the driving wheel to take the thrust of the spring. This spring should be about $1\frac{1}{4}$ inches in diameter and $4\frac{1}{2}$ inches long and should have a compression strength of about 150 pounds per inch. Two iron studs are fitted, as shown, to keep it from falling out. An iron lever forged out as illustrated and held by a brass lug with a $\frac{1}{2}$ -inch pin is used to raise the driving wheel off the ice, when starting the motor. It is necessary to have a spring arrangement as shown because if a rigid system were used the wheel or yoke would probably be wrecked if the driver should happen to hit a lump of ice projecting above the mean surface. To start, pull back the lever and slip in a small block of wood to hold it. When the motor is going remove the block and apply pressure on the ice by gently letting up on the lever, at the same time opening the throttle and advancing the spark. Build a cover over the wheel, of light pine, as shown, in order to keep out flying ice and afford protection from the mechanism.

The motor should now be installed, also the tanks and electric outfit. The water tank is mounted on a little platform as shown. It should be of light copper 12 inches wide and 22 inches long, 5 inches high at the back and tapering to $\frac{1}{2}$ inch forward. The gasoline tank is a copper cylinder 6 inches in diameter and 20 inches long, mounted on two posts fitted with saddles and secured by straps of sheet copper.

The spark coil may be hung on the side of the frame and the batteries likewise, as shown in Fig. 2.

Lead the exhaust down toward the ice so that the gases may pass under the sled. For the driving transmission use two sprockets about 8 inches in diameter with a $\frac{1}{2}$ -inch heavy motorcycle roller chain. The size of the sprockets will have to be determined by conditions, revolutions, and power of motor, etc.; but the dimensions given above should be about right for 7 horse-power at 800 revolutions; under which conditions the outfit ought to be doing something like thirty miles an hour. For paint, light gray or automobile red should present a neat finish.

WATER-JET PUMP FOR HOME USE.

BY H. B. DAILEY.

There are often occasions in home experience when a small self-acting pump of some sort for moving moderate quantities of waste water is of more than ordi-

WATER-JET PUMP FOR HOME USE.

nary utility, and there are few householders who have not at one time or another felt the need of such a device.

Perhaps the family rain cistern has become foul, and needs emptying of its remaining contents before it can be cleaned. A quantity of muddy water from our neighbor's lot on higher ground has found its way into our cellar during last night's storm, and we must wait patiently for its recession or resort to tedious hand bailing. The drain pool from the kitchen sink is full, but we dread the job of dipping it out by hand.

Then there are the laundry tubs to be emptied after washing is done; waste water from flushing the basement floor to be taken care of, and sundry other emergencies that present themselves when the advantages of regular sewer service are not to be enjoyed.

For such uses, where quantities of waste water are to be lifted a few feet, there is no form of self-acting pump so easily made and so cheaply operated as a water-jet pump, adapted to take its power from the house water-pressure service.

The illustration shows an efficient jet-pump made wholly of ordinary gas-pipe fittings. As its construction involves no machine work, the apparatus can be put together by the Handy Man in a few minutes' time.

The body of the pump, *a*, is a $\frac{3}{4}$ x $\frac{1}{2}$ x $\frac{3}{4}$ -inch gas tee, the larger end opening of which is closed by a $\frac{3}{4}$ x $\frac{3}{8}$ -inch gas bushing, *b*, into whose central aperture is screwed the pressure inlet tube, *c*, of $\frac{3}{8}$ -inch gas-pipe. The inner end of *c* is tapped out to receive the jet-nozzle, *d*, of $\frac{1}{4}$ -inch gas-pipe. The smaller end opening of the body receives the discharge tube, *e*, of $\frac{1}{2}$ -inch gas-pipe, whose length, to insure proper working, should be about 12 inches.

The jet nozzle, whose aperture is $\frac{7}{32}$ of an inch, is of such a length that its end reaches to within $\frac{1}{4}$ of an inch of the inner end of the discharge pipe. In forming the nozzle, it is first cut to the right length and screwed into the pressure inlet pipe, which can be then used as a handle for holding the nozzle while its end is being pointed down in the blacksmith's fire

to form the jet opening. The side opening of the tee receives the suction tube *f* of $\frac{3}{4}$ -inch gas-pipe.

To use the appliance, it is only necessary to connect the pressure inlet with the house water service and turn on the water. When the suction tube (which may terminate in a flexible rubber hose if desired) is dropped into a pool or tub of water, the water rises through *f* to fill the vacuum formed in the body of the pump by the rush of the jet through the discharge tube. The waste water mingling with that from the jet is carried forward and rapidly ejected.

The action of the pump is quite rapid and satisfactory, and experiments with it have shown that when the lift does not exceed six or eight feet, the quantity of water handled is considerably in excess of that required to run it. The pump should be used in a horizontal position, and the discharge should be allowed to empty freely into a funnel or sink.

