CALCULATION OF THE AMOUNT OF ICE WHICH CAN BE PRODUCED FROM A GIVEN AMOUNT OF COAL IN THE MODERN ICE MACHINE.

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The amount of ice produced by an ice machine, worked by means of an exhaust or condensing air pump, driven by steam power, is easily determined, theoretically, from the amount of coal burned in the furnace of the steam boiler. It has been proved that the combustion of one pound of anthracite coal produces, in round numbers, 14,000 units of heat, and that in order to freeze water of 72° Fah., it is necessary to abstract, besides 40° of sensible heat, 140° of latent heat—together 180°—which, for one pound of water is, of course, equivalent to 180 units of heat. As this number of units is the eightieth part of the 14,000 units produced by the combustion of one pound of coal, it is clear that the heat produced by the combustion of one tun of coal is equivalent to the heat to be abstracted from 80 tuns of water of 72°, in order to change it into ice.

But in practice we find here exactly the same state of affairs as is the case with the steam engine. Theoretically, a steam engine ought to produce at least 700 units of force (foot-pounds) for every unit of heat consumed; in practice, good machinery only produces from about 70 to 100 foot-pounds, from about one tenth to one seventh part of the theoretical amount. In the best ice machines, thus far constructed, instead of freezing 80 tuns of water for every tun of coal consumed, only from about 8 to 11 tuns of ice are produced, also, from one tenth to one seventh part of the theoretical amount, proving, thus, the remarkable fact, that in both the steam engine and the ice machine, exactly the same relation exists between the theoretically calculated effects and the practical results.

As, however, all the best ice machines accomplish the conversion of the heat of the fuel into the freezing operation by the intervention of a steam engine, the fact that they practically produce only from one tenth to one seventh of the amount of the cold they theoretically should produce, is solely due to the other fact, that the steam engine, itself, practically produces only from one tenth to one seventh of the amount of power which would be strictly equivalent to the number of heat units consumed. It must not be lost sight of that it is only the power of the steam engine which generates the cold in the freezing machines, and that, therefore, improvements in the steam engine, which bring its practical results nearer to the theoretical standard, will at once exert their influence on the amount of ice the ice machines can produce, and, consequently, also on the cost of the ice manufactured in these machines.

Moreover, it appears that the kind of freezing machines in question, which convert power into cold, notwithstanding they are yet in their infancy, have already attained such a degree of excellence, that they are ahead of that class of machines which convert heat into power, either by steam, hot air, or any other possible means, as it is proved that they produce the full theoretical equivalent of cold (negative heat) for the number of foot-pounds employed; namely, cooling one pound of water one degree for a power equivalent to 700 pounds, descending one foot, which, expressed in the adopted scientific manner, is one unit of negative heat for every 700 foot-pounds consumed.

Discovery of the Weight of Air.

The following extracts from a letter addressed to the *Chemical News* by the Abbé A. Hamy will be read with interest:

It has long been asserted that, before Galileo's experiment in 1643, the weight of air had not been demonstrated. However, many learned men, both of former times and of the present century, acknowledged that Aristotle attempted to demonstrate this important fact, while, at the same time, they are unanimous in declaring that the means employed by him were inadequate to the end he wished to accomplish. The honor of the great discovery is now yielded incontestably to Galileo, and what chance I shall stand of restoring the glory of it to the philosopher appears doubtful; but my conviction is, that he has a right to it, although his opinions on the nature of gravity differs from those of modern scientific men.

