

Homemade Foot-Powered Generator

Materials

FRAME

Bicycle frame with:

- front^{52*} and rear⁴ forks
- pedals⁵³
- pedal crank⁵⁴
- chain²¹

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" lengths⁹

DRIVE ASSEMBLY

- 4 1/2" bore self-centering pillow blocks^{10 11 18 23}
- 4 1/2" bore bushings^{13 19 22}
- 2 1/2" bore step sheaves (3 or 4 steps)^{16 25}
- 1 1/2" bore 10- or 12- tooth sprocket (bicycle sprocket)²⁰
- a 1/2" 20-thread Jacob's chuck¹⁵
- V-belt (appropriate length)²⁶
- a 12" length of 1/2" dia. steel stock (1/2"-20 right-hand thread on one end—1 1/2")¹²
- a 14" length of 1/2" dia. steel stock (1/2"-20 left-hand thread on one end—1 1/2")¹⁷
- 1 1/2"-20 right-hand thread nut¹⁴
- 1 1/2"-20 left-hand thread nut⁵¹
- 8 1/4" nuts, bolts, and washers for the pillow blocks⁵⁵
- extra chain links (if needed)
- flywheel—1/2" bore (optional)²⁴
- toe clips (optional)

IDLER

- One-piece grinder shaft assembly²⁷ complete with:
 - bronze bushings³⁰
 - 8" length steel stock same dia. of bushings²⁹
 - 2" dia. pulley to fit shaft³¹
- large gate hinge²⁸
- #62 spring³²

TABLE

- a 3' length of 3/4" steel stock³³
- a 16" x 11" x 3/4" hardwood board⁴⁰
- the following lengths of 3/4" ID steel tubing
 - 1 6" length³⁴
 - 2 3" lengths³⁸

*Numbers refer to parts labeled on photographs.

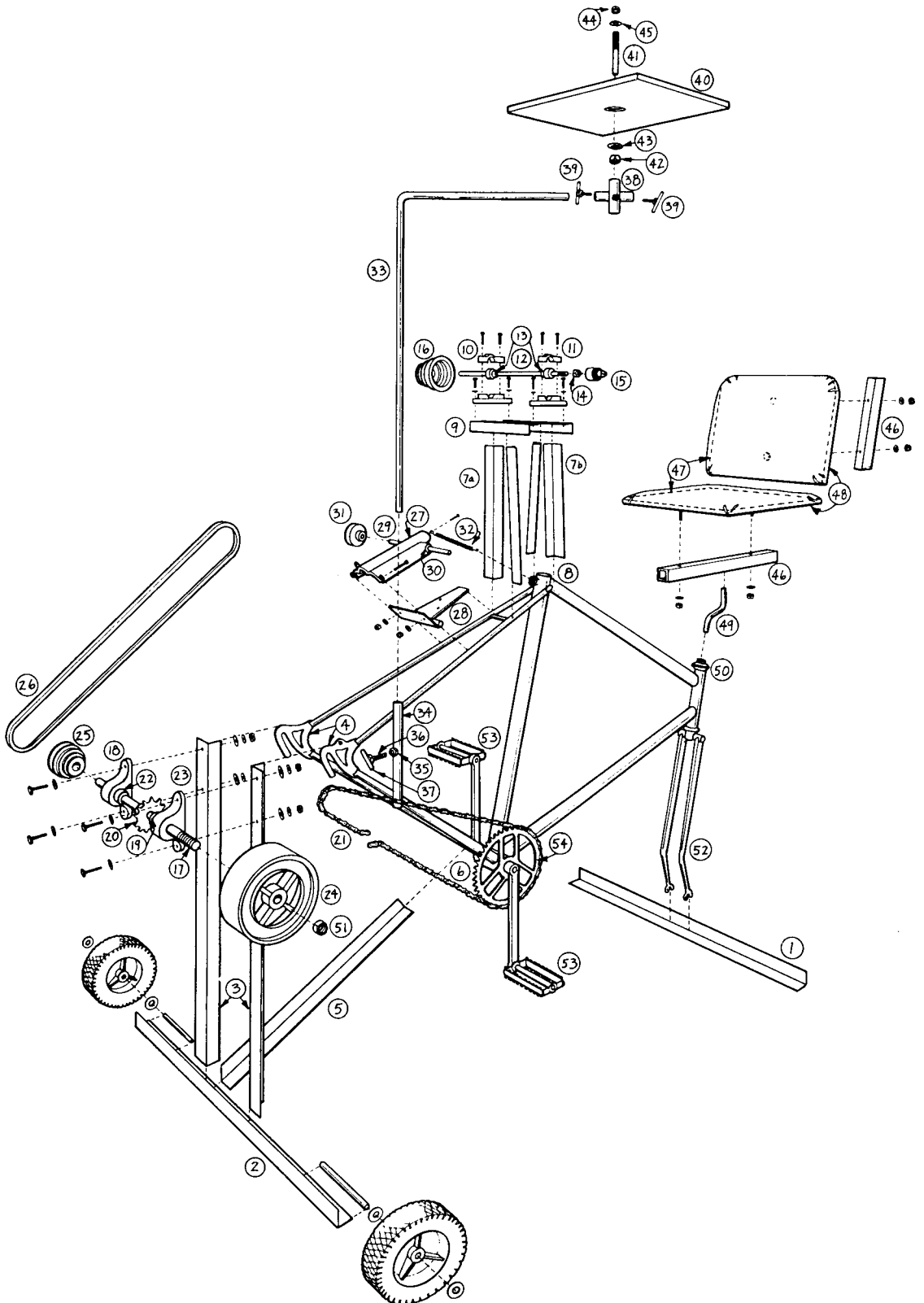


Figure 3-25 Exploded view of homemade Energy Cycle

- a 6" length of 3/4" steel stock threaded 1 1/2" on one end⁴¹
- 3 3/8" nuts³⁵
- 3 3/8" bolts³⁶
- 3 2 1/2" lengths of 1/4" steel stock³⁷
- 2 3/4" nuts^{44 42}
- 2 3/4" washers^{43 45}

SEAT

- 2 12" lengths of 1 1/4" square metal tubing⁴⁶
- 2 12" x 15" x 1/4" pieces of plywood⁴⁷
- 2 12" x 15" x 1/4" foam rubber⁴⁸
- 2 15" x 18" pieces of vinyl cloth
- 1 8" length of 7/8" dia. steel shaft⁴⁹

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 fork⁵² 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 length² of angle iron (to rest on the floor) and two vertical pieces.³ Welded to the horizontal support and the back fork⁴ 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 iron⁵ between the front horizontal support and the crank section⁶ of the frame.