METHOD OF DUPLICATING A TAPERED SPINDLE.

Mr. Charles Way, an expert mechanic, received a spindle without any centers and was asked to make a duplicate absolutely like the pattern. Using calipers was out of the question for accurate work on a

METHOD OF DUPLICATING A TAPERED SPINDLE.

taper; and having no socket to go by or centers in the pattern spindle, he devised a tapering gage by clamping parallel bars on a level bed piece. It can readily be seen that this is the best and surest way of doing the work. It is even better than having the socket, as one can examine the entire length of taper and note where any metal must be taken off.

SELF-READING BACK-LEVEL ROD.

When using an ordinary level rod in back-level work, the fact that H. E. (height of eye) has to be taken into consideration for every reading often leads to error.

While the rod described below can only be used by persons having the same height of eye, still its cheapness and simplicity will more than offset this.

Take a straight, well-seasoned piece of pine having

SELF-READING BACK-LEVEL ROD.

a cross-section about $\frac{7}{8}$ inch x 3 inches and of any convenient length, usually about 7 feet or 8 feet, and mark on it the H. E. as *A* in the diagram. Then divide it up and down as shown. It can easily be seen from the diagram how the rod is read. Instead of reading 6.4 feet, as with an ordinary rod, and subtracting the H. E., say 5.4 feet, to get the difference in elevation, the levelman reads 1 foot direct, which greatly simplifies the work. The rod reads direct going up or down grade.

HOW TO LINE UP THE CENTERS IN A LATHE.

BY H. D. CHAPMAN.

The accompanying drawing shows the way in which the tail stock of a lathe can be easily put in line with the spindle of the lathe. There are some lathes that do not have the taper attachment, and when sliding the tail stock out of line in order to cut the required taper it is a hard job to get the tail stock back in

PLUG FOR LINING UP LATHE CENTERS.

line with the spindle of the lathe. The line cut shows the way in which this can be done very successfully and quickly.

Male and female plug centers are made. These centers are made of tool steel hardened and ground to suit the taper in the spindle and the tail stock of the lathe. When the centers are to be lined up the plug centers are placed in position as shown. The centers are adjusted until the plug center will slip in the ring center of the tail stock. The centers are to be ground to a neat sliding fit; and when the tail stock has been adjusted to receive the center in the spindle, one can be sure the lathe centers line.

CUTTING A WORM WHEEL WITH A TAP.

BY J. A. BERSTROM.

The accompanying illustrations show how a worm wheel may be cut in an ordinary lathe without any gear-cutting attachment. It is only necessary to have an ordinary tap of the thread desired. The worm of course will be an ordinary screw with the same pitch as the tap. The blank of the wheel is made as shown in Fig. 2, and is mounted to revolve on a stud fastened to the tool post of the carriage. The

CUTTING A WORM WHEEL WITH A TAP.

tap is put between the centers of the lathe and made to revolve with the spindle by means of the usual lathe dog.

It is best to use a taper tap, although any of the taps will do. If the taper tap is used it is only necessary to set the tool carriage with the blank at the right-hand end of the tap as shown in Fig. 1, which is a plan view of a lathe ready to cut the wheel. The tap will just touch the blank, and as the tap revolves and begins to cut into the blank the latter will also revolve. The carriage is fed very slowly to the left, giving the tap ample time to cut the whole circumference of the wheel before the next move. It will now be seen that when the blank has been moved far enough to the left for the whole thread of the tap to be cutting, the wheel is finished.

For ordinary small threads it is not necessary to make the diameter any given size, as the thread of the tap will rectify it to the diameter, that is, it will always cut a fine thread by moving the blank closer to the center of the lathe.

INGENIOUS TUBE EXPANDER.

BY W. J. C.

A novel shop kink came under my observation some time ago by which some tubes were expanded in a header, where the only means of access to them was through a hole smaller than the tube itself. In Fig. 1 *L* represents the header and *K* the tubes, *J* being the hole left for cleaning out, afterward to be plugged up.

A tube *A*, Fig. 2, with a flange on one end, was

NOVEL EXPANDER FOR TUBES.

turned just small enough to enter *J*, and in the end of it were cut three slots *B*. In these slots the expanding rollers *C* fitted. They were supported on small pins *D*, on which they turned freely, the latter being riveted to a flat spring *E*, which was in turn fastened to *A*. The tendency of the springs was to bring the rollers into the center of the tube. The taper pin *F*, pointed at one end *H*, in order to press the rollers apart, had a parallel portion *G*, which acted as a guide. The flanges on the tube *A* also acted as a guide by being kept hard up against the header *L*. By the use of this tool both ends of the tube were expanded, and the use of right and left-hand threads obviated. On the taper pin *F* being withdrawn, the springs brought the rollers within the outer wall of the tube *A*, and permitted the entire apparatus to be taken out through the small hole *J*.