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O. D. MUNN, S. H. WALES, A. E. BEACH.

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Contents:

(Illustrations are indicated by an asterisk.)

SUPPLEMENTAL SHEET.

With the present number we issue a supplemental sheet of four extra pages, which contains the official list of patent claims.

The pressure upon our columns has been so great during the past six months, that we have been embarrassed for space in which to meet the demands of our numerous advertising patrons, without seriously curtailing our reading matter. The SCIENTIFIC AMERICAN having ten-fold more readers than any similar journal now published, advertisers find that an investment in its columns returns a large profit.

Not wishing to disappoint our generous patrons in any respect, we intend in future to issue supplements whenever, in our judgment, the advertisements and patent claims are likely to trench upon the space that we consider due to our readers.

EXHIBITION OF A NEW ELECTRO-MAGNETIC MOTOR.

In the afternoon of Friday, April 6th, a number of gentlemen met at the lecture room of the Free Academy, in this city, at the invitation of Professor R. Ogden Doremus, to witness the operation of a new electro-magnetic machine, the invention of Mr. L. C. Stewart.

Most of our readers doubtless understand the principle of electro-magnetic machines. They all depend on the power which a current of electricity has to induce magnetism, either in a bar of iron, or in a hollow helix where no iron is present. If a piece of wire is insulated, by covering it with silk, cotton, or other non-conducting material, and it is then wound around a rod of soft iron, so long as a current of electricity is passing through the wire the rod of iron is a magnet, and so soon as the electric current stops, the iron ceases to be magnetic.

The simplest form of an electro-magnetic machine is a lump or bar of iron secured to one end of a vibrating lever, directly over the poles of an electro-magnet. The helical wire of the magnet being connected with a galvanic battery, the soft iron core becomes a magnet, and pulls the iron bar on the lever down; this movement opens a gap in the helical wire and breaks the current, when the bar ceases to be attracted, and it is lifted up by the motion of a fly wheel connected with the opposite end of the vibrating lever. This movement of the lever closes the gap in the helical wire, restoring the current and renewing the magnetism, when the bar is again drawn down. Thus the current is automatically broken and closed by the action of the machine, and the vibrations are made perpetual.

It long since occurred to many mechanicians that much greater velocity could be attained by securing several bars of iron to the periphery of a rotating wheel, and fastening a series of electro-magnets around the inner side of a fixed circumscribing wheel or concave. Mr. Stewart's machine is a modification of this plan, his improvement consisting mainly in the method of breaking and closing the circuit. This is effected by two brass wheels running with their peripheries in contact—shallow depressions being sunk in the peripheries so that the wheels do not touch each other while passing these depressions.

Mr. Stewart said that with one of his engines, with a helical wire 8 miles in length, he had reversed the current 80,000 times in a minute!

One of the advantages that is claimed for this engine is that sparks are avoided in breaking the current, and thus the combustion of the brass is prevented. Mr. Stewart stated that where sparks are produced it is necessary to employ platinum, gold, or some other of the noble metals.

Professor Doremus remarked that he must go a little further than Mr. Stewart. With the powerful battery belonging to the Free Academy platinum was not merely melted, it was volatilized; and even the natural alloy which is used for tipping the points of gold pens, irridosmium, they had melted and run together in larger masses, thus increasing its value.

So far the obstacle to the employment of galvanic electricity as a motor is the high cost of the power. The power is obtained by oxidizing zinc, which is worth thirteen cents per pound, while in the steam engine the power is obtained by oxidizing coal, which is worth half a cent per pound. It is true that in the steam engine not more than one-tenth of the power generated in the furnace is utilized; but all the investigations indicate that thus far in the electro-magnetic machine, the proportion is still smaller.

EXPLOSION OF A PETROLEUM LAMP.

We had an accident at our house last night, but fortunately it did no damage except to scare the children. It was this: Our coal oil lamp exploded with but little warning; the burner, chimney and wick blew out with so much force that it struck the ceiling some six feet above the lamp. The plaster of paris that the burner was fastened in with was all blown out also. Now I want to know the cause of this thing. We have been using coal oil for four or five years without any accident before, and we often leave the lamp burning all night, which I will be afraid to do again unless I know the cause. We bought our oil of a druggist, and supposed that it was good, and I still think it was. Please answer through that valuable paper, the SCIENTIFIC AMERICAN, which I think the best paper in the world, and oblige your friend and subscriber,

SAMUEL LUTHY.

Carrollton, Ill., 1866.

Our access of new subscribers is so rapid that we are obliged to repeat explanations of familiar phenomena, in order to give satisfaction to the largest number of our readers.

