A NOVEL AIR MOTOR.

The engraving shows an air motor in which the expansion and contraction of air in a flexible receptacle is the motive power. It is a well established fact in pneumatics that air will expand three-eighths of its bulk between a freezing temperature and the boiling point of water—in other words, that eight measures of air at the freezing temperature become eleven at the boiling point of water. It is also well established that air preserves an equable rate of expansion at all temperatures. Its increase of bulk, for example, being the same from zero to 100° as from 100° to 200°, and as its expansion from 32° to 212° Fahrenheit amounts to three-eighths of its bulk at 32°, it follows that every degree on this scale corresponds to a change in its bulk amounting to $\frac{1}{480}$ of the bulk at 32°.

If a hermetically sealed vessel containing air be subjected to heat, the expansion of the air within it produces a pressure increased in proportion to the heat applied, and, under certain circumstances, in proportion to the volume of the air contained within the vessel, and it is with a view of utilizing this power that the apparatus shown in the engraving has been devised. A flexible cylinder, preferably made of silk, impervious to air, and having solid heads fixed to it at either end, is provided with rings placed at intervals in the silk cylinder to prevent collapse when subjected to external pressure. If this hermetically sealed cylinder is collapsed, and at the same time contains a certain volume of air, it follows that, owing to the construction of the cylinder, should heat be applied to it, the expansion of the air within it will force its two heads apart, and these heads will again come together when the air within the cylinder has cooled down to its original temperature.

To utilize this expansion and contraction, the lower head of the cylinder is fixed to a table. The other end is provided with friction rollers held opposite to each other on the said head, and brought in contact with the vertical guide bars. The cylinder is in this manner held in a vertical position, while it is free to move by the expansion and contraction of the air within it.

Two rods connect the top with a crosshead provided with friction rollers, which work on the vertical guides. The weight of the cylinder head and crosshead is balanced by counterbalance weights, connected to the crosshead by chains passing over pulleys held in brackets in the framework of the machine. By this system of counterbalancing the force produced by the expansion of the air will have exactly the same effect on the mechanism as an equal force produced by the contraction of the air within the cylinder.

An endless chain passes round pulleys and through holes in the crosshead, and the crosshead has pivoted on it two dogs, one of which is set against the chain, so that it will engage it when the crosshead ascends, while the other is set so as to engage with the same chain, but on the opposite side of the pulley, when the crosshead descends. By this arrangement of dogs the pulleys will always revolve in the same direction, whether the crosshead moves up or down in its guides. As the volume of air within the vessel or cylinder would not in itself be sufficient to produce a power applicable for practical purposes, an additional vessel is provided which is also hermetically sealed, and connected by a pipe to the flexible cylinder.

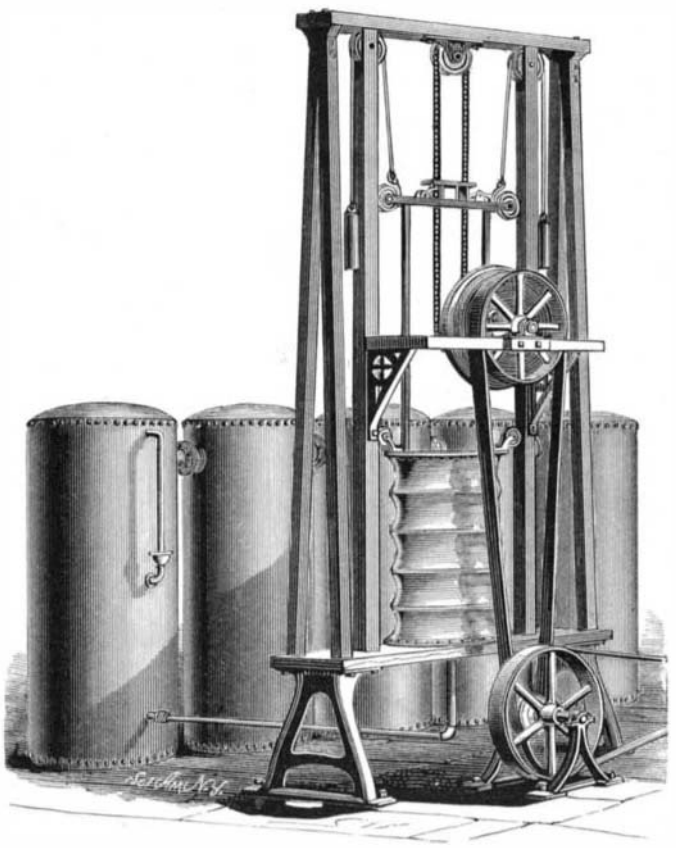
The number and size of the reservoirs can be indefinitely increased, but five only are shown in our illustration.

