AMERICAN INDUSTRIES.—No. 55.

THE MANUFACTURE OF PUMPING ENGINES AND WATER METERS.

Perhaps no department of invention has developed more rapidly than the one we now illustrate. When the attention of Mr. Henry R. Worthington was first turned to the subject such a thing as an independent steam pump was hardly known. Steamboats and steamships had no provision for running either fire, bilge, or boiler-feeding pumps when the main engine was at rest—a condition of helplessness and danger hardly to be imagined at the present time. Steam pumps for mills, factories, hotels, office and public buildings, and the thousand and one uses to which they are now applied were not then known.

The Worthington steam pumping engine, in its latest and best form, has two steam cylinders and two pumps, which are cast together to form one machine, and the pistons and valves of the two engines are so connected that the right-hand division moves the steam valve of the left-hand one and *vice versa*. No tappet, crank, or other rotary device is employed. As the right-hand piston nearly reaches the end of its stroke the other starts, in such time as to keep the water flowing in a constant and unvarying stream. The plungers are thus permitted to halt momentarily, and allow the water valves to seat without slamming, while by the combined action of the two pistons a uniform pressure and velocity of water is maintained. In all other forms of steam pumps, especially when applied to heavy resistances, or run at quick speed, there is more or less concussion of the water valves at each stroke. In a number of important services this objection has led to the exclusive adoption of the Worthington. On oil pipe lines, for example, any jar strains the joints in the pipe and causes heavy losses from leaks. In this service Worthington pumping engines are entirely successful. Some of them now at work have a capacity of 1,500 barrels of oil per day, forced through 100 miles of pipe against a pressure of 1,500 pounds per square inch—equal to a vertical lift of 3,400 feet. This is the most severe pumping service yet undertaken in this country.

The arrangement of this engine allows the use of the ordinary slide valve, such as is found on locomotives and other forms of crank engines. Single cylinder pumps are usually constructed with auxiliary piston valve throws, more or less complicated in detail. The slide valve, on the contrary, is the simplest form of steam valve known to engineers. It has no cavities in which water can collect and freeze; no tight-fitting surfaces to become rusted or adhesive; no leaks resulting from wear, or trouble from unequal expansion of the parts. As one or the other of the steam valves must be open always, there can be no dead point in the stroke. The pump is therefore ready to start when steam is admitted, and is managed by the simple opening and shutting of the throttle valve.

Mr. Worthington's offices are at 239 Broadway, New York; 83 Water street, Boston; and 709 Market street, St. Louis. In the factory, which covers an area of nearly two blocks, in South Brooklyn, L. I., there are about 500 men employed at present, working full time, and large extensions of the works are now in progress to meet the unusual demand which has succeeded the long period of commercial depression. The increase in the demand for small steam pumps for ordinary work, such as hydraulic elevator service, fire protection, railway water stations, boiler-feeding pumps, etc., has been especially remarkable.

A large force of workmen are also engaged in the construction of Worthington water meters. These machines, of which there are now over 20,000 in daily use, have been adopted by all the principal water works in the United States and Canada.

In a pamphlet published by Mr. Worthington, we find a full and interesting history of the rise and progress of his pumping engine, from which we make a brief extract. It was written at the request of the Society of Civil Engineers for use at the Centennial Exhibition. He says:

"Somewhere about the year 1840 I was engaged in experiments with a steamboat designed for canal navigation. It frequently happened that the boat was suddenly stopped by unexpected impediments in navigation or detention at locks. This often brought a hand pump into lively requisition for keeping up the boiler supply, and naturally turned my thoughts toward a labor-saving method. The result was the independent feeding pump, patented on the 7th day of September, 1844. In the course of my experience I made many arrangements for using the spring, other than that exhibited in the patent of 1844.

"This, so far as I know, was the beginning of that numerous class of following inventions for storing power to act upon the steam valve, when the momentum of the moving parts was insufficient to throw it through its full distance of travel.

"The step from this spring motion to the use of an independent piston for driving the valve was obvious enough, and very soon made.

