



The Editor of Handy Man's Workshop will be glad to receive any hints for this department and pay for them if available.

ANNOUNCEMENT.

The editor of Handy Man's Workshop has been flooded with inquiries about the home-made vacuum cleaner described in the issue of November 7. Many have expressed doubts as to the practicability of such a system, but we desire to assure our readers that the cleaner described is highly efficient. One of them has been installed near this city, and has been in constant use for some time, giving perfect satisfaction.

Owing to the widespread interest in this subject, we have asked the author to give us a second article answering the many questions of our readers. This article will appear in the next issue of Handy Man's Workshop.

LET THE CLOCK OPEN THE FURNACE DRAFTS.

BY H. L. WHITEMORE.

Most furnaces are nowadays arranged so that the drafts can be operated from the living rooms above, but still require the personal attention of some shivering member of the household, before dawn on cold winter mornings, if the house is to be comfortably warm by breakfast time. Undoubtedly much irritability and fatigue, if not actual sickness, can be traced to the strain of this early rising under the most unfavorable conditions.

It is a very simple matter, which anyone could undertake successfully, to so arrange an alarm clock that it will control all the drafts and dampers and open them at any desired time in the morning. If it is absolutely necessary to shake down the fire, remove ashes, and add fresh fuel, the problem is a much more difficult one, far beyond the strength or capacity of the dutiful alarm clock. Most furnaces, however, can, with a little experience, be so left the night before that on opening the drafts in the morning they will burn up rapidly and soon have the house at a comfortable temperature. Fresh fuel, unless absolutely necessary, actually delays the heating up of the house and is much better added later, when the demand for heat is not so urgent.

The apparatus comprises a base-board fitted with two screw eyes, through which the usual chains are passed. Hinged to the board with a pair of staples is a U-shaped lever, with one arm about 5 inches long and the other just long enough to catch the chains. The lever is located far enough above the screw eyes to allow for the proper opening and closing of the drafts. The screw eyes are not placed directly under the short arm of the lever, but on either side, so as to prevent the chains from kinking and catching on the hooks when they are released by the lever.

The alarm clock, which furnishes the brains for this apparatus, may be supported on a long hook or nail, and others bearing against the feet on each side will prevent it from swinging sidewise. Some people, who desire unbroken dreams, will turn the gong or bell upside down to put it out of the reach of the fiendishly energetic clapper, but that is an unimportant detail which may be left to personal taste and preference.

The clock, intended for a hard physical job like this, must have the alarm winding key so arranged that it unwinds when the alarm "goes off." There are a

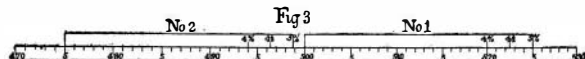
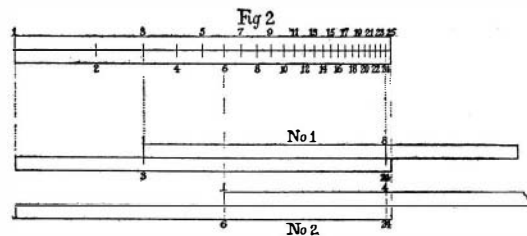
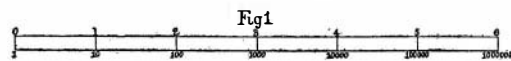
number of clocks on the market of different shapes and sizes which are made with this important feature.

To prevent chafing of the cord, unscrew this winding key and slip on, back of it, a thick cardboard washer. Then connect the key and wire lever with a piece of cord and the contrivance is ready for operation. After setting the clock, the cord should be wound onto the key in winding the alarm. Then the chains are hung in place on the lever. When the alarm "goes off" the lever turns on its pivot, releasing the chains and permitting the usual weight to drop and thereby open the drafts and damper. If the furnace is not arranged with a weight for operating the draft the chains may be connected directly to the key by a cord which will be wound up on the key as the alarm goes off.

HOW TO USE THE SLIDE RULE.

BY FREDERIC R. HONEY, TRINITY COLLEGE.