Although the greatest motion will be produced when the temperature changes to the greatest extent, it will be understood that upon every slight change in the temperature the motor will be affected more or less. If exposed to the bright rays of the sun, the air will expand. Should the sun become clouded for a short period, the air will naturally contract, and so on during the whole day, at each and every change of the temperature, the air either expands or contracts, and consequently the apparatus imparts to the motor a power given out as described.

As the movement of this apparatus will be irregular, sometimes fast and sometimes slow, and sometimes imparting no movement at all, the inventor applies a spring mechanism devised to store the power produced by the motion of the apparatus.

This machine will hardly be classed among perpetual motion machines of the usual types, as it has an ever varying force of nature behind it which will cause it to operate so long as heat and cold alternate, or until the machine is destroyed by wear or time.

This motor has been patented by Mr. Benjamin J. Foster, of Glen William, Ontario, Canada.



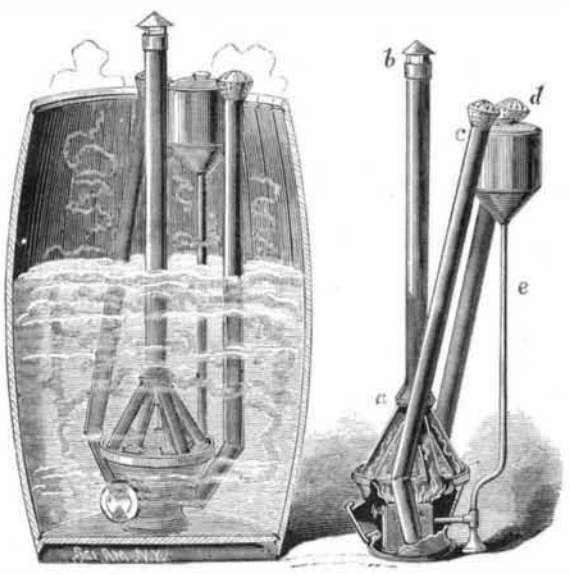
FOSTER'S ATMOSPHERIC AIR MOTOR.

IMPROVED WATER HEATER.

We give an engraving of an improved apparatus for heating water in large or small quantities, without trouble and with very little expense. The heater is more particularly designed for use in places where water backs and hot water boilers are not provided; but it may be used to advantage wherever hot water is required. It will be found very useful for stablemen, dairymen, farmers, and others.

The apparatus is to be submerged in water contained in a barrel, tank or other suitable receptacle. The fuel used is oil or gasoline.

The body, *a*, of the heater is made of sheet metal, and has flaring sides and a broad base. In one side there is an opening closed with a screw cap, which is packed to make it water-tight. This opening is to give access to the burner for lighting or adjusting. The closed top of the body, which is of copper, is provided with a series of tubes communicating with a central tube, *b*, which leads upward and forms a chimney to convey the products of combustion above the surface of the water in which the heater is placed. Two inclined draught tubes, *cd*, extend above the surface of the water and supply air to the flame in the body, *a*.



WEBSTER'S IMPROVED WATER HEATER.

The burner used in the heater may be of any approved pattern for burning kerosene or gasoline. The liquid fuel is supplied through the tube, *e*, from the reservoir above. To heat a quantity of water with this apparatus the cap is unscrewed, the burner lighted, and the cap replaced after the flame is properly regulated. The heater is then plunged in the water, which, being in contact with highly heated surfaces, soon becomes heated.

This apparatus is convenient for heating water for bathing purposes, for laundry and for indoor as well as out of door uses.

This useful invention has been patented by Mr. John B. Webster, of Los Angeles, Cal., who may be addressed for further information.

Protection for Glass Vessels.

Dr. E. Schaal, a chemist in Stuttgart, writes as follows in the Wurtemberg *Gewerbeblatt:*

In chemical laboratories it is customary to put a coating of clay on glass vessels that are to be exposed to a temperature that would soften or melt the glass, or where they are liable to be broken by draughts of air. Sometimes cow's hair or asbestos is mixed with the clay to strengthen it. Although this mass is cheap it is liable to fine checks and cracks, or it scales off, which frequently causes the glass to break.