Next, you will build a power-head support where the seat used to be. Cut four lengths⁷ 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 platform⁹ 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 lengths⁹ of angle iron and weld one horizontally on top of each set of support posts⁷ to form the platform. Mark and drill holes and bolt two 1/2-inch self-centering pillow blocks^{10,11} in place. Next, insert the threaded end (right-handed thread 1 1/2 inches up shaft) of a 1/2-inch x 12-inch

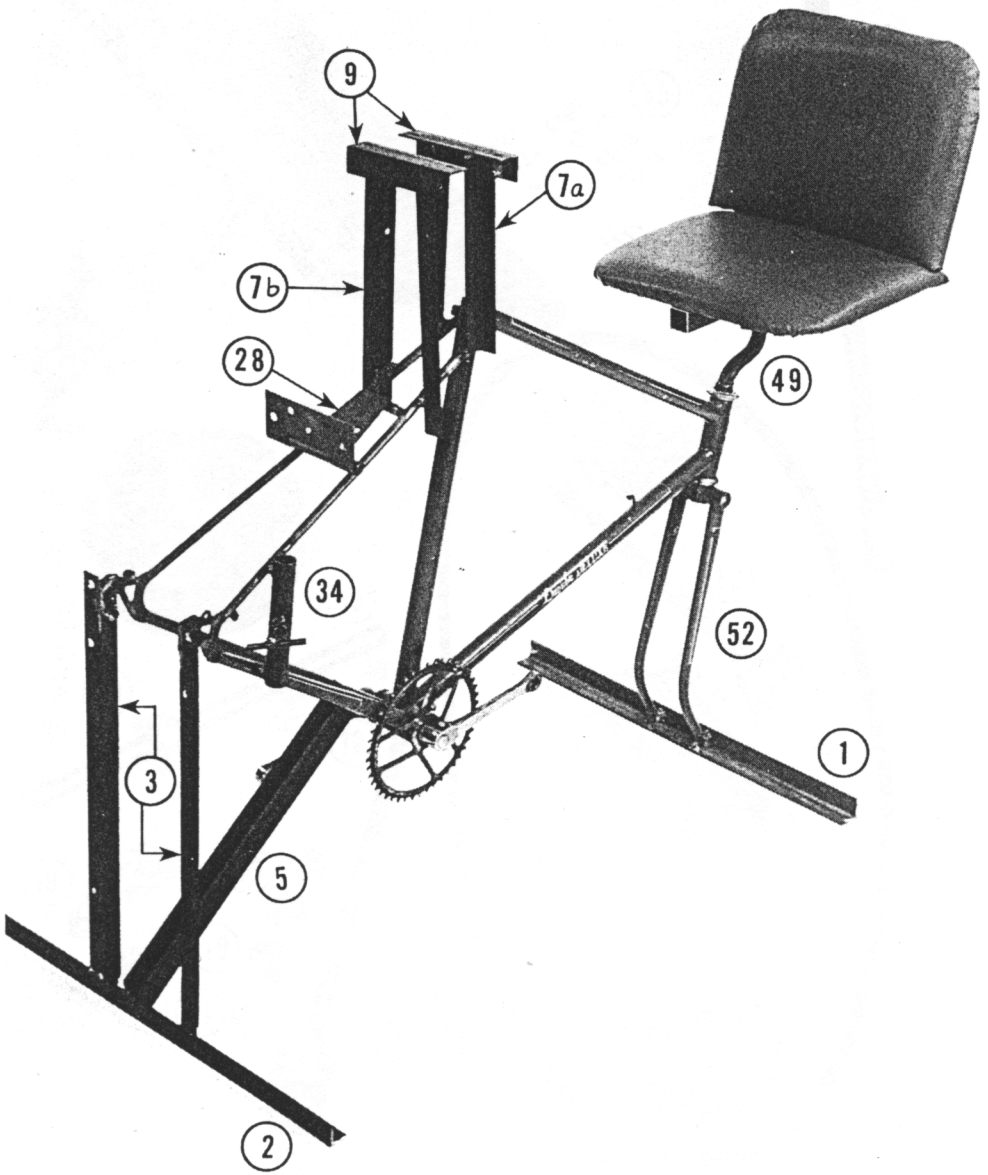


Figure 3-26 Basic frame with seat, power-head support, hinge for idler, table support tubing, and pedal crank