In comparatively recent times, the slide rule—whose value as an aid to rapid computations had been fully appreciated by the actuary, the engineer, and



SOME PRACTICAL USES OF THE SLIDE RULE.

the architect—had not made its way into general use, owing partly to the cost of manufacture. At the present time, the instrument is constructed in a way so adapted to the needs of the business man, and at a cost which brings it within the reach of everyone, that it has become an indispensable possession of many who are engaged in commercial affairs.

A clear understanding of the fundamental principle of this valuable invention will make plain some of the many ways in which it may be practically applied. The illustrations here given are very much simplified, in order that a knowledge of the principle may be easily grasped. The parts composing the slide rule may be described as graphic representations of logarithms; i. e., the lengths of the measurements on the scale are proportional to the logarithms of the numbers which they represent.

Thus the scale, Fig. 1, which may be made of any convenient length, and may be assumed to represent the number one million, is divided into six equal parts from 0 to 1; from 1 to 2, etc. The number is indicated on the lower edge of the scale, and its logarithm on the upper edge: The logarithm of 1 = 0, of 10 = 1, of 100 = 2, etc. This scale may be extended indefinitely, and if the logarithms of the intermediate numbers are marked upon it, the process of multiplication may be performed by addition; that of division by subtraction; a number may be raised to any power by multiplication; and any root may be extracted by division. Thus if it is required to multiply 100 by 1,000, add 2 to 3 (the logarithms of these numbers) = 5; and the product 100,000 is found under 5 (its logarithm). Two divisions on the scale are added to three divi-

sions. If it is required to divide 10,000 by 1,000, three divisions on the scale are subtracted from four divisions, and the quotient is represented by one division or 10. The fourth power of 10 is found opposite 4; i. e., the number opposite 10 or 1 is multiplied by 4, which is the logarithm of 10,000. The cube root of 1,000,000 is found opposite 2; i. e., 6 (the logarithm of 1,000,000) is divided by 3; and the required root is 100. In the slide rule all of these operations are performed mechanically.

Fig. 2 represents two scales graduated alike, on which are shown the logarithms of numbers from 1 to 25. These scales may be made of any convenient length provided the representations of the logarithms are correctly proportioned. They may be obtained from any table of logarithms; and the unit may be assumed as large or as small as we please. In these scales the number is marked against the graduation instead of its logarithm.

A very simple example will illustrate the way in which the scales may be used for more complex computations. Find the value of the fraction $\frac{3 \times 8}{4} = 6$.

Move the upper scale into position No. 1, bringing one end opposite 3 on the lower scale; and the reading opposite 8 on the upper scale is 24 on the lower scale. This operation is performed by adding the length of log 8 to that of log 3; and the sum is log 24, the logarithm of the product. Now move the upper scale into position No. 2, so that the graduation 4 is opposite 24 on the lower scale; and the reading opposite the end of the upper scale is 6 on the lower scale. In the second operation log 4 is subtracted from log 24; and the difference is log 6, the logarithm of the quotient. The logarithms of 2, 3, 4, and 5 are respectively one-half of the logarithms of their squares 4, 9, 16, and 25; i. e., the square of a number is found by doubling its length on the scale; and conversely the square root of a number is one-half its length. The cube of a number is three times its length; and its cube root one-third; the fourth power is four times; and the fourth root one-fourth, etc. The scale may be extended indefinitely; and products, quotients, powers, and roots of any numbers may be measured upon it.

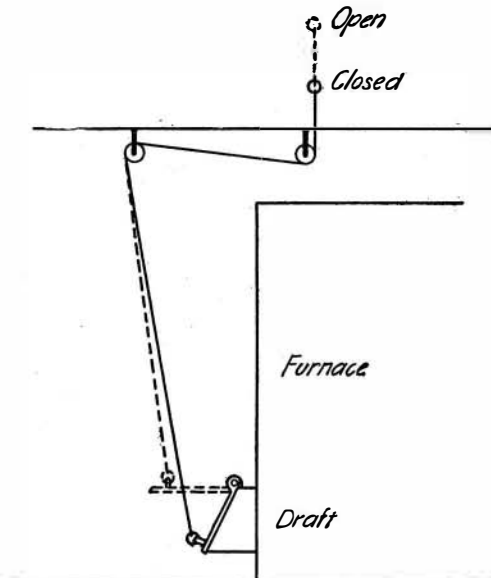
AN INTEREST AND DISCOUNT SLIDE RULE.