I have recently been using, with better results, a mixture of infusorial earth and water-glass, which, if properly applied, will last for weeks and hence is not expensive, while it protects and strengthens the vessel to such an extent that I have, for the sake of experiment, heated thick but cracked retorts that were protected in this way to 400° or 500° C. (932° Fahr.) when exhausted almost to a vacuum, and yet they did not break, or collapse. It is important to make this mixture so that it shall form a soft and somewhat elastic, but not liquid, paste. A mixture of one part by weight of infusorial earth with 4 or 4½ parts of water-glass will fulfill this end approximately; the exact proportions cannot be given because commercial water-glass differs in strength, and the infusorial silica is not always dry.

The part of the vessel to be protected is covered one-fifth to two-fifths of an inch thick and dried at not too high a temperature, and it is better to dry in a drying closet or on a support over the stove. If the temperature is too high at first, it will cause air bubbles in the mass and it is not so good then. It can be dried by swinging it back and forth over a flame, the bubbles being prevented by pressing them out. If a crack appears, it is plastered over with more of the mixture and allowed to dry again. If some parts of the vessel are to remain transparent, they may be protected by water-glass alone by applying several thin coats and letting each dry before putting on the next.

There is no doubt that the same mass can be used to cover gas retorts, furnaces, stoves, and walls, just as well as for glass and porcelain utensils.

The editor of the *Gewerbeblatt* adds that the disadvantages which the author refers to of using potter's clay, water, sand and calf's hair for protecting glass and porcelain can be entirely overcome by mixing up the mass with a little glycerine. This cheaply and easily prepared mass is thus rendered very easy to apply, always retains its desired softness, and never cracks nor checks.

Covering Tables and Writing Desks.

The *Neueste Erfindungen* gives the following practical directions for covering tables etc., with cloth or leather:

Thick rye paste is boiled with thick turpentine (not the oil) slightly warmed. Thin strips of wood are then prepared not over 1⅜ inches wide and ¼ inch thick, and the sharp edges trimmed off. The best thing is a shade roller cut lengthwise, and the round side put downward. The cloth is stretched at one end and one side, to such a lath and basted fast to it, but the lath must lie two inches from the edge of the veneering (inside), and the cloth must extend half an inch beyond the edge of the veneer, because it will be shorter in spite of the stretching. The lath may be tacked at intervals of six inches apart.

After one end and one side are fastened the cloth may be stretched and basted around laths on the other two sides so as to form an inner border or frame two inches from the edges. The paste is then applied to the top of the table close to the veneer but not too near the lath, perhaps 1½ inches from it, and the cloth that projects beyond the laths is pressed down on the paste and rubbed against the edge of the veneer with the finger nail. There will be little folds in the cloth where it is basted, and these must be stretched out in pasting it down. It is then left to dry and the excess of cloth trimmed off with a sharp knife. Care must be taken in trimming it off, especially when the veneer is thin. If the cloth is cut back too far, a narrow strip should be pasted in between. The laths are then carefully removed and the cloth brushed off.

The cloth should be put on so that the nap runs toward the front of the table if its length permit of doing so.

In covering a table with morocco, of course these strips of wood cannot be employed.

To preserve its luster the leather is evenly but not too strongly moistened on the wrong side with pure water to which a little vinegar is added. The whole top of the table is covered with paste and the leather laid on and smoothed out by scraping from the middle toward the sides.

If one skin is too small they should not be joined in the middle, but a seam may be made near each end. The edges are cut with a rule and sharp knife and placed close together. A modeling iron, to be had of any book-binder, is run over these joints and along the edges. It is not necessary to heat the iron, but it is well to do this if the leather is not dry yet.

Zapallo Fruit.

The fruit of the zapallo, a cucurbitaceous plant of Uruguay, appears to afford a most wholesome food. It is cut up with the saw, because the rind is too hard for a knife to penetrate. It is firm, of a yellow color, a sweet amylaceous flavor, and slight smell resembling that of the carrot. The most esteemed quality, called rubango, has a ligneous rind of a dark green color, with orange pulp, and white oily seeds. The relative proportions are: Seeds, 4; pulp, 39; and rind, 57. According to M. Sace, the chemical composition is as follows: Gum, 0·44; sugar, 2·52; starch, 13·73; fibrine, 0·47; lignose, 0·22; ash, 0·81; water, 81·81; total, 100.

THE total number of puddling furnaces in operation at the end of 1882 in the United Kingdom was 4,369, being 814 less than in the preceding year.

THE experiment of electrically lighting the dining room and libraries of the House of Commons has, it is stated, cost more than £2,000, but the Commissioner of Works contracted to pay a sum not exceeding £900.