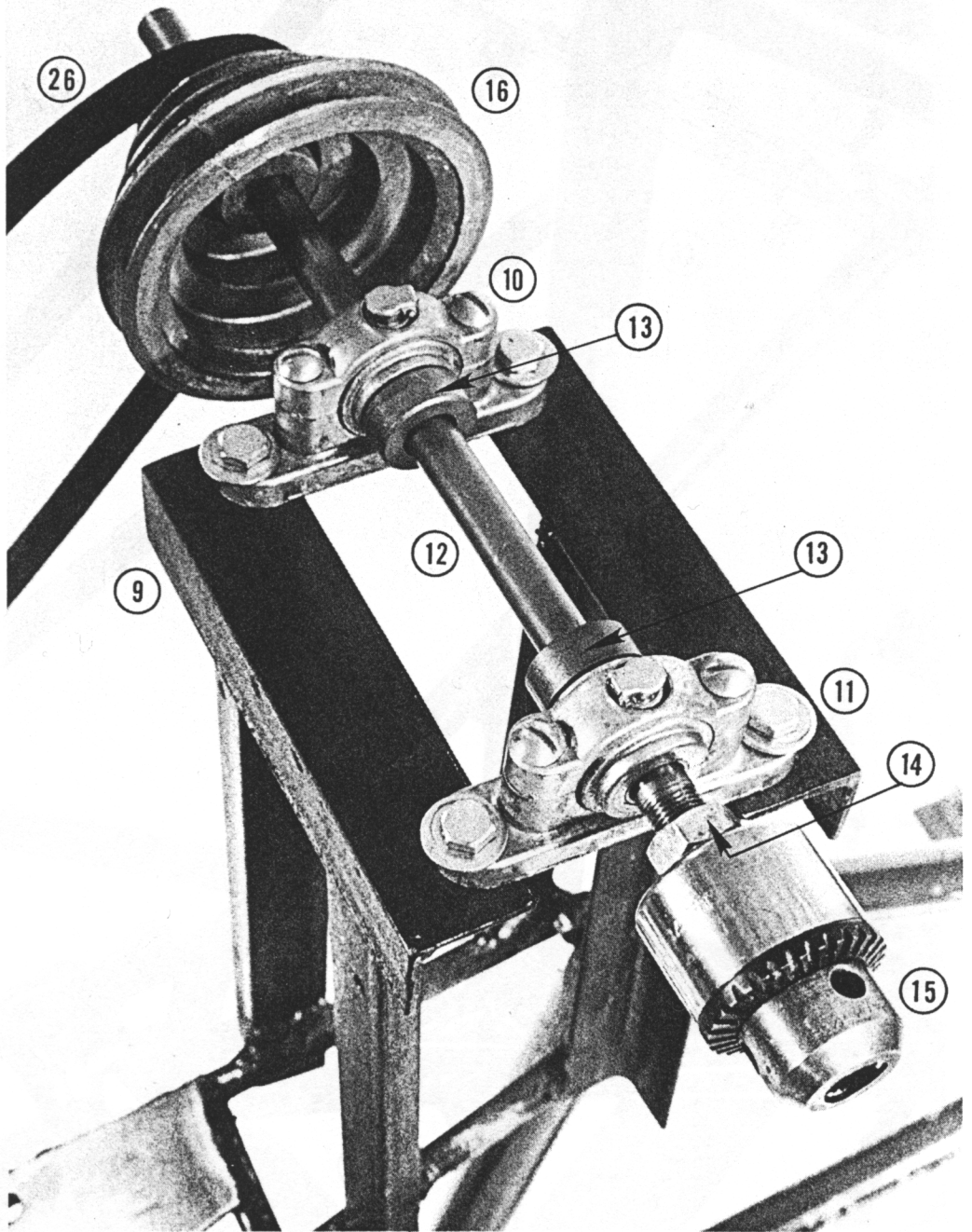


Figure 3-28 Power head: self-centering pillow blocks support an axle which transfers power from the V-belt to the chuck.

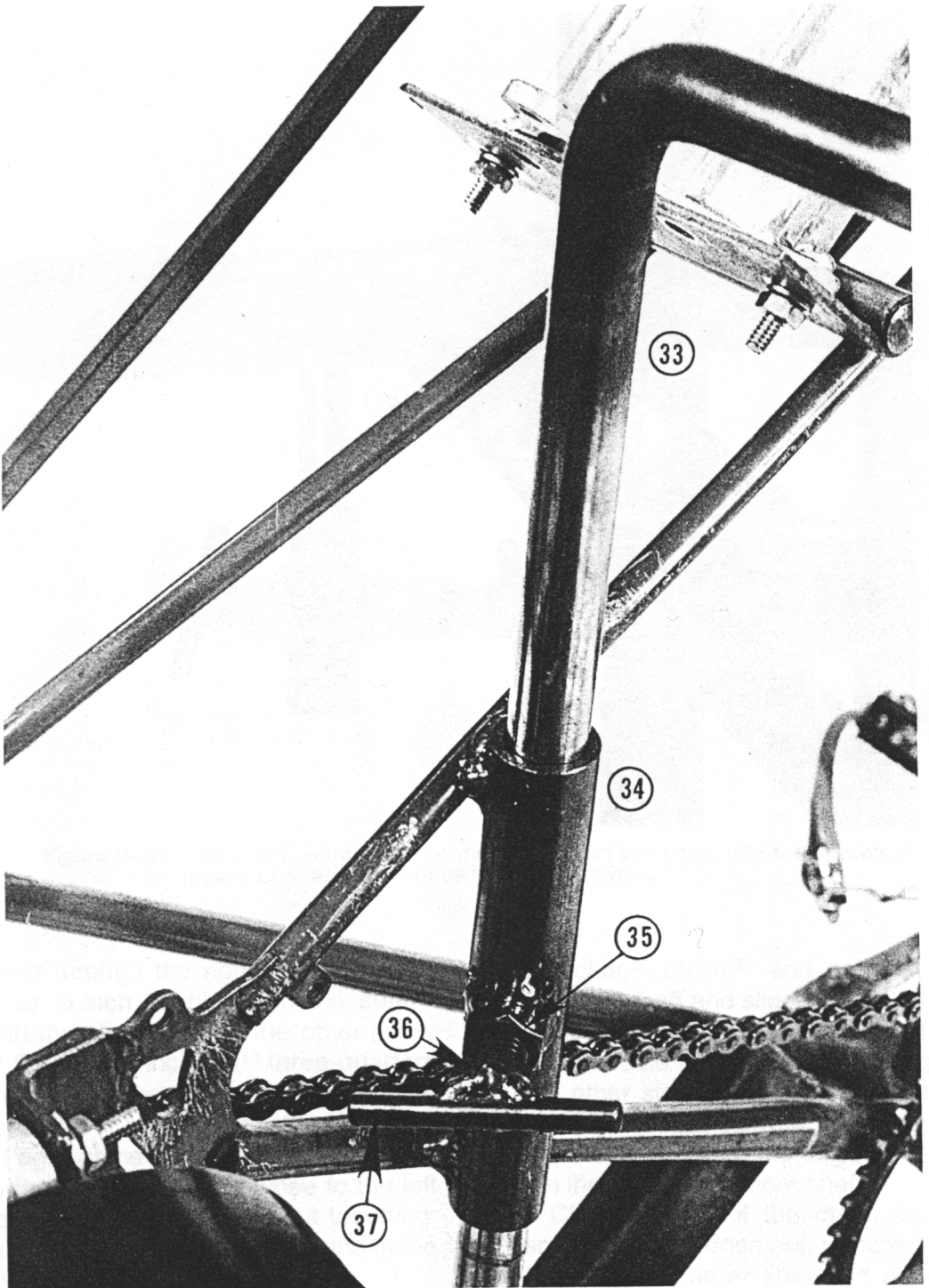


Figure 3-29 The table support bar is supported by a 6-inch length of tubing and locked in place by a hand-tightened "T-bolt."

