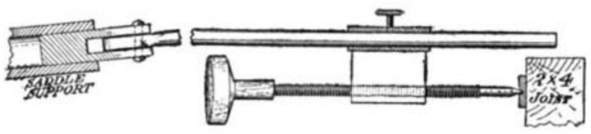
AN EASILY CONSTRUCTED EQUATORIAL MOUNT FOR SMALL TELESCOPES.

BY PROF. R. W. WOOD, JOHNS HOPKINS UNIVERSITY, BALTIMORE.

In the course of some experiments which I have been making at my summer laboratory in East Hampton, Long Island, on the photography of the moon in ultra-violet light (=3,100—3,200) it became necessary to provide an equatorial stand with a slow-motion screw for accurate following. As a polar axis is often desired in a hurry for special work, and as there are doubtless many amateurs who sometimes feel the need of such a stand, it seems worth while



THE SLOW-MOTION SCREW.

to give a short description of a very efficient, though hurriedly improvised, one which I constructed for my purpose.

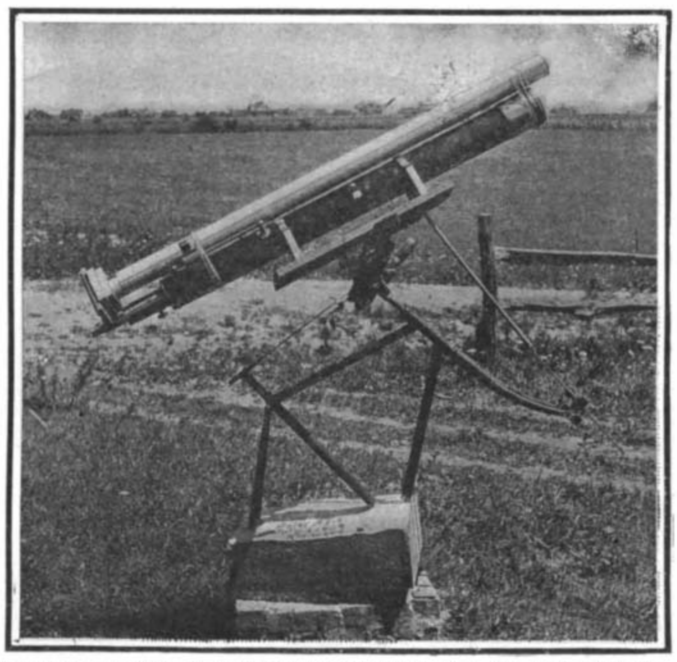
It was made from the frame of a discarded bicycle, the bearings of the steering rod being, however, in good condition, with little or no lateral movement. The wheels, sprockets, saddle, etc., were removed, and the frame stood up in a wooden box, in such a position that the steering axis was approximately at the latitude angle. The box was then filled with Portland cement (1 part cement with 3 parts of clean sand and sufficient water) which was allowed to solidify. The larger places were filled with bricks and rock fragments to economize the cement. A day or two is sufficient for the solidification, after which the box can be knocked to pieces, leaving the frame rigidly mounted in a solid and very massive block. This block was placed on a small brick pier and the adjustment of the polar axis made by blocking up one end of the cement base. A short piece of 2 x 4-inch joist was lashed to the handles of the bicycle with strong wire, which served as a support for the declination axis. The rest of the stand is to be designed according to the use to which it is to be put. In my own case I required merely a device which would enable me to keep my quartz telescope pointed accurately at the moon for two minutes. From odds and ends which had accumulated in my shop the arrangement shown in the illustration was built. A short plank was mounted on the 2 x 4 on a horizontal steel axis turning in brass bearings. To the forward end of the plank a rod was fastened which passed through a wooden block clamped between the lower ends of the front forks with a small bolt. This block could be turned to suit the elevation of the telescope, and the rod fastened with a "set-screw," shown by an arrow in the picture.

