pavements have largely superseded all other styles, it has been proved that without a pitch filling, such pavements are like leafy roofs in wet weather. The rain percolates through the crevices and injures the foundation, rendering repairs necessary in a very short time. Pitch, on the other hand, prevents the bricks from absorbing moisture, effectually seals up the joints, and keeps the pavement firm and intact. Should the pavement sink from any cause, the points of fracture join naturally together again; whereas, with hydraulic cement or mineral grout of any kind, breaks and cracks are hard to repair, and pavements so laid soon present a ragged and uneven surface.

Coal tar pitch was extensively used for the vulcanite asphalt pavements in Washington, D. C., which was admitted to be the finest in the country. A recent estimate shows that 1,500,000 yards of asphalt and 500,000 yards of vulcanite have been laid in that city with pitch or coal tar distillate; and in all instances where the proper ingredients or proportions have been used, the results have been in the highest degree satisfactory. Pitch is also used to excellent purpose in floorings of establishments where there is much moisture. Where oils or acids are liable to fall, an asphalt floor laid with pitch is superior to asphaltum alone. Petroleum softens asphalt, but it has no effect whatever on a floor of coal tar pitch. These facts have been recognized in numerous cities. In Pittsburg fully 80 per cent. of the asphalt pavements have been laid with pitch, with splendid results.

But there are other and equally important avenues for the employment of coal tar pitch. It enters extensively into the manufacture of carbons for electric lighting. Various substitutes for pitch have been tried, but none have thus far proved successful. In Germany it is used in the manufacture of pipes for the conveyance of cold acids in chemical works, and also for lining acid holders. Underground pipes for gas or water are coated with pitch to prevent rust or corrosion. Boat bottoms are pitched to preserve the timber and give a smooth surface. The wooden pipes, manufactured in Michigan and New York, are made more useful and durable by their pitch coating.

Another important use for coal tar pitch has been found in the manufacture of egglette coal, the new fuel which bids fair to revolutionize the market. This fuel is made of hard and soft coal dust, mixed with 10 per cent. of pitch, and pressed into egg-shaped pieces. Its popularity for family and manufacturing purposes is already so pronounced that factories for its production are contemplated in various sections. This industry will undoubtedly give great impetus to the pitch market. Even the dust and screenings of the mines can be converted into as valuable a fuel as hard coal, while many grades of Western coal can be re-rendered bituminous by the use of pitch as a binder. All the indications are that the demand for the new fuel will go on increasing. In England its manufacture and sale has already reached large proportions, and egglette has given great satisfaction whenever tried.

Owing to the manufacture of gas from petroleum products, of late years the supply of coal tar has diminished. A quantity of pitch obtained from gas tar derived from petroleum products has been used for paving and roofing purposes; but the large percentage of water in the tar has rendered it very difficult to handle. While the pitch made from this tar is not as good as genuine coal tar pitch, yet the cheapness of the tar has forced it into the market as a substitute for many purposes, with fair success.

The expanding market, as well as the revenue from the production of pitch, ought to stimulate the production of coal tar, and tend to the diminution of gas making from petroleum. When the gas companies fully realize the conditions of the market, they will no doubt govern themselves to meet those conditions in the most profitable manner. Besides those already referred to, there are hundreds of avenues, some of them individually small, but large in the aggregate, for the consumption of pitch. Indeed, taken altogether, the outlook for this valuable product of coal tar is very promising. With the increasing demand for felt roofing, the growing popularity of brick for paving, where pitch will in time be universally used for filling, the employment of granite block for paving with pitch filling, the extension of electric light, causing a larger demand for carbons, and the expanding consumption of the new fuel, to say nothing of the many minor avenues of use, the producers of coal tar pitch certainly have every reason to expect a bright and profitable market.

THERMOSTATIC REGULATORS FOR INCUBATORS AND OTHER HEAT APPLIANCES.

By G. D. HISCOX, M.E.

IN answer to the many inquiries in regard to the construction of thermostatic bars, heat regulators and ventilators for incubators and other purposes, we illustrate such as we have tested for reliability, and of a construction within the means of most amateurs.

The materials that possess a large range of motion for each degree of change in temperature are somewhat limited, and, with the best, its range requires to be multiplied for effective work.

Among the metals, zinc has the largest range, equal to 0.0002 of an inch per foot in length for each degree F. of change of temperature. This being too small for the direct movement of a zinc rod, even when multiplied by a lever system, in order to utilize it to the best advantage the zinc rod may be fastened to a strip of thin steel which has a movement of only 0.00007 of an inch per foot in length for each degree of change in temperature, and thus multiply its range by differential expansion and lateral motion as shown at A, Fig. 1. The strip of zinc may be cut from rolled sheet zinc No. 16, not less than 2 feet in length clear of fastenings, 2 inches wide at the butt end, tapering to 1/2 inch at the free end. The strip of steel No. 20, or if steel cannot be easily procured, a strip of Russia sheet iron will be nearly equal, having a slightly higher expansive property, may be cut of the same form as the zinc, but slightly longer for making the damper connection as shown in the cut. The strips should be riveted together with soft copper wire 1-16 of an inch diameter, headed lightly and only sufficiently to hold the strips together. The lever and bell crank connections with

the damper should be made very light and with an adjusting screw and nuts as shown.

The lateral motion that should be obtained in a clear length of 2 feet, for the free end, is 1/4 of an inch for each degree or 1/2 of an inch for the full range of 6 degrees for an incubator.