The two elements, carbon and hydrogen, combine in a great number of different proportions, forming as many different substances. These hydro-carbons have some properties in common, while they differ in others. For instance, they are all combustible, but they differ widely in their fluidity and volatility. At ordinary temperatures some are solid, as paraffine, and others are gaseous, as olefiant and marsh gas, which constitute the principal proportion of illuminating gas, while between the solids and gases in volatility are a large number of liquid hydro-carbons that boil or evaporate at different temperatures. Petroleum is a mixture of liquid hydro-carbons, usually holding also in solution both gaseous and solid hydro-carbons.

When explosions of petroleum occur, they are produced in this way. The oil is in a tight room or vessel, which prevents the gaseous and volatile hydro-carbons of its constitution from passing away as they escape from the liquid, but confines them together with the atmosphere of the room or vessel. After a sufficient quantity of the combustible vapor or gas is mingled with the air, if fire is applied to the mixture, each atom of hydrogen in the hydro-carbon enters into combination with an atom of oxygen to form a molecule of water or steam, and each atom of carbon enters into combination with two atoms of oxygen to form a molecule of carbonic acid. In other words, the petroleum vapor is instantaneously burned. The heat generated by this rapid burning causes so sudden an expansion of the carbonic acid and steam, which are the products of combustion, as to produce the effects of explosion.

The more volatile portions of petroleum are separated from the illuminating oil, in the process of refining, and are sold as naptha. We have heard dealers charged with mixing this naptha with illuminating oil, in order to sell it at a higher price, and it is possible that our correspondent's oil had been thus adulterated. It may be, however, that the explosion was due to a different cause. When the wick of a petroleum lamp is turned down very low, the oil will ascend and be evaporated more rapidly than it will burn, filling the room with the odor of petroleum, a fact that, probably, most people have observed who are in the practice of burning petroleum. At all events there can be no doubt that, in some way, the upper portion of our correspondent's lamp became filled with a mixture of atmospheric air and the vapor of petroleum, and then this explosive mixture was set on fire.

THE MIDLAND STEAM BOILER INSURANCE CO.

This is the title of a new company, recently organized in England to inspect and insure steam boilers against explosion. They had, at the last report, no less than 1,839 steam boilers under their care, and of these but one had exploded—being the first accident that happened in four years, and this one the proprietors had been repeatedly warned of, but disregarded the warning. During the year, 605 reports have been sent in to owners, and 7,172 inspections have been made, showing that each boiler was inspected every three months.

There were 55 boiler explosions in England in 1865, attended with great destruction of property and loss of life. "Great efforts," says the engineer, in his report, "have been made to obtain the facts in the cases, as they generally show some simple cause, and the utter fallacy of the 'mysterious' theories so popular among those who have only partially considered the subject."

Some of the causes of disaster are mentioned, and being exceedingly interesting to engineers and others, we republish them in a condensed form.

Many old boilers have been removed and replaced by new ones of better construction; explosions of the past year, showing that boilers which have been used for twenty years should be worked with great caution. Many cylinder boilers have been burnt by short water—arising in one case from a chip under the check valve—from the uncertainty of a float indicator where water boils violently, and to the want of back valves to prevent the water being forced out of one boiler into another. Several cases occurred where scale had become detached from the sides of the boiler, fallen to the bottom and there burnt fast; and very great injury has been done to boilers by emptying them under pressure and immediately filling them with cold water.

Many safety valves have been found habitually overloaded. When they leak, instead of grinding them tight, the engineer, or others, put on extra weight, and the want of repair was forgotten. Boilers used without gages, the proprietors depending on the calculated weight on the safety valve, are often found working at much higher pressures than were suspected. Pressure gages are frequently found out of order, one registering as much as 40 pounds out of the way. The most dangerous defects were found in cylinder boilers, and, curiously enough, where the inspectors were assured by the attendants that all was in perfect order. Around the brick work, even though the boiler was entirely separated from it, most dangerous corrosion occurred, and this even in new boilers. One singular case was where a sprung rivet had caused several jets of steam to play on the plates, which by long continuance had cut channels almost through. These defects were discovered by the vigilance of the inspectors, and undoubtedly saved much property and many lives. They are as common in American as in English boilers, but are suffered to pass unattended to until explosion occurs.

The London *Mechanics' Magazine* reproaches us in a late issue for publishing a long account of boiler explosions without comment, saying that life is held so cheap in this country that hundreds may be killed through accidents by steam without especial notice. It would take a larger paper than the SCIENTIFIC AMERICAN to record and comment on all the boiler explosions in the United States, and the mere publication of them would do no good.

We have no such admirable concerns as these English boiler insurance companies, but we hope to before long, and in the meanwhile, let every engineer be his own assurer.

NOTES ON NEW DISCOVERIES AND NEW APPLICATIONS OF SCIENCE.

A NEW SODA PROCESS.