"I should weary you by undertaking to set forth any considerable part of the numerous engines made on the general basis here indicated. I believe almost every change was rung upon a steam valve throw, but in those days the amount of refinement and complication attending their construction and management seemed to be an insuperable bar to their rapid introduction. Upon the smallest provocation the use of a steam pump would be abandoned and the old well-tried arrangements resumed; for no work was fitted up with reference to the exclusive use of a steam pump—it was always secondary. Even so good an authority as the late Mr. James P. Allaire nearly reduced me to hopeless inaction, by saying he considered it his duty to tell me that I was trying to invent a machine that was not wanted; that no part of the machinery, either for steamboats or factory purposes, was more satisfactory and complete than that for pumping. And this appeared to be the opinion of almost every engineer. Another opinion expressed by a prominent engineer of the day, Mr. Alfred Stillman, of the Novelty Works, was sufficiently discouraging at the time, yet of great value, as compelling me to look still further. He came to my works one day to inspect the last and best arrangement of piston valve throw. After a careful and quiet consideration of the case for a few minutes, instead of the approval which I not only expected but needed, he said: 'This is all very well and very ingenious, but if you expect to bring these things into general use you must contrive to have a man see something he has seen before in his life, when he takes the cover off from a steam chest.' There was no appeal in those days from the decision of the Novelty Works, and this one might well be called conclusive.

"The desideratum of a direct-acting steam pump with a simple ordinary slide valve was at last accomplished, and from its discovery may date the real introduction and popularity of a class of machines which now covers the length and breadth of the land.

"I would call attention to a principle of construction first adopted in a pump used on board the steamer Washington in 1850. Up to that time my practice, and I believe the concurrent practice of the day, was to make a large water valve with considerable lift. A moment's reflection will show that when the motion of a pump changes, the valves are in a wrong relation thereto, and must be immediately changed. For an instant of time, therefore, the resistance is suspended much as in the case of a gear suddenly reversed and producing back lash. My idea was, by the employment of a large number of diminutive valves, each one insignificant, and with but a small fraction of an inch of lift, but aggregating in an ample water way, to reduce this lost interval and keep the valves nearer to their seats, thus enabling them to get home in less time. The valve adopted was a plain India-rubber disk half an inch thick, and working upon a central stem over a series of half inch holes, with a lift of not over a quarter of an inch. There were nine of these in each chamber of the Washington pump, making thirty-six in all. I offer a drawing of this pump with its valve arrangement, not only as marking the time of its introduction, but because it represents my present views in the construction of all pumps designed for important purposes.

"I come next to a point in my experience of great importance, involving new considerations and justifying much greater cost and complication of engineering than any hitherto called for in my business. I refer to the department of water works for cities and towns. My first connection with any important enterprise of this kind was at the city of Savannah in the year 1854.

"A duplicate of the Savannah engine was erected at Cambridge, Mass., in the year 1856. This engine was first tested by Messrs. W. E. Morris and Samuel McElroy, with the result of 70,463,750 pounds duty.

"From the time of its first introduction the progress of this engine toward its present popularity has been steady and rapid. They are now found in more than 200 water work stations in this country and Canada, numbering 230 engines, and aggregating, in a delivering capacity, 430,000,000 gallons per day. It may be said, without fear of contradiction, that they have been successful and well approved. Nothing approaching even an inconvenient stoppage of a water supply has yet been traced to their failure. While trivial breakages or the necessity for larger or more permanent repairs has occurred, no breakdown or disaster has ever taken place.

"The remarkable exemption of these engines from the numerous accidents to which ordinary pumping engines are liable, leads to a consideration of the philosophy of their action and cause of this immunity.

"How should a pumping engine be made to reciprocate quietly? A careful consideration of the causes at work suggests the answer. To think of the difficulty is almost to find the remedy.

"I claim that it should be accepted as proved that the cessation of motion at the end of the stroke, for a length of time sufficient to allow the seating of the valves by gravity, instead of by the action of the return currents, will completely obviate noisy, imperfect, and injurious action."

