LABORATORY APPARATUS

I. A SIMPLE ELECTRIC THERMO-REGULATOR

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ONE FIGURE

The electric thermo-regulator here described is the result of several years of sporadic experiments. The object was to design an instrument that could be readily built by any laboratory technician; that could be run on an ordinary lighting circuit without the use of a relay, condensor or other apparatus of that sort; that would be more positive and less subject to fluctuations due to jar than the mercury column; and finally that would be more accurate than a bi-metallic regulator. It is believed that this instrument fulfills many of these requirements.

The principle is simple. It consists of a walking beam actuated by an ether tambour. The expansion of the tambour forces down the reach of the walking beam so that the consequent raising of the other reach breaks the electric circuit. Figure 1 gives the details of its construction. The whole apparatus should be built of brass with the exception of the steel pin which acts as the bearing of the walking beam, and the platinum-iridium contact points which are forced under pressure into the ends of the walking beam and adjustment screw. The dimensions given may be varied to suit the convenience of the material at hand although the measurements given have been found to be the most satisfactory.

The most difficult part of the construction is the ether tambour. While it is possible to make it in a well equipped shop it will be found more satisfactory to purchase a thermostat manufactured by the Banner Incubator Company, Baraboo, Wisconsin or a Newtown thermostat manufactured by the Giant Incubator Company. A good mechanic, however, can spin a tambour provided he has a speed lathe available. The method is as follows: In the end grain of a hard wood block a series of concentric grooves and ridges of semi-circular cross section are worked. Then by fastening a sheet of thin soft brass against the wood block, the whole being fastened to the face plate of the lathe, the soft brass can be worked into the grooves. Two plates are crimped in this manner, cut into circular disks slightly larger than the diameter of the tambour and soldered gas tight over a spreader plate.

The assembled instrument should be supported upside down in the constant temperature box or room, that is to say, it should be fastened to the sidewall with the wooden base up and the instrument hanging down so that gravity will keep the long reach of the walking beam pressed against the contact adjustment screw. The expansion of the ether then depresses the short arm, raises the long arm and breaks the circuit. Two adjustments are provided so that any temperature within the range of the heating element may be maintained.

Almost any electric heating apparatus from simple batteries of carbon lights to an electric radiator may be used with complete satisfaction. Where large spaces are to be heated it will be found best to have sufficient heat on all the time to keep the temperature up to

within 5° of the required temperature, the regulator being then cut in on a circuit with a sufficient heating element to readily raise the temperature the remaining 5° .

In installing this instrument the most satisfactory result will be obtained if the box or room is thoroughly insulated from the surrounding temperature. For ordinary paraffine work in the class room or research laboratory, a tight, thick-walled wooden box serves admirably. Such an oven with inside dimensions of 12 by 12 by 18 inches is especially adapted for paraffine work since a temperature of 54° on a shelf placed just above the heating element gives a temperature on a shelf 6 inches higher that will flatten our paraffine sections and dry them. A small room may be kept at a constant temperature provided the heat elements are scattered throughout the floor of the room.

With well insulated walls any given space can be maintained at a constant temperature with less than 0.5° of variation. Little work is required to keep the apparatus in good working order; it is only necessary at intervals to clean the platinum contacts.

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II. AN AUTOMATIC AIR PRESSURE VALVE

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ONE FIGURE

Those who have had to depend upon the ordinary means for applying air pressure for injecting such as a hand or water pump, recognize the difficulty of accurately regulating the pressure or maintaining known constant pressure over any length of time. The essential feature of an apparatus used in this laboratory for several years which accomplishes the above object is the automatic air pressure valve described below (fig. 2).

The valve consists of a piston working against a spring within a cylinder and connected with the lever of an air cock. The air from the reservoir, under high pressure, is led through the air cock to the rear of the cylinder and forces the piston outward, compressing the spring, which partially shuts off the supply of air through its connection with the lever of the cock.