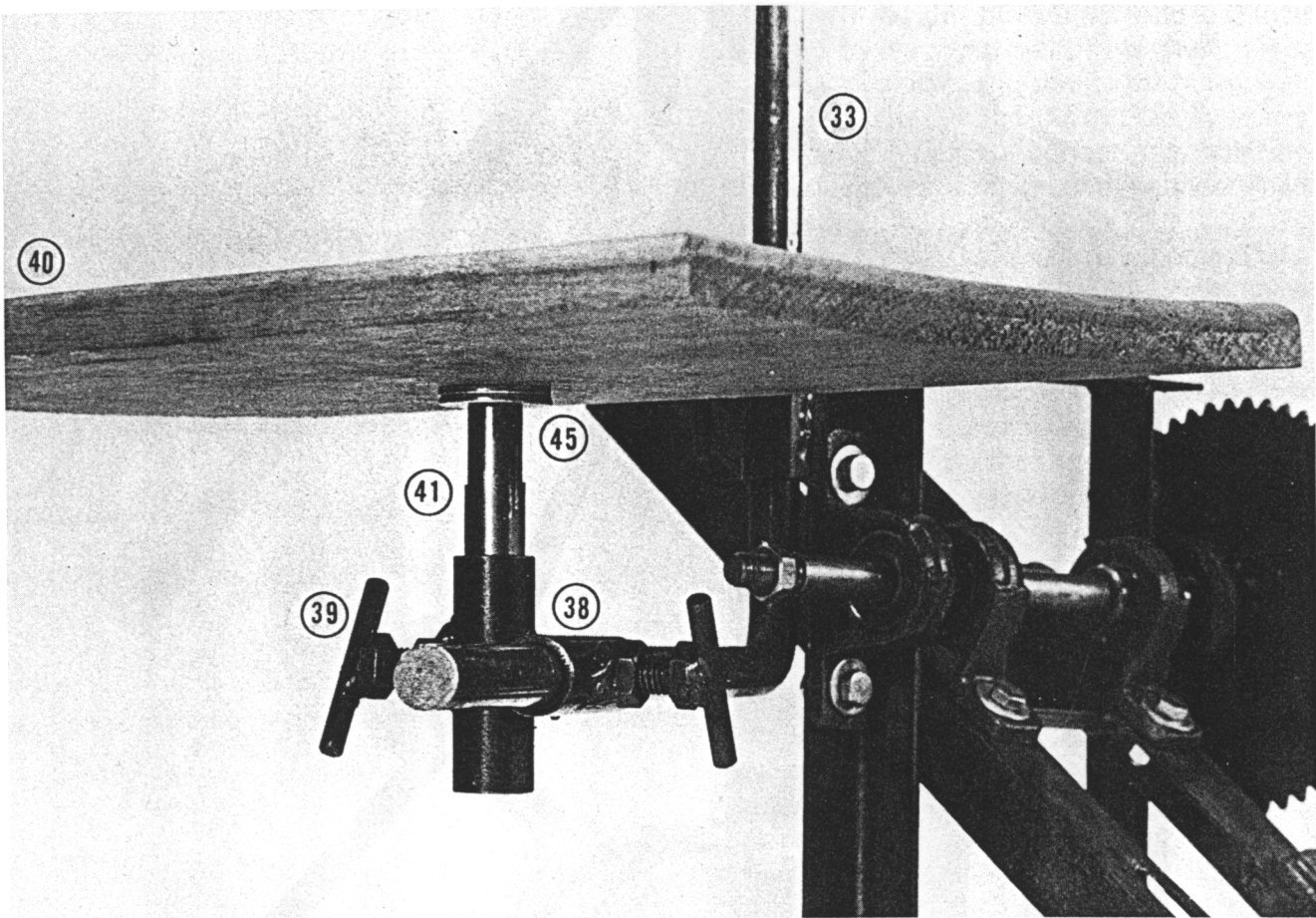


Figure 3-30 The table, which can be moved to most positions, offers a universal means of attaching various tools to the cycle.

steel shaft through the right pillow block.¹⁰ Place two 1/2-inch bushings on the shaft¹² and push the shaft through the other pillow block.¹¹ Screw a 1/2-inch nut¹⁴ three-quarters of the way onto the thread and screw the Jacob's chuck¹⁵ 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 block¹¹ as possible without touching. Place a step sheave¹⁶ 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 shaft¹⁷ through the right pillow block.¹⁸ In order, place a bushing,¹⁹

sprocket,²⁰ chain,²¹ and another bushing²² onto the shaft and slide the shaft through the other pillow block.²³ The threaded end is for a removable flywheel²⁴ and the right end for the other step sheave.²⁵ If the top sheave¹⁶ has been mounted with the small pulley on the inside, be sure the large sheave²⁵ 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 sprocket²⁰ can align itself. Then align all the bushings ^{13, 19, 22} and sheaves ^{16, 25} and file "flats" onto the shafts