Slow motion about the polar axis was accomplished by a brass rod, hinged to a larger piece of rod which fitted into the T tube which formerly carried the saddle. A small piece of brass tubing was soldered to a small piece of ⅛-inch sheet brass, through which passed the slow-motion screw, sharpened to a point and turned by a small wooden wheel, made from a spool (indicated by an arrow). The brass tube and screw could be clamped at any point on the long brass rod by means of a set-screw. The point of the slow-motion screw turned in a small conical pit in a piece of brass fastened to the end of the 2 x 4 joist. The weight of the instrument being carried on the handles, that is, above the polar axis, the instrument always tended to turn (by gravity) upside down, except when pointed at the meridian. This it was prevented from doing by the pressure of the point of the slow-motion screw; and by turning the screw either forward or backward according to whether the instrument was pointing east or west of the meridian, a very uniform rotation about the polar axis was secured. A diagram of the slow-motion screw is given in the accompanying line drawing.

The instrument was set approximately in the meridian by sighting the pole star in line with the edges of the two front tubes of the diamond frame. The proper elevation of the polar axis was secured by trial, observing whether, in following the moon, it moved up or down in the field of the telescope. In half an hour I got the thing in such shape that I could keep the center of a small crater on the point of intersection of the cross hairs of the telescope for ten minutes, and as this was more than the required accuracy I let it go at that. The instrument as constructed works admirably except when pointed at the meridian. On passing the meridian the slow-motion screw is carried over to the other end of the 2 x 4 joist, this movement being allowed by the hinge at the end of the rod. When accurate following is not necessary, that is, when it is merely necessary to keep the object in the field, a more convenient arrangement would be a brass cog wheel attached to the steering rod below the handles, and turned by a worm wheel: this would obviate the trouble when crossing the meridian. It would not, however, give such uniform motion as the arrangement described, unless accurately and carefully made.

For mounting a small telescope any device can be used which will permit the instrument to swing up and down in a plane.

It is quite remarkable how well the old bicycle frame lent itself to the construction of the stand. The front forks which hold the "elevation" fixed, and the saddle tube for supporting the slow-motion rod, could hardly be improved upon if made for the purpose.



EASILY CONSTRUCTED EQUATORIAL MOUNT FOR TELESCOPES.

ALTERNATING CURRENT EXPERIMENTS.

BY FREDERICK E. WARD.

Students and amateurs who like to make electrical experiments are particularly fortunate if they have alternating current lighting service in their homes, as the alternating current lends itself especially well to the performance of easy experiments that are at the same time both amusing and instructive. Of the many kinds of experiments that may be made with simple apparatus there are perhaps no others that are more interesting than those which illustrate the principles of the rotary magnetic field and its application to electric energy meters and to induction motors.

For making the necessary apparatus there are required two similar laminated iron rings about 3½ inches inside diameter, 4½ inches outside diameter, and ¾ inch thick. These may be built up by coiling up a sufficient length of thin sheet iron strips, cut ¾ inch wide, using a round wooden block to start on. Compact iron wire bundles of about the same dimensions may be substituted with good results, or, better than either of the above, rings made up of a sufficient number of thin sheet-iron punchings. After the rings are made, all sharp edges should be rounded off with a file and a smooth covering of cotton tape be applied as shown in Fig. 1, *A*.

If there is any choice between the two rings, select for the field the one that comes nearest to being a true circle on the inside. For the winding on this ring use No. 23 or No. 24 double cotton-covered magnet wire. Have the wire on a spool small enough to pass through the ring easily, and begin at any point such as *B*, Fig. 1. Wind the wire in a single layer, with turns as smooth and close as possible on the inner circumference, until exactly one-quarter of the latter has been covered. Next reverse the direction of winding as shown at *C*, Fig. 1, and cover the second quarter of the ring by passing the spool through in the opposite direction, after tying down the little loop at *C* with a piece of thread. Make similar reversals at the half and three-quarter points, and cut off the wire near the place of beginning. This completes one-half of the winding. The second half is to be wound on top of the first half, and is to be similar in all respects except that the place of beginning must be shifted to a point 45 deg. away, as at *D*, Fig. 1.