Another combination as shown at B, Fig. 1, may be made with a strip of hard rubber which has a range five times greater than zinc, or equal to 0.001 of an inch per foot in length for each degree of change of temperature. It will not have a proportionally large range, because it must be made of thicker material in order to give the bar the proper stiffness of motion. A combination of a hard rubber strip 1/4 inch thick, 1 inch wide, or if convenient wider at the butt, as in the first named arrangement, with a piece of sheet steel, Russia iron No. 20, or a strip of heart hickory 1/2 in. thick, will give a strong motion and a range of nearly 1/4 inch for each degree of change of temperature in a bar 2 1/2 feet long clear of fastenings.

The volute coiled thermostat, Fig. 2, is a very compact form, although a little more difficult to make.

The strips of steel or iron and zinc are to be made as in Fig. 1, and may be 2 1/2 feet long. Instead of riveting the strips together, they should be cleaned on the faces that are to be united and tinned with pure tin by a soldering copper; then placed together, bound with strips of wood and the edges united by melting the tin with a hot soldering copper. Any tinsmith can make a neat piece of work in this line. It can then be bent in the form as shown, and the butt end screwed to a wooden stud, or soldered to a metal bracket.

The manner of connecting the spring with the lamp and warm air flue is plainly shown in the cut, subject to any modification required by the position of the lamp and the thermostatic coil. The connecting rods, C and D, have a running thread and two nuts on each

THERMOSTATIC REGULATORS.

for adjustment of the air valve and lamp flame; the latter being operated by a sleeve sliding loosely over the wick tube and operated by a bell crank shaft so as to cover the wick without moving it in the wick tube. The lamp chimney, B, should be made of thin copper for the best transmission of heat, and the warm air chamber, A, may be made of tin. The counterbalance weight, E, may not be needed if care is taken to otherwise balance all the moving parts.

The round rod of hard rubber is also in use for thermostats, as shown in Fig. 3. Such a rod should be 5/8 inch in diameter by 3 feet in length, and will have a temperature variation of 1-40 of an inch for 6 degrees, by multiplying which by a delicately arranged bell crank with adjusting screws as shown in Fig. 3, the warm air throttle and burner sleeve will receive the proper amount of motion for regulating the temperature of an incubator.

The rods and strips of hard rubber are kept in stock by the makers of hard rubber goods, and may be obtained through the rubber trade.

Other constructions of thermostatic regulators are in vogue, such as a long brass wire, about No. 30 wire gauge, wound around a series of small grooved wheels set some distance apart on a wooden frame, but as brass wire only varies 0.0125 of an inch per 100 feet for each degree change of temperature, or 0.075 of an inch for 6 degrees, it is not suitable for the purposes of an incubator. A flat hollow disk of hard brass with concentric corrugations, half filled with sulphuric ether and hermetically sealed with solder, has a large range of movement. The ether boiling at from 98° to 105° Fah., according to its purity, and thus generating a slight pressure above its normal vapor pressure near its boiling point has also been used. It is of too inflammable a nature to be recommended for amateur use.

A NEW TRANSATLANTIC CABLE.

ON August 16, 1858, at twelve minutes past eleven in the morning, telegraphic communication between the Old and the New Worlds was inaugurated by the following dispatch sent from Valentia to Newfoundland:

"Directors Atlantic Telegraph Company, Great Britain, to directors in America. Europe and America are united by telegraph. Glory to God in the highest; on earth peace, good will toward men." On September 1 following, however, the cable ceased to work, having, during the twenty-three days, conveyed 400 telegrams of 4,359 words and 21,421 letters. It was not until July 28, 1866, that telegraphic communication was again restored between the two continents by a new cable, and from that date the Anglo-American Company had no rival until August 15, 1869, when the French Atlantic Company's cable began operations. The competition thus commenced brought the tariff of both companies down from £1 a word to £1 10s. for ten words. Further competition was avoided by combination. Somewhat similar arrangements followed later attempts at competition. Thus, in 1874, the Direct United States Company entered the field, brought down the rates, and finally, in 1877, was forced into combination. In 1879 the French "Pouyer Quartier" cable was laid, and in the following year entered into a joint purse arrangement. Then, in 1881 and 1882, the two Western Union (Gould) cables were laid, and in the following year also joined the combination.

The next competition which the old company had to face was of a different character to the former attempts, the capital for the new cable being practically supplied by Mr. Mackay, the "Bonanza King" of California, and Mr. Bennett, the well-known proprietor of the *New York Herald*. These enterprising gentlemen in 1883

organized the Commercial Cable Company, and have since maintained the independence of their undertaking. The competitors have wisely given up a "war of rates," and content themselves with energetic and determined attempts to secure a fair share of that transatlantic cable business which has so far kept the companies' lines fully employed. The competition for business thus insured, together with the natural development of international relations, has, indeed, caused such an increase in the daily telegraphic correspondence between this country and America that the Anglo-American and Commercial companies have found it necessary to lay new cables. The Commercial Company in this race are slightly ahead of their rivals, and their steamer with the two shore ends started recently. Since the last cable was laid in 1884 experience and scientific research have indicated directions in which the old cables might be improved, and the new lines of the Commercial and Anglo-American companies, it is safe to say, will be far ahead of the old ones in carrying capacity, durability, and in other respects.

Messrs. Siemens Brothers & Co., Limited, laid the two cables of the Commercial Company, and naturally, therefore, secured the contract for the new Mackay-Bennett line. The headquarters of Messrs. Siemens are in one of the fine old mansions at Queen Anne's Gate, Westminster, and our representative, who called for particulars concerning this new link of communication with our transatlantic cousins, found Mr. Alexander Siemens in one of those delightful rooms overlooking St. James's Park which make the rush and hurry of these latter days appear strangely out of place, and unsatisfying.

A visit to the company's great works at Woolwich, with their electrical appliances, steam hammers, and all the other adjuncts of a mighty workshop, brings one back, however, from the old world memories of