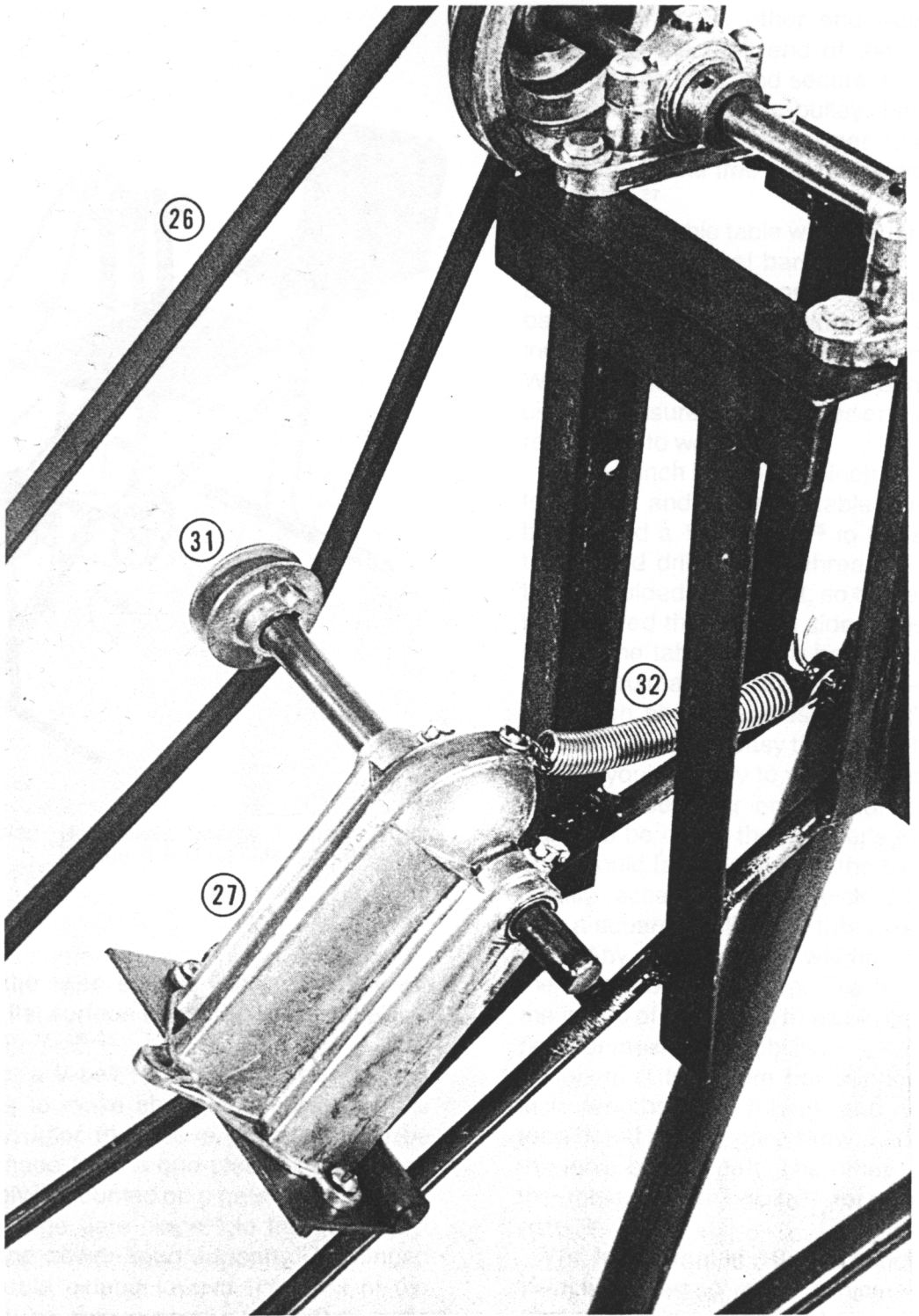


Figure 3-31 Research and Development personnel adapted a one-piece grinder shaft assembly to perform the task of an idler—a mechanism to remove slack from the V-belt.

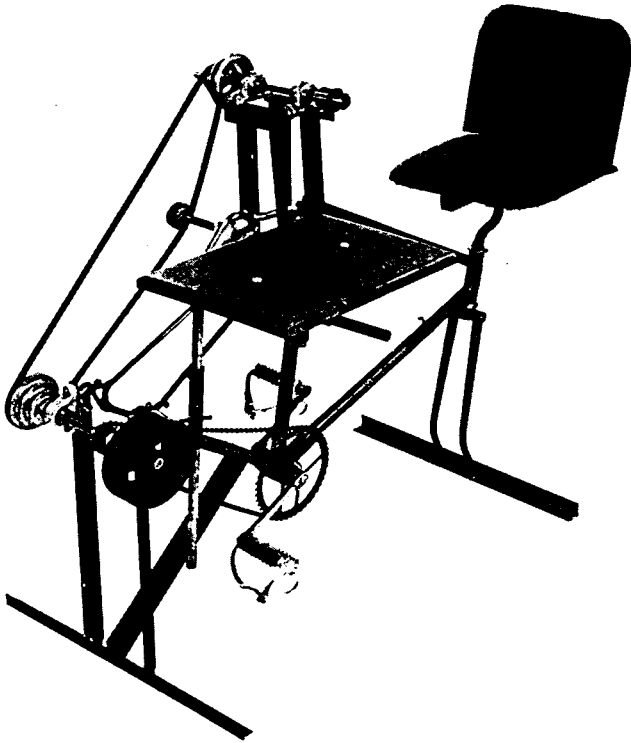


Figure 3-32 Homemade Energy Cycle built by Rodale R & D for less than \$60

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-belt²⁶ 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 assembly²⁷ mounted on a gate hinge.²⁸ First, weld a large gate hinge²⁸ 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 shaft²⁹ through the bronze

bushings³⁰ at the other end. Add a 2-inch pulley³¹ 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 spring³² from the former seat hole⁸ on the frame to the free end of the grinder shaft assembly.²⁷

The adjustable table will be supported by a 3/4-inch, 3-foot steel bar³³ 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 3/4-inch steel tubing³⁴ to support and guide the table bar³³ you just bent. Weld a 3/8-inch nut³⁵ to the side of the tube³⁴ and drill and tap threads through the tubing, guided by the nut, so that a bolt³⁶ 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 2 1/2-inch piece of 1/4-inch shaft³⁷ 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 lengths³⁸ 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-bolts³⁹ for the bar supports.³⁸

We found that a 16 × 11-inch piece of 3/4-inch hardwood made a nice table top.⁴⁰ Thread a 6-inch length of 3/4-inch steel rod 1 1/2⁴¹ inches.

Screw a 3/4-inch nut⁴² onto the rod, add a washer,⁴³ and insert the shaft through a 3/4-

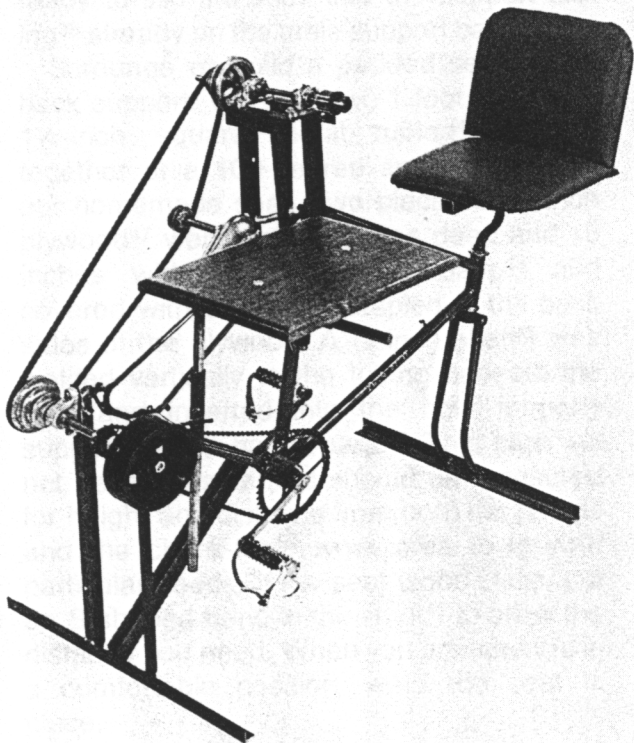


Figure 3-32 Homemade Energy Cycle built by Rodale R & D for less than \$60

inch hole in the table. Countersink a thin nut⁴⁴ and washer⁴⁵ when securing the shaft on the other side of the table. Now you are ready to slip the shaft into the support tubing³⁸ 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 tubing⁴⁶ welded together at a 100-degree angle to support our homemade seat. Two pieces of ¼-inch plywood⁴⁷ 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 shaft⁴⁹ 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 shaft⁴⁹ 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 flywheel²⁴ 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 bolting⁵¹ 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" lengths²⁴
- 1 5" length²⁵
- 2 4¾" lengths²⁶
- 2 7½" lengths²
- 2 18" lengths³
- 2 self-centering pillow blocks¹⁶