The second ring, which is for a reactance, is to be wound with 600 turns of magnet wire of any size larger than No. 20. This winding must not have any reversals in it, all of the turns being passed through the ring in the same direction.

Lay the two rings down flat on a piece of board and make connections to a 110-volt 60-cycle supply circuit as shown in the diagram in Fig. 1, where *S* indicates a snap switch or knife switch, and *L, L, L, L* four 16-candle-power 110-volt lamps. When the switch is closed, current flows through the two windings on the field ring in such manner as to produce four magnetic poles that are not stationary but rotate

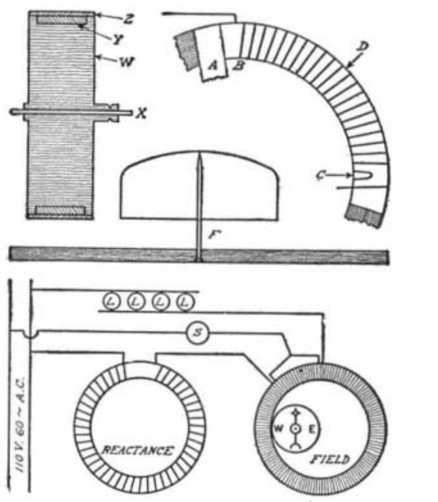


Fig. 1.—DETAILS OF THE EXPERIMENTAL APPARATUS.

or progress around the ring 1,800 times per minute. A pocket compass placed close to one side in the field as shown will rotate at this speed and illustrate the principle of the synchronous motor, in which the magnetized rotor is dragged around by the rotating magnetic poles of the field just as positively as if it were geared directly to the dynamo. If the compass be placed close to the ring on the outside, it will turn in the opposite direction. The field can be reversed by exchanging the connections to either one of its two coils.

To show the poles made by the field, lay a sheet of white paper on the ring and sprinkle some fine iron filings on it while the current is on. It is not so easy to show the movement of the poles in this way, but it may be done as follows: Shake some very fine iron filings through a piece of cloth on a sheet of paper, and then hold up the latter by one corner. The larger particles will slide off, and only the very finest will cling fast like dust. Lay the paper on the ring while the current is off, and close the switch for the briefest possible moment. Do this several times in succession, and considerable movement of the particles will be observed.

Drive a large pin through a piece of wood as shown in Fig. 1, *F*, and balance on the point a brass box cover or bell so that the latter is free to turn. If the magnetic field be then placed around the bell, the latter will be slowly dragged around by reason of the eddy currents set up therein, and will illustrate in part the principle of the driving mechanism of some forms of integrating wattmeters. Observe how the speed of the piece of brass varies in proportion to the number of lamps that are lighted at *L*.

If an iron (tin) box cover be substituted for the brass one the speed will be higher and the pull more vigorous, illustrating the principle of the induction motor. If an empty tin can be thus supported in the field, it will be rotated with considerable force and soon get off the pin. Fig. 2 shows how the field may be supported in a vertical position and provided with a better rotor, from which it is possible to get enough power to drive light toys. The details of the rotor are shown in Fig. 1, where *W* is a turned wooden support provided with a small shaft *X*, and having in its periphery an iron hoop *Y* over which is slipped a copper hoop *Z*. To be efficient the rotor must be made of a diameter as large as possible without touch-

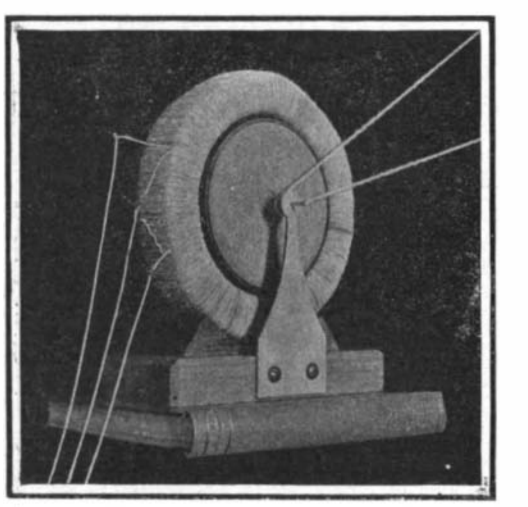


Fig. 2.—ALTERNATING CURRENT MOTOR.

ing the windings of the field. It should be made to run true, and turn easily on its shaft.