A process for obtaining soda from common salt, which, if it should prove successful in practice on the great scale, will be an even greater advance upon the method by which what Dr. Hoffman has well called "the most valuable of all known transformations" is at present effected, than in the Bessemer process upon all previous methods of converting iron into steel, has just been patented by Mr. Walter Weldon. At present, the manufacture of "soda crystals" involves six distinct operations, requiring very extensive and costly plant, and a very large amount of both labor and fuel, besides rather more than an equivalent of that costly reagent, sulphuric acid. The first of these six operations consists in causing sulphuric acid to react upon salt at a high temperature, whereby sulphate of sodium is formed, hydrochloric acid flying off as vapor, and being condensed by means of towers filled with pieces of coke over which water is kept constantly trickling. The hydrochloric acid gas enters at the bottom of these towers, and in its way upward comes into contact with so large a surface of water as to be completely absorbed thereby, forming the aqueous solution of hydrochloric acid which is known in commerce as "muriatic acid," or "spirits of salts." The second operation consists in calcining the sulphate of sodium produced by the first operation with coal and lime, in what are called "balling furnaces," the result being the compound known as "black ash," and usually containing about 24 per cent of carbonate of sodium, 12 per cent of hydrate of sodium, or caustic soda, 2½ per cent of undecomposed salt, 2 per cent of undecomposed sulphate of sodium, and 59 or 60 per cent of "soda waste," consisting mainly of a mixture of oxysulphide of calcium with carbonate of the same base. The third operation consists in carefully lixiviating the "black ash," so as to separate its soluble constituents from its insoluble ones, the results being a solution of mixed hydrate and carbonate of sodium, and that insoluble residue which accumulates in such enormous quantities in the neighborhood of every alkali works, occupying valuable space, and giving off most offensive gases into the atmosphere. The fourth operation consists in boiling down to dryness the solution of mixed hydrate and carbonate of sodium, and the fifth in calcining the resulting "soda ash" with sawdust, in order to convert all the hydrate in it into carbonate. The sixth and last operation consists in dissolving the product as the fifth operation in water, and leaving the solution to stand until the carbonate of sodium in it crystallizes out. When a very pure product is required, the crystals first obtained are again dissolved, and the solution so obtained is left to crystallize as before. These six operations occupy altogether about a fortnight, and if the soda is wanted as bicarbonate, a seventh operation has to be performed, which occupies several days more. By Mr. Weldon's process, however, it is said that a large charge of salt may be converted into bicarbonate of sodium by a single operation, which may be performed in twelve minutes, and this, too, without the use of sulphuric acid, or of anything whatever that is not used over again, except coal, and without the production of a single ounce of any kind of "waste." Mr. Weldon's process is said to consist simply in placing within a suitable vessel, capable of withstanding a moderate amount of internal pressure, an equivalent of magnesia and an equivalent of chloride of sodium, or common salt, together with a small quantity of water, and then pumping in carbonic acid gas, obtained by blowing air through a coal fire. The result is said to be that the carbonic acid converts the magnesia into bicarbonate of magnesium, which can only exist in solution, and that this compound, as fast as it is formed, decomposes an equivalent of the chloride of sodium, forming chloride of magnesium, which is exceedingly soluble, and so remains in solution, and bicarbonate of sodium, which is much less soluble, and therefore falls to the bottom. Bicarbonate of sodium is thus obtained at one operation, extending over less than a quarter of an hour, and without the aid of any more costly reagent than can be obtained by the mere combustion of coal. The bicarbonate thus obtained can be converted into neutral carbonate by the application of a very moderate amount of heat, under the influence of which the bicarbonate gives off one equivalent of carbonic acid, which can of course be used over again. The solution of chloride of magnesium is evaporated to dryness, and the residue then heated to a little below redness, when the hydrochloric acid is all driven off, to be condensed in the usual way, and magnesia is left behind. ready for use over again. The magnesia used in the process thus costs nothing after the first time, and the only materials consumed are salt and coal. It is said that by this process soda may be produced at virtually no cost whatever, the value of the hydro chloric acid obtained exceeding the raw material, fuel, labor, wear and tear, and interest on capital. The quantity of soda now manufactured in this country annually is equivalent to about 700,000 tons of "soda-crystals," the present value of which is about £7 per ton. It follows that Mr. Weldon's process, if it should prove successful on the great scale, would save to this country alone, on its present consumption of soda, something like five millions sterling a year.

BURNING MAGNESIUM IN STEAM.

MM. Deville and Caron have found that magnesium will burn brilliantly in an atmosphere of *steam*. They passed steam through a tube containing magnesium, **heated by the flame of a spirit lamp. The** magnesium burnt vividly, liberating hydrogen. They tried the same experiment with zinc, and succeeded in making that metal also burn in an atmosphere of steam, but the temperature required was of course very much higher than in the case of magnesium. MM. Deville and Caron have also found that the presence of the feeblest acid will enable magnesium to decompose water, even in the cold. Water containing carbonic acid is decomposed by magnesium with great rapidity.