BICYCLE MOUNTS

The following lengths of angle iron:

- 2 14" lengths⁶
- 2 8" lengths⁷
- 2 7" lengths⁸
- 4 1½" lengths⁹
- 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 stock¹²
- 1 11" length of steel stock¹²
- 1 6" dia. wheel²⁰
- 4 bushings (optional, if pillow blocks without lodging screws)
- 2 54-tooth sprockets, #35¹⁷
- 2 12-tooth sprockets, #35¹⁷
- length of #35 chain²²
- 1 heavy-duty spring²³

TABLE (see other set of plans)

- 1 3-foot length of ¾" steel stock³³
- 1 16" × 11" × ¾" hardwood board⁴⁰
- 3 3" lengths of ¾" ID steel tubing^{34 38}
- 1 6" length of ¾" steel stock threaded 1½" on one end nuts, bolts, washers⁴¹
- 3 2½" lengths of ¼" steel stock³⁷

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.

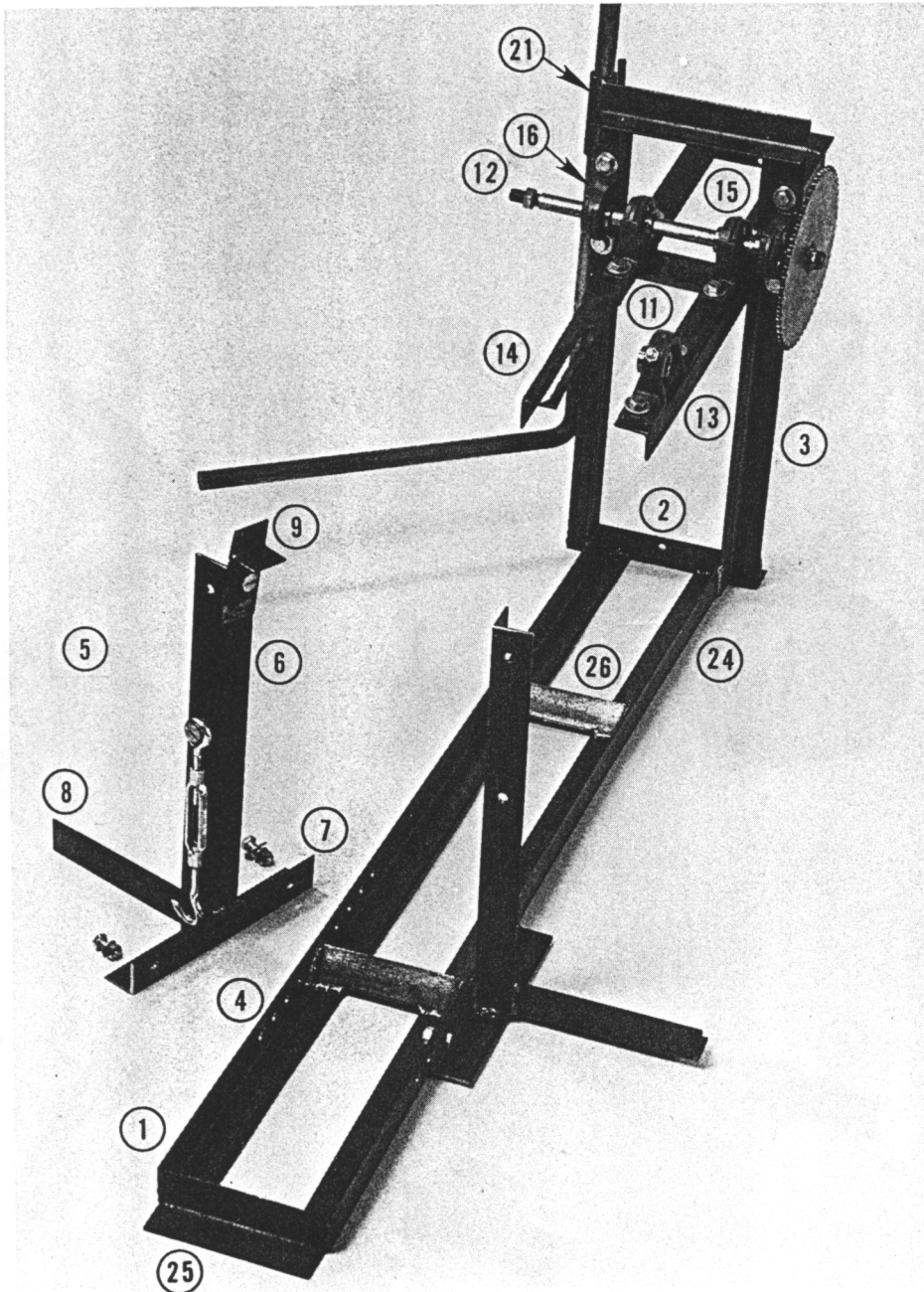


Figure 3-33 The rear-wheel adapter model consists of three components: floor frame and rear uprights, bicycle frame mounts, and spring-loaded power arm.