The performance of the above experiments and of others that will be suggested by them can be made more interesting by studying the reasons why from some good textbook on the elements of alternating currents, to which the reader is referred for a fuller explanation of the principles involved.

DEVICE FOR REMOVING WOOD SCREWS.

BY JAMES PATERSON.

In the Handy Man's Workshop department of July 31st, a device for removing wood screws was described which struck me forcibly. Another device for the same purpose has been designed by William Laycock, a weaving section hand in the Arlington Mills of Lawrence, Mass. Quite often screws in the shuttle springs for holding down the spindle will break, and the difficulty formerly was to get out these screws with-

DEVICE FOR REMOVING WOOD SCREWS.

out injury to the shuttle, so Mr. Laycock bethought him of an old screw-driver spindle, cut the point off, and then with a hacksaw cut two grooves in it at right angles as indicated in the illustration. The grooves were made as wide as possible and fairly deep, leaving the edges sharp. In use the tool thus prepared is pressed against the broken piece of screw and digs into it sufficiently to permit of turning and thus removing the screw.

MENDING A BROKEN METALLIC FILAMENT.

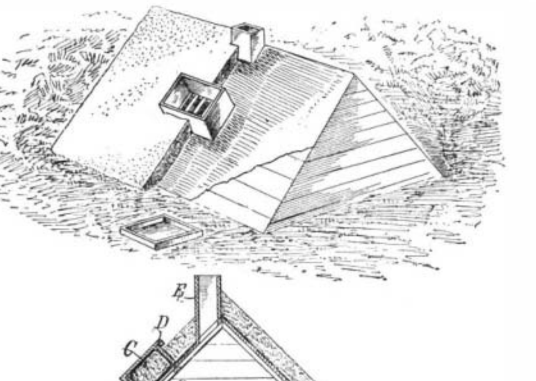
BY HOWARD W. NICHOLS.

A carbon-filament incandescent lamp, when the filament breaks, is of no further value, but in the case of a tungsten or tantalum lamp it is often possible to mend the filament so that the lamp will be nearly as good as new. Place the lamp with the broken filament in a socket which is connected to the lighting circuit by a flexible lamp cord. Turn on the current and gently shake the lamp so that the broken ends of the filament will strike against the main part, and draw a small arc which will weld them securely to it and thus allow the current to pass through the filament, lighting it up brighter than before breaking. This mending process usually cuts out only a small section of filament; but if a comparatively large portion of the filament should happen to be cut out of the circuit, it would reduce the resistance of the remaining filament to such an extent that an excessive current would flow and thus soon burn the filament out. However, while it lasted, the lamp would give a very bright light.

A SIMPLE FRUIT CELLAR.

BY F. A. KAISER.

Doubtless many readers of the Scientific American have found it difficult to keep apples and the produce of their gardens, such as carrots, beets, turnips, celery, etc., in perfect condition until they could be used. The accompanying drawings show a cheap and easily made fruit cellar in which I kept twelve bushels of apples, besides carrots, squashes, and potatoes, from October until April. My house was six feet wide, eight feet long and six feet high, and cost me



A SIMPLE FRUIT CELLAR.

about $4. Smaller ones can be built for a proportionally smaller sum.