A useful application of the logarithmic measurements is found in a scale for the rapid determination of interest and discount. A portion of it is shown at Fig. 3. Let the numbers 470 to 530 on the lower scale represent these numbers of dollars. The lengths are proportioned to the logarithms of the corresponding numbers. The measurements are supposed to be made from a point beyond the limits of this page; but that part of it which is here shown, is determined without reference to this point. Its length is the difference between the logarithms of 530 and 470; and the positions of all the graduations on the scale are determined in the same manner. The scale may be made of any convenient length provided the proportions are correctly maintained; and the graduations may be carried out to any fraction of a dollar.

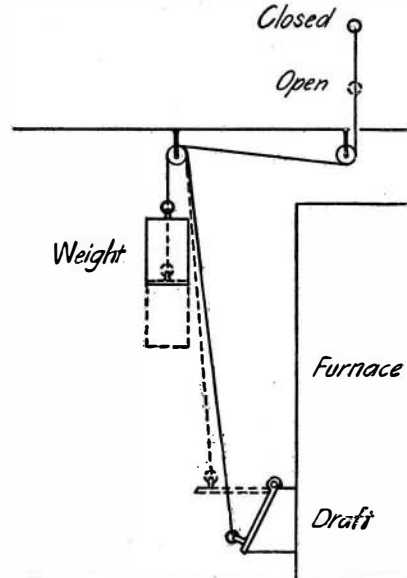
The upper or sliding scale is graduated for interest and discount. The lengths between the zero point—the logarithm of 1—and the points marked 4 per cent, 4½ per cent, and 5 per cent, represent the logarithms of 1.04, 1.045, and 1.05. This scale may be expanded indefinitely. For example: if the length for 7 per cent is required, the measurement is the logarithm of 1.07. While the scales may be made of any convenient length representing the logarithms of the numbers marked upon them, it should be noted that the same unit of measurement must be adopted in both scales. If it is required to find the amount, i. e., the sum of the principle and interest at a given rate per cent, the zero



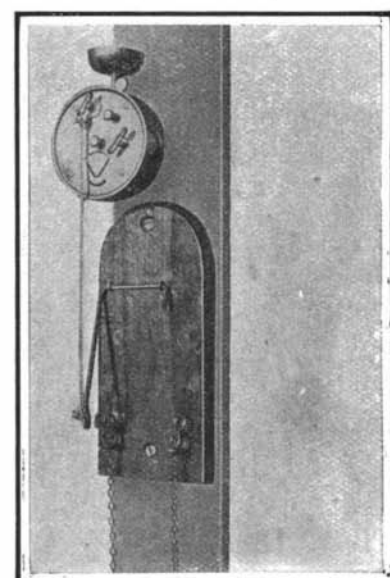
Drafts closed, alarm set.



Drafts directly connected to alarm key.



Arrangement with counterweight to open drafts.



Chains released, drafts open.

LET THE CLOCK OPEN THE FURNACE DRAFTS.

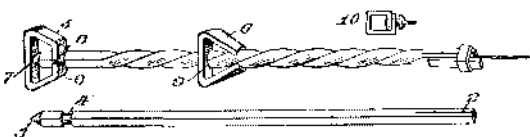
point of the sliding scale is placed opposite the reading for the principal and the amount is found on the lower scale opposite the rate per cent graduation on the sliding scale. The zero point of the sliding scale (No. 1) is opposite 500 (dollars) on the lower scale; and the readings opposite 4 per cent, $4\frac{1}{2}$ per cent, and 5 per cent are respectively \$520, \$522.50, and \$525. These amounts, which might have been obtained by multiplication, are determined by addition. For example: $\$500 \times 1.05 = \525 . By the scale the logarithm of 500 is added to that of 1.05. The same position of the sliding scale illustrates the method of determining the present value of a sum of money due at some future date. The present value of \$525 at 5 per cent; of \$522.50 at $4\frac{1}{2}$ per cent; and of \$520 at 4 per cent is \$500. Each of these values is obtained by placing the percentage graduation on the sliding scale opposite the amount on the lower scale; and the reading \$500 is opposite the zero point on the sliding scale.