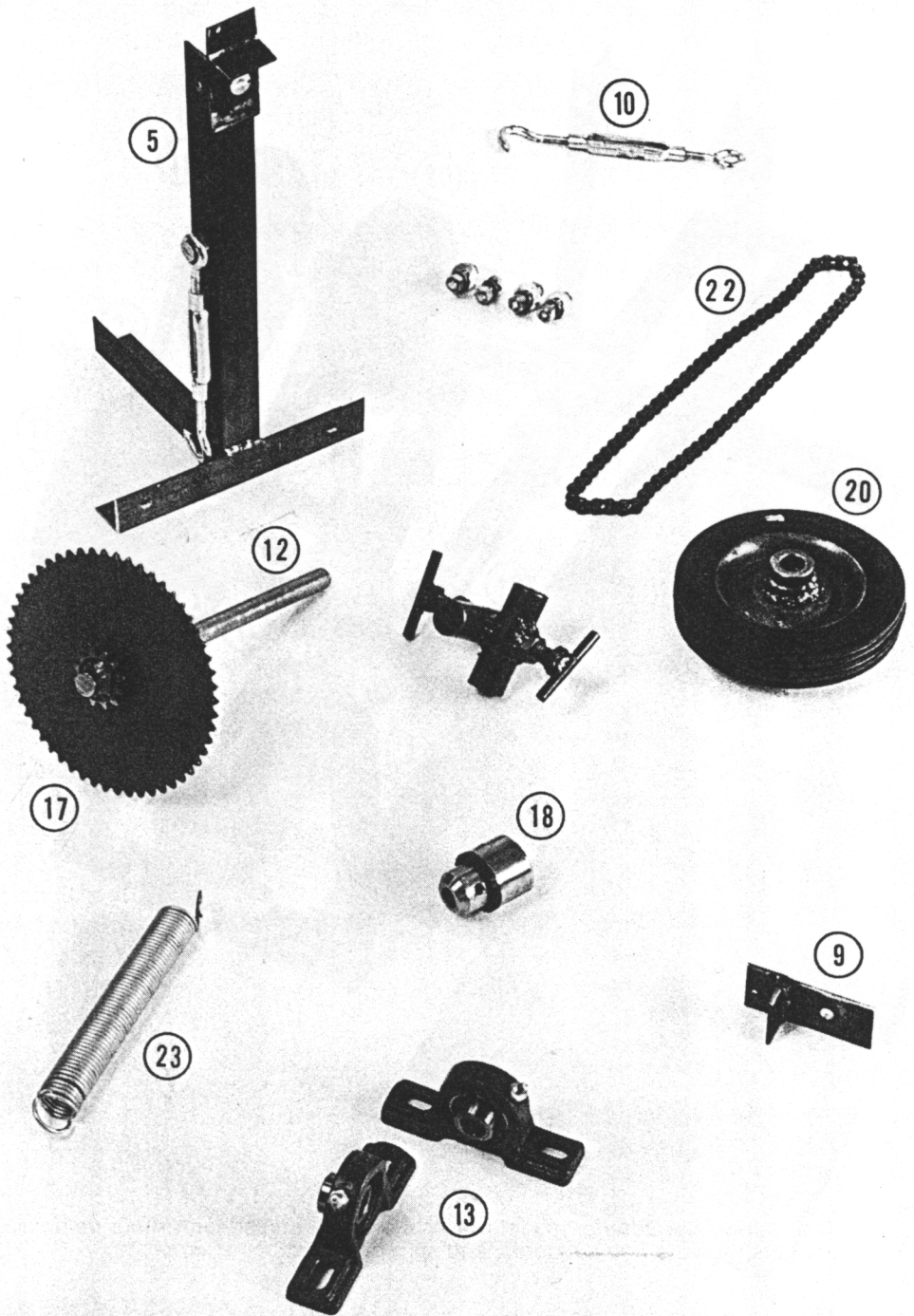


Figure 3-34 A few simple fabricated parts and some basic hardware make up the rear-wheel power adapter.

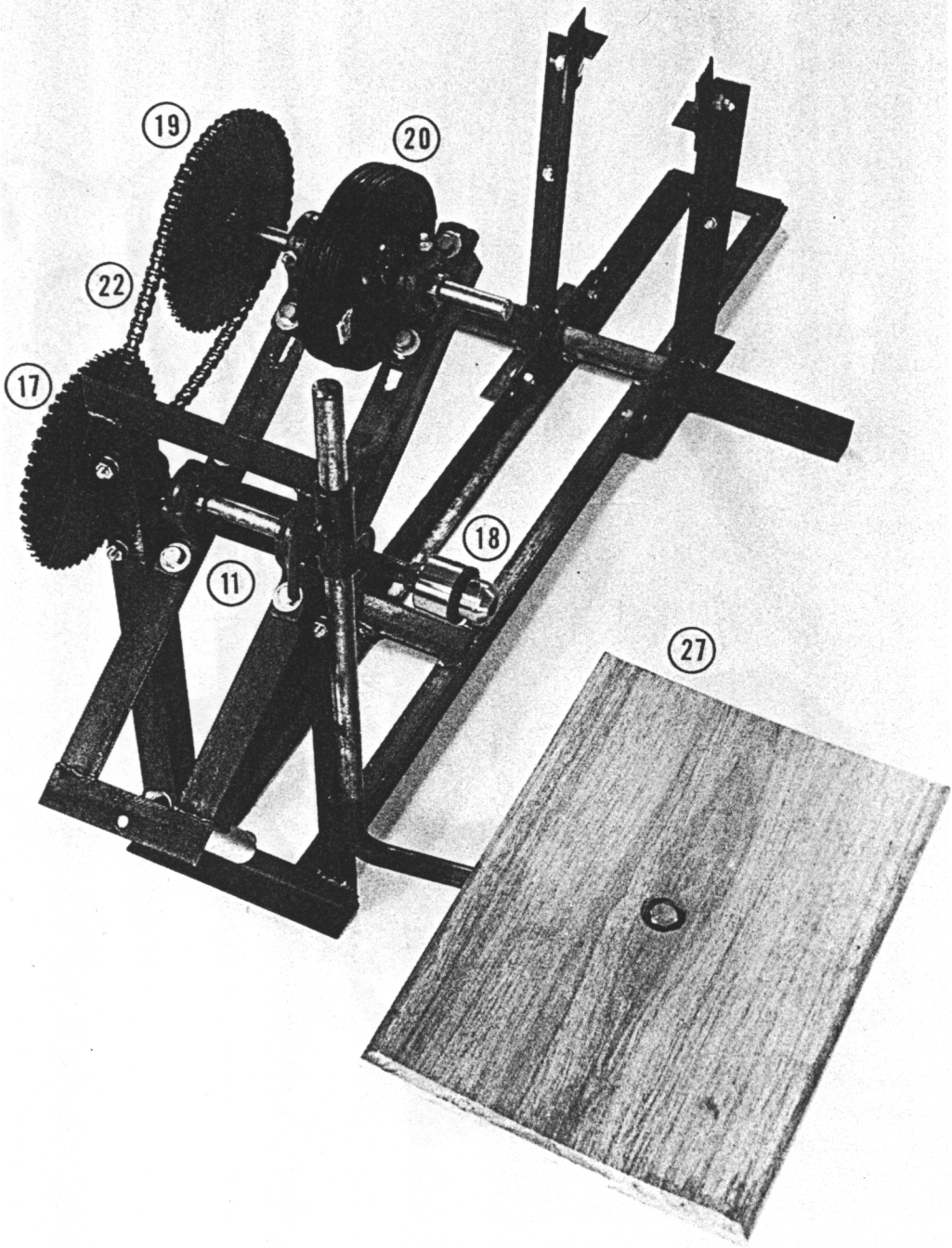


Figure 3-35 Attached to a five-speed bicycle, this prototype spun the chuck at a rate of over 5,000 rpm's.