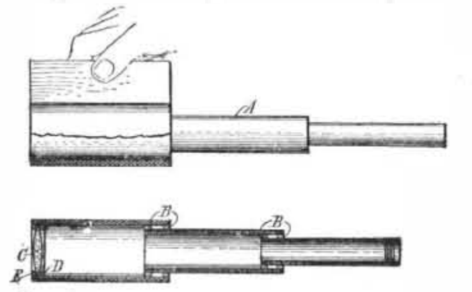
I dug a hole about eighteen inches deep and set the house over it, as shown in the cross section. The entrance is made like a box, about twelve inches deep, so that soil or manure can be spread over the roof to a depth of about ten inches. Cleats *A* on the inside of the opening hold slats *B* at the bottom of the box opening. In the space *C* I stuff an old tick filled with straw or leaves. Outside cover *D* protects the tick from moisture. The rafters should be about two inches square, or 1 x 3. Provide a chimney, *E* (of wood), which must be stuffed with straw during zero weather. The chimney is not absolutely necessary, as the house can be ventilated through the door during mild weather. The proper slant for the roof is about 45 deg., as earth can be packed on at that slope. Cover the roof with a cheap grade of building paper, or with newspaper, before putting on the earth, but do not use a paper that has a strong smell, like tar paper.

I have had this house in use now during three winters, and it has saved me more than its cost every year. Apples and vegetables keep fresh and plump in it, and do not shrivel up as they will in an inside cellar.

HOW TO MAKE A PAPER TELESCOPE BARREL.

BY C. R. M'GAHEY.

The making of a paper telescope barrel is shown in the accompanying illustrations. First we make a wooden mandrel, *A*, that represents the various reductions in the barrel of the instrument. These portions of the mandrel are made of such diameters as to bring the interior of the barrel to the proper size. Wrap on a layer or so of paper having a dull black finish so as to keep down any reflection of the rays of light on the interior of the instrument. When several layers of this paper have been carefully applied, Manila paper such as used by draftsmen in making pencil drawings should be laid on over it. It is understood that this paper is laid with glue between each layer, and this can be done to best advantage with the wooden mandrel placed between lathe centers. When the paper has been wrapped on to a thickness of about ¼ inch we shall have good substantial tubes. The exterior may be varnished or covered with cloth or paper of fancy pattern. The stop pieces are simply rings laid on as shown at *B*. When these stop rings have been placed in position the ring *E* is applied and glued fast, after which the lens is fitted against it and a second ring *F* is applied to hold it in place.



A PAPER TELESCOPE BARREL.

These rings must be of dull black finish. The eyepiece may be applied in the same way. This makes a most excellent case for a telescope.

RESTORING A DRY CELL.

BY DR. EDWARD M. HANSON.

Having experienced a great deal of trouble with the usual small cell batteries, such as are used for medical wall plates, gasoline engines, etc., I have experimented until I have discovered a very simple method of restoring the ordinary dry cell sal-ammoniac battery. My method is as follows: Midway between the carbon and zinc at the top of the battery drill a hole 3/16 inch in diameter down to within 1½ inch of the bottom of the cell. On the opposite side drill a hole through the sealing wax covering 1/16 inch in diameter and 3 inches deep. Place a small glass funnel in the large hole with the stem at least 2 inches long. Into this pour one ounce C. P. hydrochloric acid. After this is thoroughly absorbed pour in the funnel one ounce of water. When all is absorbed, seal the holes with ordinary stationer's sealing wax. After twelve hours it will be found that the batteries so treated will work with increased voltage and amperage over a new dry cell. They will work well on either closed or open circuit and have from four to six times the life of a new dry cell. I am using a series now that I employed in my office for three years, and during that time have renewed them three times. The batteries will work until the zinc pole is completely exhausted if the chemical elements are kept at the required strength by renewal.

THE HANDY MAN'S SUB-CALIBER GUN.

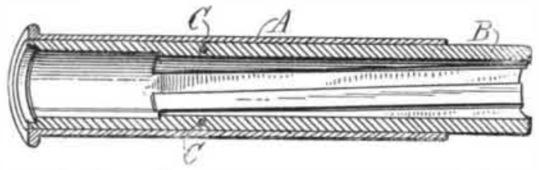
BY AUGUST MENCKEN.

Those familiar with heavy artillery know that subcaliber work forms a very important part of the drill. Very accurate work can be done by this method, but of course the range is very much shortened and the recoil and noise are missing.