No. 2 shows how the interest on any other sum of money is determined. The principal is \$475, and the rate per cent is 4. The zero point of the sliding scale is placed opposite 475, and the reading opposite 4 per cent is 494. This example also illustrates one in discount. If the graduation 4 per cent is placed opposite 494, the reading opposite the zero end of the upper scale is the present value, viz., \$475. An interest and discount scale may be advantageously constructed in segments. The desirability of doing this will be evident from Fig. 2, in which the spaces between the graduations rapidly diminish. A different unit may be assumed in each segment, provided the same unit is adopted in the construction of both scales for that particular segment. The interest and discount slide should be graduated for every rate of interest at which money may be loaned. To make it available for general use, it should also be graduated at intervals of one-half of one per cent, to include computations in interest and discount for short intervals of time. For example we will suppose that it is required to find the present value of a sum of money due three months hence at 6 per cent per annum. The graduation on the sliding scale which would be used in determining the discount would be that for $1\frac{1}{2}$ per cent, or one-fourth of the rate of interest. The measurements from the zero point should be the logarithms of 1.005, 1.01, 1.015, 1.02, 1.025, etc.

SIMPLE DRIVER FOR SMALL DRILLS.

BY L. G. HANDY.

In an emergency the writer made a drill driver as follows: A piece of $\frac{3}{16}$ -inch square brass wire about 10 inches long was slit at one end with a hack saw,



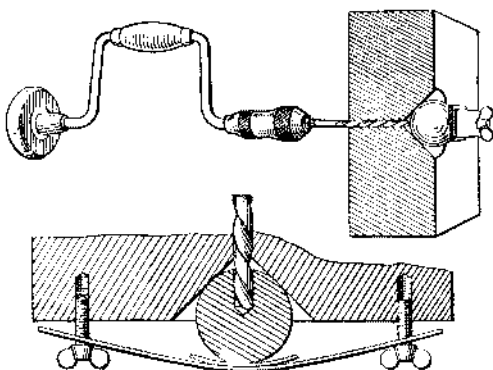
DRIVER FOR SMALL DRILLS.

as at 2. The opposite end was filed to a blunt point 3. About $\frac{1}{2}$ inch from this end a round section 4 was filed. From a piece of sheet brass a swivel 5 and the slide 6 were formed. The swivel was made with a socket 7 to receive the point. Notches 8 were filed to fit the round section. The slide was formed with a square hole to fit loosely on the wire. The lugs of the slide were slightly concaved to permit displacement. By holding one end of the wire in a vise and gripping the other with a wrench, the wire was twisted. A ring and wedge, as illustrated, formed an effective grip for the drill. A more practical grip might be made, as shown at 10. The two ends of this ring should be soldered. A slot might be filed in opposite sides of the twisted wire to receive the ring and prevent it from dropping off. This driver has done good service for nearly two years.

DRILLING HOLES IN MARBLES.

BY J. O. BROUILLET.

Recently a man came to the writer and wanted a hole put through the center of some marbles. The accompanying sketch gives an idea of the way the work was accomplished. Through a piece of soft steel $2 \times 3 \times 1$ inches a hole was drilled of the size of the



A METHOD OF DRILLING HOLES IN MARBLES.

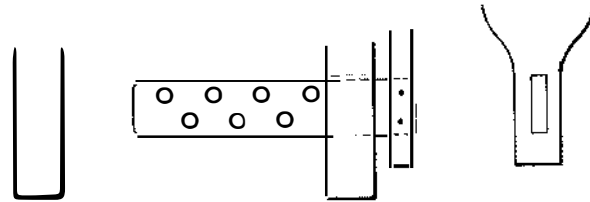
one wanted in the marbles. Then with a countersink a conical aperture was made in one side as illustrated. Two tapped holes, one above the other, below the aperture, admitted a pair of thumb screws that secured a flexible strip made from the spring of an eight-day clock. On the strip next to the marble which was seated in the conical aperture a piece of emery cloth was placed. The whole was then held in the vise and the marble was easily bored.

