inch upright,[6] an 8-inch securing bar[7] with ¼-inch holes drilled 1 inch from either end for bolting the mount to the 40-inch floor frame, a 7-inch balancing extension,[8] and a specially constructed frame-rest.[9] Weld the three lengths of angle iron at right angles to each other according to the photograph. The frame-rest[9] is made from a 1-inch length of angle iron welded to a 1½ × 2-inch steel plate so that a ledge is formed for the bicycle frame to rest upon. A bolt fastens it to the upright. Another bolt fastens a 10-inch turnbuckle[10] to the side of the upright. The turnbuckle[10] should remain loose so you can swing it into place on the bike's frame before tightening.

The power arm[11] is an 18-inch-long, 5-inch-wide frame hinged slightly rear of center on the frame's rear uprights via an axle[12] and pillow blocks.[13] Using 1¼-inch angle iron, space the two 18-inch lengths at the middle and rear with 5-inch lengths. Secure a set of sleeve-bearing pillow blocks[13] at the front end of the power arm in slots[14] rather than holes so the front pillow blocks[13] are left adjustable. Center a second set[15] slightly rear of center on the power arm and a third[16] at the top of the frame's rear uprights.

Next you will need two axles[12] to fit the pillow blocks.[13,15] Thread the end of one

with a right-handed thread[12] to fit the Jacob's chuck.[18] Flush with the other end, weld a 12-tooth sprocket and a 54-tooth sprocket[17] separated ⅜ of an inch by washers. Place the axle[12] through the pillow blocks[15] threaded end first and attach the chuck.[18] The other axle[19] should have the remaining sprockets welded in inverse order to those on the first axle. Placing a 6-inch wheel[20] between the pillow blocks,[13] insert the axle[19] through the pillow blocks,[13] wheel,[20] and bushings to secure the wheel. If the pillow blocks [13,15,16] do not have lodging screws, you will need to secure the two axles[12] with one more bushing on the outside of each pillow block.[13,15,16]

See the preceding set of plans for the instructions for building and supporting an adjustable, swiveling table.[27] The supporting tube[21] for this model will be welded high on the frame's rear uprights.[3]

For the finishing touches, adjust a chain[22] to fit the sprockets. You can loosen the left pillow block[13] and loosen the chain[22] to change gears. Next, drill holes for and attach a heavy-duty spring[23] between the rear end of the floor frame. This will keep the wheel[20] on the power arm firmly wedged against the rear bicycle wheel.

To use your new power adapter, push the power arm[11] to the floor (expanding the spring[23]) and back your bicycle onto the frame. Lift the bicycle so the rear wheel is off the ground and set the frame on the two frame-rests.[5] Swing the turnbuckles[10] around to secure the frame in place and tighten. Let the power arm up[11] and align it against the wheel.[20] Fix your tool in the chuck,[18] secure it to the table[27] or wedge it against the floor. Most jobs will require two people for this setup—one to pedal, the other to operate and feed the implement being powered.