In "De Cælo," lib. 4, we read: "*Suo enim in loco gravitatem habent omnia præter ignem. Signum cujus est, utrem inflatem plus ponderis quam vacuum habere.*" "In their own medium, all bodies except heat, have weight; the proof of which is, that a leathern bottle weighs more when filled with air than it does when empty." It was, I believe, on this experiment that Aristotle founded his assertion of the gravity of air; and the only ground on which men of science based their opinion that the merit of the discovery was not due to him was, that in endeavoring themselves to test the truth of this assertion, many of them failed to detect any difference in weight between a bladder filled with air and one entirely empty. Such were the arguments used till the time of Galileo; then by the exact measurement of the gravity of air, the failure of Aristotle's experiment could be accounted for; and, during the present century, in all elementary books in which the barometer is mentioned the vain attempt of Aristotle to measure the real weight of air is also spoken of. But it appears to me, that the arguments used by the philosopher's enemies failed to prove what they really intend. Of course they are are right if they can demonstrate that he experimented with air at the same pressure as that of the atmosphere. But what grounds have they for such an opinion? Is it that they attribute to Aristotle what are, in reality, the failures and mistakes of his followers? We have, on the one side, the clear assertion that all bodies except heat, possess weight; and, on the other, Aristotle furnishes us with a process for the verification of this statement, which consists in weighing, not an extensible bladder, but an almost inextensible leathern jar successively full and empty of air. Now, what conclusion are we to arrive at from such premises? That it is impossible to succeed? Or might it not be more correct to say, that by a process, the details of which have not been transmitted to us, Aristotle himself succeeded in proving the gravity of air, while the attempts of his followers to do the same resulted in failure? For myself, I believe that the great philosopher, by means of a blow pipe, confined in his leathern jar more air than it would contain at the normal pressure; and, after weighing it, first empty and then full, he found such a difference that he could positively assert the gravity of air.

In these days, when *a priori* arguments are so decried, we may be allowed to dissent from a similar reasoning which would rob antiquity of its glories. Therefore, instead of saying, "Although Aristotle stated that air was heavy, he tested it by a wrong process which tended rather to prove the contrary," it would be more just to say, "Although Aristotle made use of a process, which, at first sight, appears a wrong one, yet, as we find that by the supposition of compressed air he might succeed, we conclude that he discovered the truth, since it was he who asserted the fact."

Self-Sealing Gas Retort Lids.

Self-sealing lids for gas retorts having a mechanically fitting edge, have been introduced in one of the London gas works, and are said to answer the purpose well. The lids are circular, and are stamped out of plate iron, being buckled to give them stiffness. The mouthpiece is faced true, and the projecting edge of the lid is truly turned to a semicircular section, so as to give only a line of bearing all around. Screwed up, this bearing is said to be, and to remain, gas tight, which is certainly more than would have been supposed. The makers of these lids, Messrs. Tangye Bros., of Birmingham, remark as follows:

The chief advantages obtained are: 1. The sound sealing of the retort during the whole time it is carbonizing the charge of coal, there being no jointing medium between the lid and the mouthpiece. 2. The lid requires no preparation on the part of the stoker, beyond slightly scraping the surface to remove entraneous grit or dirt. 3. The lids are only about two thirds the weight of the whole form in general use; a lid of a 16-in. mouthpiece weighing a little over 20 lbs. 4. The self-sealing lid reduces labor, saves wear and tear, obviates all the inconvenience and discomfort consequent on the preparation of luting, and effects a great reduction in the working expenses. The cost attending the process of "luting" in several large gas works exceeds £1,000 per annum, ranging in various works from 20s to 35s per mouthpiece. It will be obvious that a round lid is the most convenient and the cheapest form. Some engineers are having the mouthpieces of D-retorts adapted for round lids, by carrying the bottoms down the necessary depth for that purpose.

Boiler Inspector's Reports for June.

The Boiler Inspector's reports for June show that during the month 319 visits of inspection have been made, 573 boilers examined—465 externally and 139 internally—and 26 tested by hydraulic pressure. The whole number of defects discovered, 354; of which 31 were regarded as especially dangerous. These defects were distributed as follows: Furnaces out of shape, 16. Fractures in all, 56—2 dangerous. Burned plates, 45—1 dangerous. Blistered plates, 50—6 dangerous. Cases of incrustation and scale, 45. Cases of external corrosion, 33—4 dangerous. Cases of internal corrosion 2. Cases of internal grooving, 1. Water gages out of order, 5 Boilers without blow-out apparatus, 3. Blow-out apparatus out of order, 3—1 dangerous. Safety-valves overloaded, 7—3 dangerous. Steam gages out of order, 48—2 dangerous. Boilers without gages, 2. Boilers with loose stays, 2, Seam rips, 4—all dangerous. Mal-construction, 1—dangerous. Cases of deficiencies of water, 6—3 dangerous.