FURNISHING THE WORKSHOP.—I.

BY I. G. BAYLEY.

THE WORKBENCH.

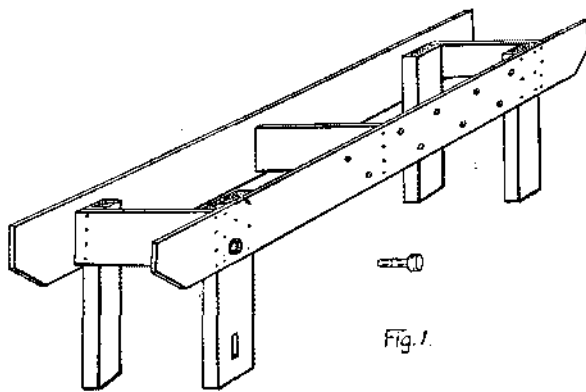
In the article on the Construction of a Workshop (SCIENTIFIC AMERICAN, November 21, 1908) we showed a workbench attached to the wall, thus saving time and



DETAILS OF THE HEEL OF THE VISE.

labor in making it; but a stationary workbench is not always desirable, especially if there is no permanent shop for it. The standard size of a joiner's bench is 12 feet in length and 2 feet 9 inches in height and width. This size is altogether unnecessary for home purposes, and in particular for a boy or young man. From 8 to 9 feet in length, and about 32 inches high is a convenient size. Mechanics sometimes test the height by sitting on the front edge of the bench sideways, with one foot dangling over the side, which should just touch the floor.

If the planking and supports are made of yellow pine, a sound solid bench will be the result. In any case, the top front plank should be of this material, the rest can be of white pine or hemlock. The vise

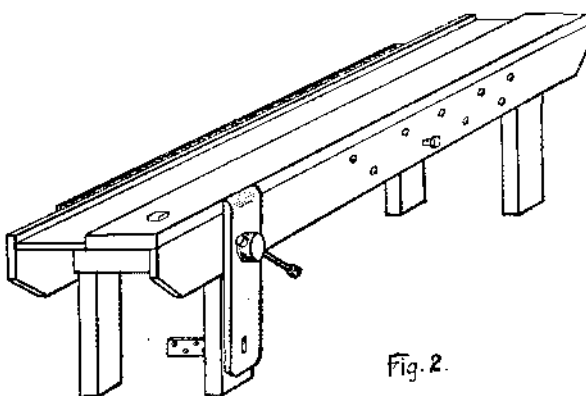


THE SKELETON FRAMEWORK OF THE BENCH.

should be of oak, the screw being purchased at any hardware store for about fifty cents.

Referring to Fig. 1, three of the supports are made of 3 by 4-inch timber, 30 inches high. The one at the vise is 3 inches by 6, of the same length. Care should be taken that the bearing surfaces are true, and the posts set up level. The slotted hole, or mortise, at the bottom of the vise post, should be cut before the post is set up, but the round hole for the screw can be made when the bench is complete. The mortise is made by boring two $\frac{7}{8}$ -inch holes 2 inches apart, vertically, and cutting out the wood between with a flat chisel. The ends, top, and bottom can be left round, or squared up with the chisel, as illustrated.

Cut three short lengths of 1 by 10-inch boards, 23



THE BENCH COMPLETE WITH VISE AND TOOL RACK.

inches long, and nail two of them across the tops of the posts or supports as shown. Set them up on end, and nail the front board, or apron, which is 9 feet in length, to the forward posts, spacing the latter 1 foot from each end. The top edges of the front board and the three cross pieces are brought up exactly level with each other, but the back board, which is 12 inches deep, is nailed to the posts, with the top edge 2 inches above. The top of the bench consists of two planks, 12 inches wide by 9 feet in length. The front plank is 2 inches in thickness, and should bear evenly

along the top edge of the front board, or apron, which supports it. The board at the back is only 1 inch thick, and like the rest of the bench, can be made of cheaper and lighter timber. With the exception of the tool rack, the bench can be put together with 8-penny or $2\frac{1}{2}$ -inch wire nails. The 2-inch thick plank should be nailed down with 10-penny flooring nails, or nails having finished heads, which must be driven in below the surface with a nail set or punch.