Anyone having a large-bore rifle, such as the old model Springfield, and wishing to use it for short-range or gallery shooting, can sub-caliber it very easily in the following way:

Take an empty regulation shell and bore out the head so that its inside diameter will be the same throughout its length. Then take a 0.32 caliber 3-inch revolver barrel—the hexagonal kind used in cheap revolvers is good enough for this purpose—and turn it up until it fits in the shell snugly but not so tightly as to swell the shell. Then carefully chamber the barrel to take the 0.32 cartridge. Great care must be taken in doing this, as the accuracy of the gun depends greatly on this part of the work. Next countersink the revolver barrel, *B*, so that the head of the 0.32 will lie flush with the head of the regulation shell *A*, as shown in the illustration. If this is not done the breech will not close and the shell may be accidentally exploded. Pins, *C*, should then be driven through the shell and barrel to keep the latter in place. This will not be needed if the barrel and inside of the shell are slightly tapered, the taper increasing from the muzzle end to the breech.

For ranges from 25 feet to 100 feet this method will



THE HANDY MAN'S SUB-CALIBER GUN.

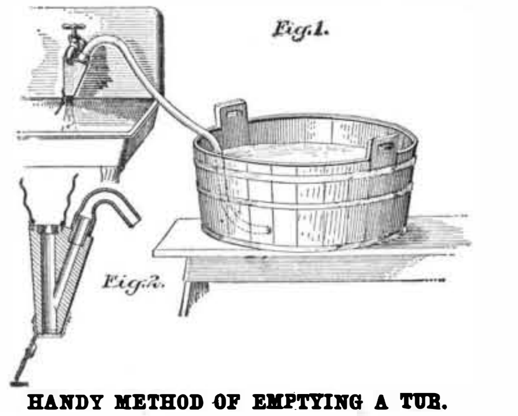
work very well, and if the rifle is built so that a longer barrel could be inserted, of course its range would be increased.

A DEVICE FOR EMPTYING A TUB.

BY C. W. FAIRBANK.

Considerable difficulty is often experienced in emptying and refilling the common form of movable washtubs. Stationary washtubs are usually provided with suitable plumbing connections whereby the water may be easily and quickly drained off, but with the ordinary form of wooden movable washtubs the entire tubful of water must either be lifted and carried to the sink or other drain to empty it, or the water must be bailed out of the tub and carried to the sink or drain by the pailful. The lifting of the tubful of water is often a physical impossibility, and the carrying of the water from the tub to the sink by the pailful is a tiresome task. If the house be provided with running water at the sink, a very simple contrivance may be devised for utilizing the city water pressure for the emptying of the tub. By providing a simple form of ejector at the faucet and connecting one inlet of the ejector to a short piece of hose leading to the sink, the water may be very easily drawn out of the tub into the sink, even though the latter be at a higher elevation. In the accompanying sketch, there is shown a simple contrivance of this character, in which the ejector is formed of a block of wood adapted to be detachably secured to the faucet. The ejector includes two passages intersecting at an angle and having a common outlet as shown in section in Fig. 2. One of these passages receives a stream of water under pressure from the faucet, and the escape of this water from the lower end of the ejector tends to draw water out of the tub through the hose and to deliver the latter to the sink.

The same device may be used for refilling the tub. To secure this object, it is merely necessary to close the lower end of the ejector with a plug or in any other suitable manner. As shown, a short rubber plug is connected to a strap tacked to one side of the block. By inserting the plug within the open lower end of the passage and securing the free end of the strap to a button on the opposite side of the block, as shown in dotted lines, the water will be caused to flow from the faucet down through one passage and



HANDY METHOD OF EMPTYING A TUB.

up through the other to the hose and thence to the washtub.

An interesting experiment to determine whether the strength of iron and steel was affected by magnetism was carried out at the Technical Institute of Belfast with the following reported result: Bars of mild steel and wrought iron 8 inches long by ½ inch to 1 inch in diameter were used, part of which were magnetized by being saturated in a solenoid. When tested, the elongation of the magnetized parts decreased 3 to 16 per cent, and the average breaking load seemed to be increased.