The Locomotive calls the attention of steam users to the necessity of exercising greater care in the raising of safety-valves. It says: "It is the practice of many, to lift the valve suddenly, and then let it fall, the spindle thereby receiving a violent blow; and in numerous cases we find the spindle sprung to such an extent by this practice, that the valve can lift but very little, and in some instances not at all. The valve should be raised carefully and let down gently; not only for the reasons above stated, but from the fact that nothing is more dangerous than the sudden shock caused by the valve being suddenly opened and shut. Valves should be frequently raised to prevent their becoming stuck, but too much care cannot be used in the operation.

"During the month, several cases of this evil have come to our knowledge, in one of which it was necessary to cut the spindle out, after the cap had been taken off."

ELECTRO-PLATING OF PAPER OR OTHER FIBROUS MATERIAL. The *Druggist's Circular* says: "A mode has been devised for depositing copper, silver, or gold, by the electric process, upon paper or any other fibrous material. This is accomplished by first rendering the paper a good conductor of electricity, without coating it with any material which will peel off. One of the best methods is to take a solution of nitrate of silver, pour in liquid ammonia till the precipitate formed at first is entirely dissolved again; then place the paper, silk, or muslin, for one or two hours in this solution. After taking it out and drying well, it is exposed to a current of hydrogen gas, by which operation the silver is reduced to a metallic state, and the material becomes so good a conductor of electricity that it may be electro-plated with copper, silver, or gold, in the usual manner. Material prepared in this manner may be employed for various useful and ornamental purposes.

MANUFACTURING, MINING, AND RAILROAD ITEMS.

RAILROAD accidents succeed each other with alarming frequency, simply adding fresh chapters of horror, and shedding no fresh light on their cause. Railroad companies continue to assert through the press and in our law courts that they have made ample provision against these catastrophies in their bye-laws and regulations, that they are therefore responsible only in a subordinate degree, and that the blame and punishment must rest upon the officials immediately intrusted with the safety of the traveling public. The practice of these companies would seem to be to work their lines with the least possible cost and to reap the largest possible dividends. An open draw-bridge, a broken rail, or a defective axle is too often discovered by its effect upon a passenger train; or, again, a collision is the result of a sleeping—probably overtasked—engineer. The question to be considered is not are these railroad laws sufficient, but is there ample provision made for their due fulfillment.

We learn from an exchange that considerable excitement is felt in Wallingford and Shrewsbury, Vermont, upon the discovery of a mountain of of lead. This mountain formerly belonged to the late Morton Dawson. Last spring a son of his, in making sugar, built an arch of the loose stone found in that section. After adjusting his pan and kindling a fire, he noticed melted lead or solder run out of the fire. He supposed his pan was melting down, and removed it, but found it entire, and also found that the melted metal came from the stones of the arch. It is said that specimens have been sent to Washington, New York, and Boston, for examination.

At the coming fair at St. Louis, a large amount is to be distributed in premiums for cotton. The St. Louis *Republican* says: "We understand that these premiums will be awarded as follows:—For the best bale of upland or short staple cotton $500. For the best bale of New Orleans, or long staple cotton $500. The St. Louis Fair Association have added to this a third premium of $250 for the best bale of cotton raised in Missouri. The cotton entered must be of the growth of 1869, and the bales must not weigh less than 450 pounds each. Sea Island and Peeler cotton are excluded from competition.

The acidity of mine waters, so often noticed and so deleterious to steam boilers, has been the subject of some remarks by Dr. Willigk, who has analyzed water from a coal pit in Bohemia. It contained acid sulphates and free sulphuric acid in notable quantity. He recommended that it should be filtered over witherite (natural carbonate of baryta), which is abundant in the locality. The experiment was successful, and prevented the corrosion of the boilers or machinery. Chalk or limestone would have proved equally efficacious.

Two thirds of all the prints made in the United States are produced in New England. Massachusetts and New Hampshire can print from ninety to ninety-five thousand pieces weekly; New York State, New Jersey, and Pennsylvania can print about ninety thousand weekly. Of all these there are three of the largest printing companies that have a capacity to print one half of this whole production.