The pressure valve was made from a steam radiator air valve. The base is unscrewed from the bowl, the parts within removed and a spring and piston inserted into the bowl. The spring is of No. 14 brass wire, coiled $\frac{3}{4}$ inch in diameter and $1\frac{3}{4}$ inches in length. The piston is of leather, fastened to the piston rod by a nut above and below it. The piston rod is of $\frac{1}{8}$ inch round brass, $3\frac{1}{2}$ inches in length, threaded for $\frac{1}{2}$ inch at the end to which the piston is attached and for $1\frac{1}{4}$ inches at the other end, which is fastened to the connecting rod. The vent of the air valve is enlarged to allow the piston rod free play. A connecting rod of $\frac{3}{32}$ inch round brass, $2\frac{3}{4}$ inches in length, with a sharp right angle bend $\frac{1}{8}$ inch long at each end, is fastened to the piston rod by a link at one end and to the lever of the cock at the other. Both ends are burred to hold them in position. The link is made of brass, $\frac{1}{16}$ by $\frac{3}{8}$ by 1 inch in size, bent in the middle at an angle of 90° . A hole in one end admits the connecting rod, allowing free sideways motion. Through a hole in the other end, the piston rod is passed and clamped by a thumb nut on each side. By shifting these thumb screws along the piston rod, the distance between the piston and the lever of the air cock may be lengthened or shortened, thereby changing the tension on the spring within the valve which thus decreases or increases the pressure.

The pipe conveying the air from the reservoir to the cylinder is led to a Y tube, one branch of which leads through a low pressure reservoir (any large bottle, which acts as an air cushion on the mercury) to a U-manometer graduated to millimeters and indicating the pressure beyond the valve. The other branch of the Y tube leads to the receptacle containing the injecting fluid. As the pressure in the cylinder is reduced by the decrease in the amount of injecting fluid, the spring is released pulling on the lever of the air cock, opening it and admitting a fresh supply of air. This maintains a balance between the air pressure in the cylinder and a tension on the spring.

III A LABORATORY TIMING CLOCK

AUGUSTUS E. SCHARFF

The device described below is of great value in measuring the length of time that pieces of tissue or slides are to be left in the different reagents. It is the experience of every laboratory worker that either his entire time must be devoted to the staining of slides or great variations in the length of time in which they remain in the different reagents are almost sure to follow divided attention. The clock as described below has been used in this laboratory for over a year and it has been found that much time may be saved in staining sections and greater accuracy in their treatment obtained from its use.

The works of an ordinary clock are removed from the case. With a number 28 drill make a hole through the face, just above the twelve o'clock mark and about $\frac{1}{8}$ inch from the end of the minute hand. Through this hole a piece of insulated annunciator wire 6 inches in length is passed. Strip the insulation for about $\frac{3}{8}$ inch from the end of the wire and bend the bared portion in the form of a flat loop so that the minute hand in passing will rub over it. The insulation must not be removed from that portion of the wire which passes through the hole in the clock face. Wrap the end of this wire behind the clock face, around one of the cross stays of the works and leave the end free.

Drill a hole through the shell of the clock through which the loose end of the annunciator wire may be passed. If the clock used is an alarm clock, the clapper may be removed and the wire passed out through the clapper slit. Place the works within the shell.

Fasten one wire of a 2 or 3 foot piece of double, flexible, electric light cord to the end of the annunciator wire from which the insulation has been stripped for the purpose. Wrap the union with tape. Fasten the stripped end of the other wire to any convenient portion of the clock. Fasten one wire from the other end of the flexible cord to a buzzer or bell, the other two to dry cells. Complete the circuit, interposing a simple switch so that the circuit may be broken at will.

For convenience in turning the minute hand a piece of brass tubing may be fastened to the thumb screw controlling it.

To use the clock: wind it, turn the minute hand to the desired number of minutes before the even hour that it is desired to leave the slides in the stain. Place slides in stain. Close the switch. When the time has elapsed, the minute hand connecting the contact with the wire loop will sound the buzzer, which may be stopped by opening the switch. Remove the slides from the stain and reset the clock for the next stage. In the intervals between the actual processes of setting the clock and changing the slides from one reagent to another, the mind is left free for other things.

By fastening a piece of sheet metal to the bottom of the shell of the clock so that it will project backward just behind the clock and fastening a strip of metal to the table so that the projection on the bottom of the clock may be slipped under it, the clock is rendered more stable.