The tool rack can be made from $\frac{1}{2}$ -inch stuff, about 2 inches wide, running the full length of the bench, or cut off within a foot or so of each end. Partitions can be made of the same wood, spaced from 1 to 3 inches apart, to suit various sized tools. A strip of wood nailed across the top edge of the back, and furnished with a number of different-sized bored holes, will answer the purpose just as well.

While there are many different kinds of vises on the market, it is safe to say the old style, as shown in cut, is very generally used, and it has the advantage of being easily rigged up and inexpensive. Procure a piece of oak, $1\frac{1}{2}$ inches thick, $7\frac{1}{2}$ inches wide, and about 30 inches in length, for the movable jaw of the vise. A hole for the screw is bored in the middle, 9 inches from the top, and a mortise for the guide is made in the lower end, after being marked off from the one in the 3 by 6-inch post of the bench. Corresponding holes for the vise screw are to be bored through the apron and the post, a trifle larger than the screw. The guide is made from hard wood, 18 inches in length, cut to easily fit the hole in the bench post, but having a driving fit in the vise jaw, to which it is secured by toe-nailing. Sometimes the jaw of the vise is tapered at the lower end, as shown in the detail view, when the guide can be secured by driving nails through the sides. The guide is furnished with holes evenly spaced, as shown, and a peg provided, similar to the one shown in Fig. 2, for the apron or front board of the bench.

The apron is provided with holes and a peg, to rest the free end of a long plank upon, when being worked in the vise. A suitable bench stop is put in the planing board of the workbench. Various designs are on the market, which can be easily attached, but a very good one can be made by using a 2 by 2-inch piece of oak, a foot in length. A hole is cut about 9 inches from the end of the bench, and the stop must have a driving fit, being raised or lowered by hitting it with a hammer. This is much better than the metal stops, since there is no possible chance of injuring the tools. The nut of the vise screw is secured to the inside face of the 3-inch by 6-inch post, to prevent its revolving when adjusting the vise.

When the vise is set up, the top can be planed true and level with the working face of the bench, slightly rounding off the corners. The 2-inch plank should be planed up true, and no work done upon it which will break up the surface. Any rough work should be done on a board placed on top of the bench.

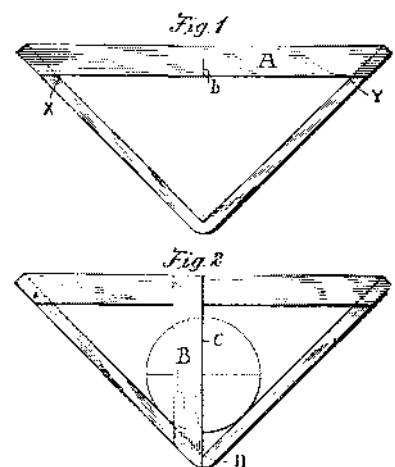
The workbench is now complete. It is a convenient size, and can be easily taken out through an ordinary door, and when it comes to moving, there will be no necessity to leave it behind, or knock it to pieces to get it out of the shop.

(To be continued.)

DEVICE FOR FINDING CENTERS OF ROUND WORK.

BY M. D. SWEET.

This little device if carefully made will enable one to accurately determine the centers of round bars, disks, and in fact any object of a circular form. A piece of $\frac{3}{16}$ -inch square brass rod about eight inches long is bent to form approximately a right angle, both legs being of equal length. A strip of brass, A, about $\frac{3}{8}$ inch wide and $\frac{1}{16}$ inch thick is soldered to the ends of the legs. Equidistant between points X Y make a mark b. Another brass strip B of same size as A is soldered in place as shown, being careful to have edge C exactly on the line b and over the angle D. Fig. 2 shows method of using the device. Simply place it on the end of the bar or shaft; make a mark with scratch awl; give a quarter turn, and make another mark. The intersection of the lines will give the exact center.



DEVICE FOR FINDING CENTERS OF ROUND WORK.