Thirteen hundred and fifty men were engaged in changing the gage of the Missouri Pacific Railroad. So complete were the preparations and facilities that the feat was accomplished in the incredibly short time of twelve hours, and without the loss or delay of a single train. The business of the road is progressing now as usual.

Isaac Heene, of Duxbury, Mass., being invited to address a school, responded by offering each scholar an acre of good land to plant on shares, he manuring and plowing the same, and promising in two years to give a clear title to such as had improved the land in a farm-like manner.

It is officially announced by M. Lesseps, that the ceremonies of the opening of the Suez canal will take place on the 17th of next November. The two great enterprises by which the year 1869 will be distinguished in history, are the Union Pacific railroad and the Suez canal.

The colored mechanics of Baltimore, and the State of Maryland, are forming trades unions and societies of their own, as the white workingmen deny them admission to their unions.

The construction of a ship canal from New Orleans to Lake Pontchartrain, it is asserted, would diminish greatly the port charges in pilotage and towage.

Answers to Correspondents.

CORRESPONDENTS who expect to receive answers to their letters must, in all cases, sign their names. We have a right to know those who seek information from us; beside, as sometimes happens, we may prefer to address correspondents by mail.

SPECIAL NOTE.—This column is designed for the general interest and instruction of our readers, not for gratuitous replies to questions of a purely business or personal nature. We will publish such inquiries, however when paid for as advertisemets at $1·00 a line, under the head of "Business and Personal."

☞ *All reference to back numbers should be by volume and page.*

A. S. G., of D. C.—The power necessary to drive a train of wheelwork seven hours, so that a driven wheel, one inch in diameter, may revolve 40 revolutions per minute, with four pounds at its periphery, may be computed as follows: 1 inch×3·1416=3·1416 inches, 3·1416 inches×40=125·664 inches the circumferential motion per minute. This multiplied by 420, the number of minutes in seven hours,=5277·88 inches=439·824 feet. As four pounds of resistance are to be overcome through this distance in seven hours we have for the power required 1759·296 foot-pounds. To accomplish this work by a weight falling through a space of seven feet, th weight must weigh one seventh of 1759·296 pounds, which is 251·328 pounds making no allowance for friction, which will, we estimate, require in your case, twenty per cent more power than this, making the entire weight required, nearly 3,016 pounds.

C. R. F., of N. J.—As good a tool as you can use for roughing down a large wooden drum on the shaft where it is to run, is an old file ground down to a sharp point. This will not split out fragments even though it should catch in a knot or a nail. When the approximate form has been attained you can use a gouge, chisel, and sandpaper to finish. A rest good enough for the purpose can generally be made of hard-wood plank suspended with nails from and braced to the joists overhead.

T. R. J., of Mass.—The best tool to burr off small castings is a vulcanized emery wheel. If you have much such work to do it will pay for itself soon in the saving of files. To remove the rust from such castings, put them—a bushel at once—in a tumbling barrel, with leather cuttings and chips, they will soon wear bright. This will not however take the rust from the inside of small hollow castings. To clean such, dip in dilute sulphuric acid—1 part of commercial acid to ten of water—wash in hot lime water, and dry in the tumbler with dry sawdust.

H. H., of Ohio.—Experiment can only determine your first querry. We think, however, that you will find it difficult to make an alloy of platina and silver, whose fusing point will be exactly what you require. The asbestos used in making clothing is a variety of amphibole not containing much alumina.

C. R., of Vt.—Saws may be made to cut so smoothly that a very good finish may be obtained by sand-papering only. You will find such saws at work in manufactories of veneers, and it would pay you before proceeding further with your invention to visit some such establishment.

S. McN., of Cal.—The substance you send us is nothing but wood charcoal mixed with a little sand and sufficient plastic clay to cement it into lumps. How it came fifty feet below the surface where you found it must be a matter of conjecture. Charcoal is however, unchangeable at ordinary temperatures, and it may have remained there a thousand years.

A. G., of N. Y.—Good strong glue is the best thing for fixing emery to cloth belts for polishing wood.