Mr. Worthington concludes this communication as follows:

"I have endeavored to touch upon every point upon which I depend to prove that I have made an important, radical, and permanent improvement in the hydraulic machinery upon which towns and cities depend for their water supply. If the question were only to decide between a durable and reliable engine, or one of opposite characteristics possessing great refinements of construction, it would be without doubt speedily answered in favor of the first-named engine, regardless of relative cost. On these points I trust I have shown that the engine which bears my name has taken and maintained the highest ground, and unless the calculations which I have offered as to the cost of investment be impeached and finally rejected, I may claim to have further shown that the engine is also superior in point of economy, commercially and practically considered. In addition, the size and cost of the requisite buildings are reduced at least twenty-five per cent, and the cost of foundations in much larger proportion. The necessity for stand-pipes or similar provision for softening the shock is obviated. In a word, I am able to point to a record of almost unqualified success in the performance of more than 200 large and important water work stations, unbroken by disaster or change. No water work engine of mine has yet been superseded by one of another form of construction, either for fault or by the demand for increased supply. I therefore respectfully ask that my case may be considered with care and candor, hoping that you will substantiate my claim to the high honor of having originated a pumping engine which is worthy to be mentioned as constituting a part of American progress in this most useful and arduous department of mechanical engineering."

Our first page represents various departments of these immense works, and the works themselves are shown in one of the upper views in the engraving. The central view represents the fine compound pumping engine of the Newark, N. J., water works, having a capacity of 8,000,000 gallons daily. On the right is shown one of the smaller pumping engines, and on the left a water meter. The lower view shows the department in which the heavy work is erected. The work in progress at the time of the sketch and shown in the engraving is one of the heavy engines for pumping oil under great pressure.

Grimmer's Prophecy.

An anxious reader submits a reprint of an extended and direful prophecy made about a year ago by C. A. Grimmer, of Kingston, Jamaica, and asks our opinion of it.

Mr. Grimmer professes to be an astrologist, and to base his predictions upon the position of the four great planets, whose conjunction in 1880 will produce "one universal carnival of death" from 1880 to 1887. During this period the elements are to play high jinks; things will be turned upside down generally by earthquakes and frightful storms, which will convert the whole world into a universal Sodom and Gomorrah. Famines, plagues, inundations, wars of mutual extermination, and other unpleasantnesses will conspire to exterminate pretty much all the animal and human life that escapes the elemental cabobbery, until August, 1887, when the Star of Bethlehem will arise, and things be worse than ever. "After that," the precise time being unhappily not stated, good times will come again, and whoever is lucky enough to remain alive, will live twice as long as he ever did," owing to the healthy electricity or magnetism that will surround the globe."

This general outline is filled in by Mr. Grimmer with a parade of learning and a wealth of horrible detail well calculated to deceive and alarm the timid and superstitious. The circumstance that his astronomy is as wild as his insane imagination takes somewhat from the edge of his prophecy in the minds of the cooler and more intelligent. Comfort may also be drawn from the fact that the larger part of 1880 has already passed away, and yet the malefic influence of Saturn, Uranus, and the rest of the planetary malefactors, has not been able to inaugurate any of the pestilential storms, famines, civil wars, and other horrors predicted. If the rest of the seven years are off the same pattern, as they promise to be, a fair proportion of those now living will be able to look back upon them, by and by, with reasonable satisfaction. Anyhow, it is too early and too late to be badly scared.

An Exhibition of Gas and Electrical Appliances.

The Philosophical Society of Glasgow, Scotland, propose to have an exhibition of apparatus for the utilization of gas, electricity, etc., during the month ending October 25, next. The exhibits will include apparatus, models, and drawings relating to or illustrating:

1. *Coal Gas.*—Its manufacture, purification, storage, distribution, regulation of pressure and measurement. Its utilization in lighting, heating, cooking, ventilating, and as a motive power. Photometric testing of gas or other sources of light. Residual products of gas manufacture, coke, tar, benzole, aniline dyes, ammonia salts, etc.

2. *Oils, Oil Gases, Candles.*—Their manufacture and use for lighting, heating, cooking, and motive power.