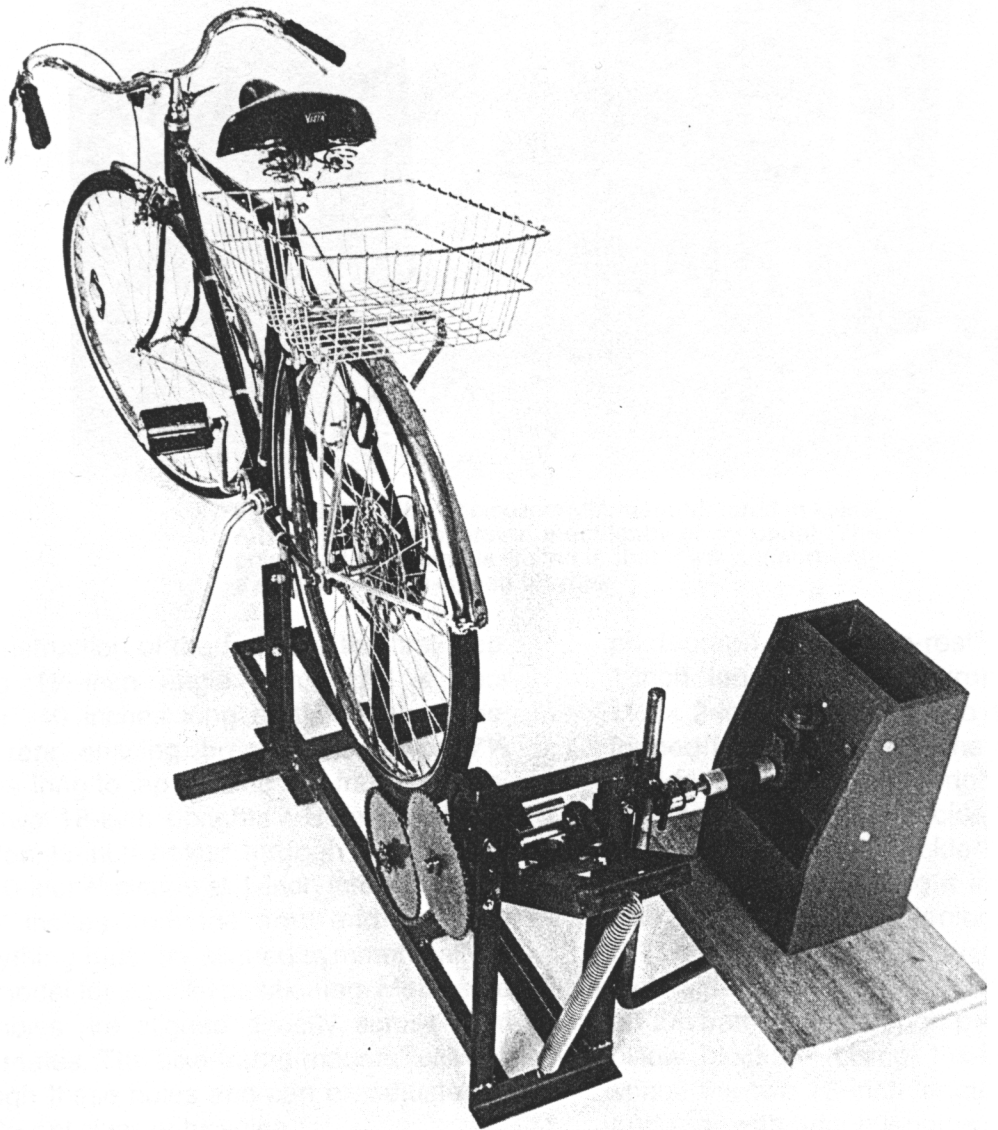


Figure 3-36 Bicycle rests on the two frame mounts and is secured in place with two turnbuckles. A converted electric grain mill sits on the adjustable table and its drive shaft is clamped inside the chuck.

Construction of the frame is the first step. Using 1¼-inch angle iron, build a floor frame¹ 40 inches long and 5 inches wide. The rear spacing brace² should be 7½ inches long to lap outside the frame to support two 18-inch uprights.³ Before welding, drill ten ¼-inch holes⁴ through the sides of the 40-inch²⁴ 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 mounts⁵ will bolt through these holes and can be adjusted to fit different sizes of bicycles.

To build each bicycle frame mount⁵ you will need a 14-inch upright,⁶ an 8-inch securing bar⁷ 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-rest⁹ 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 turnbuckle¹⁰ to the side of the upright. The turnbuckle¹⁰ should remain loose so you can swing it into place on the bike's frame before tightening.

The power arm¹¹ is an 18-inch-long, 5-inch-wide frame hinged slightly rear of center on the frame's rear uprights via an axle¹² 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 blocks¹³ at the front end of the power arm in slots¹⁴ rather than holes so the front pillow blocks¹³ are left adjustable. Center a second set¹⁵ slightly rear of center on the power arm and a third¹⁶ at the top of the frame's rear uprights.

Next you will need two axles¹² to fit the pillow blocks.^{13,15} Thread the end of one

with a right-handed thread¹² to fit the Jacob's chuck.¹⁸ Flush with the other end, weld a 12-tooth sprocket and a 54-tooth sprocket¹⁷ separated $\frac{3}{8}$ of an inch by washers. Place the axle¹² through the pillow blocks¹⁵ threaded end first and attach the chuck.¹⁸ The other axle¹⁹ should have the remaining sprockets welded in inverse order to those on the first axle. Placing a 6-inch wheel²⁰ between the pillow blocks,¹³ insert the axle¹⁹ 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 axles¹² 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 tube²¹ for this model will be welded high on the frame's rear uprights.³

For the finishing touches, adjust a chain²²

to fit the sprockets. You can loosen the left pillow block¹³ and loosen the chain²² to change gears. Next, drill holes for and attach a heavy-duty spring²³ between the rear end of the floor frame. This will keep the wheel²⁰ on the power arm firmly wedged against the rear bicycle wheel.

To use your new power adapter, push the power arm¹¹ to the floor (expanding the spring²³) 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 turnbuckles¹⁰ around to secure the frame in place and tighten. Let the power arm up¹¹ and align it against the wheel.²⁰ Fix your tool in the chuck,¹⁸ secure it to the table²⁷ 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.