IMPROVED PROCESS OF SEPARATING SILVER FROM LEAD.

Pattinson's well-known process for separating lead from silver has recently been improved upon on the continent. After having been melted the lead is run into a crystallizing pan, and its surface covered with finely broken coke, upon which a stream of water plays. The mass of metal then receives a circular motion from an agitator, by which the whole is equally moistened and cooled. A crust forms on the top of the mass in about an hour, which encases the fragments of coke. The water is then turned off, the agitation stopped, and the unsolidified lead holding the silver, drawn off from the bottom of the crystallizing pan.

NEW METHOD OF MAKING ICE.

A new method of making ice has been devised by Signor Toselli, who uses a machine, adapted for household purposes, in which compressed steam replaces the ammonia or other agents in ordinary use. The machine consists of two cylinders, in one of which a solution of common salt is placed and heated. When the temperature of the saline solution reaches about 100 deg., the steam is passed into the second cylinder; after evaporating for an hour the connection between the two cylinders is broken, and the one containing the compressed steam is placed in a vessel of cold water.

A SINGULAR OVERSIGHT OF SEVERAL PHILOSOPHERS.

In his recent lecture on "The Relations of Radiant Heat to Chemical Constitution, Color, and Texture," delivered at the Royal Institution and since published in the *Fortnightly Review*, Professor Tyndall gives a curious instance of how small an oversight may entirely destroy the value of otherwise very careful researches, and of "what extreme caution," to use his own phrase, "is essential in the operations of experimental philosophy." Long before he had proved, as he has since done so completely, by varied and most conclusive experiments, that the fact actually is so, Professor Tyndall was convinced that what had already been established, in relation to the phenomena of radiation and absorption, with respect to gases and vapors and the liquids from which vapors are derived—namely that "the acts of radiation and absorption are molecular, depending upon chemical and not upon mechanical conditions," —must necessarily be true also of solids. At the threshold, however, of the researches which he determined to undertake in order to test the soundness of this conviction, he was met by a multitude of facts, obtained by celebrated experimenters, which seemed, at first blush, quite conclusive the other way. Melloni, for example, had found that lampblack and chalk each exhibited precisely the same amount of radiant and absorbent power, and MM. Masson and Courtepee had performed a most elaborate series of experiments on chemical precipitates of various kinds, the results of which went to show that all such bodies possess exactly the same degree of radiative and absorptive energy, and led the experimenters to the conclusion that "where bodies are reduced to an extremely fine state of division, the influence of this state is so powerful as entirely to mask and override whatever influence may be due to chemical constitution." A host of other inquirers had arrived at similar results, but they had all committed a little oversight which utterly vitiated their work. The nature of that oversight Professor Tyndall thus explained:—"I have here," he said, "a metal cube with two of its sides brightly polished. I fill the cube with boiling water and determine the quantity of heat emitted by the two bright surfaces. One of them far transcends the other as a radiator of heat. Both surfaces appear to be metallic. What then, is the cause of the observed difference in their radiative power? Simply this. I have coated one of the surfaces with transparent gum, through which, of course, is seen the metallic luster behind. Now this varnish, though so perfectly transparent to luminous rays, is as opaque as pitch or lampblack to non-luminous ones. It is a powerful emitter of dark rays; it is also a powerful absorber. While, therefore, at the present moment it is copiously pouring forth radiant heat, it does not allow a single ray from the metal behind to pass through it. The varnish, then, and not the metal, is the real radiator. Now, Melloni, Masson, and Courtepee experimented thus: they mixed their powders and precipitates with gum water, and laid them by means of a brush upon the surfaces of a cube like this. True, they saw their red powders red, their white ones white, and their black ones black, but they saw these colors through the coat of varnish which encircled every particle of their powders. When, therefore, they concluded that color had no influence on radiation, no chance had been given to it of asserting its influence; when it was found that all chemical precipitates radiated alike, it was the radiation from a varnish common to them all which showed the observed constancy." In order to show still more conclusively that the case is really thus, Professor Tyndall performed the following further experiment: He took two powders of the same physical appearance, one of them being a compound of mercury and the other a compound of lead. He spread these powders, without varnish of any kind, one on one surface and the other on another surface of such a cube as that used in the experiment already quoted. Filling the cube with boiling water, and determining the amount of the radiation from the two surfaces respectively, he found that the surface covered with one powder emitted only thirty-nine rays while that covered by the other powder emitted seventy-four. He then took a second cube, having two of its surfaces coated with the same powders, but in this instance by the aid of a transparent gum. The radiative power of the surface coated with the one powder was now absolutely the same as that of the surface coated with the other