3. *Electricity.*—Its generation and application for lighting, telegraphy, motive power, etc.

4. *Hydraulic Appliances.*—Motors suitable for comparison with gas motors, and apparatus for the measurement and regulation of the flow and pressure of water.

5. *Architectural Appliances.*—More especially those which relate to lighting, ventilation, heating, and lightning conduction, and architectural ironwork and sanitary appliances, such as can be exhibited in the open grounds.

6. *Miscellaneous Apparatus.*—Gas lighted buoys, fog horns, miners' safety lamps, fire damp indicators, and apparatus for lighthouse illumination, ventilation of mines, etc.

Hop Growing in the United States.

At a recent annual meeting of the Hop Growers' Association of Central New York, one of the speakers called attention to the remarkable growth of the hop industry of this country, as shown in the following statistics:

Total hops grown in the United States in 1839, 6,193 bales; in 1859, 55,055 bales; in 1879 (estimated), 110,000 bales.

The estimate for the current year runs between 120,000 and 125,000 bales. With the increase in quantity grown there has been a considerable increase in price, the average for the decade just ended being 8½ cents a pound more than the average of the decade just preceding the war.

The English Patent Laws.

The engineering journals and nearly all classes of industrial newspapers of London are seriously advocating a change in the English patent laws whereby the cost of patents shall be so reduced as to enable British workmen to secure to themselves their inventions. Under the present law, which seems to have been enacted for the sole benefit of the capitalist and manufacturer, the rights of the inventor are disregarded. The employer patents for his own benefit his workman's invention, and some of the newspapers find fault with Her Majesty's Parliament for the lack of interest which the members manifest on the subject in not bringing up the new patent bill for discussion.

The *Chemical Review*, lamenting over the inertness of Parliament on the proposed amendment bill, says the subject is attracting no attention within that body, and adds:

"As a nation we forget the old proverb: 'For want of a nail the shoe was lost, for want of a shoe the horse was lost, for want of a horse the rider was lost, and overtaken by the enemy.' A good patent law, which shall enable even the poor man to protect his right to his own ideas, is the nail. May we not then say, 'For want of a good patent law invention was lost, for want of invention our industrial pre-eminence was lost, and for want of industrial pre-eminence the nation was lost, being overtaken by its enemies, or, as they are called in the dialect of the day, its competitors'?

"It is sad, and at the same time almost farcical, to see what 'trifles light as air' engross public attention in preference to what is, in fact, the very key not merely to our prosperity, but to our very existence. The interests of invention ignored, and crowded meetings assembled to protest against the monument to the late so-called Prince Imperial! Surely John Bull must for ever abandon his old claim to practical common sense, and be content to rank for the rest of his days as a maudlin, moon-struck, hysterical sentimentalist!"

ENGINEERING INVENTIONS.

Mr. Marshall Wood, of Alderson, W. Va., has patented an improved railway switch which is adapted to be opened and closed by the passing engine, and it dispenses with the frog usually placed at the crossing of the rails of the switch and main track.

Mr. Eugene H. Angamar, of New Orleans, La., has patented improved apparatus for removing snow and ice from railroads and streets by heat; and the invention consists in a double furnace mounted on wheels, the wheels being incased within the fire boxes of the furnace, so that when used the whole apparatus will become highly heated, and the snow and ice melted by radiation of heat and contact with the heated surfaces.

Mr. John G. Curtis, of Ludlow, Pa., has patented a sectional boiler. The object of this invention is to provide a simple and inexpensive boiler, designed especially for burning wet tan, sawdust, etc. It is so constructed that the tubes may contract and expand without straining the joints, and so that any of the tubes may be removed for repairs and replaced without disturbing the others.

Mr. Junius Poitevent, of Ocean Springs, Miss., has patented an improved traction engine, so constructed that it may be used at will with full power for traction purposes, or as a stationary engine. The engine is especially adapted for plowing.

The Mexican Calendar Stone.

A Mexican archæologist, Señor Alfredo Chavero, has written a book to prove that the famous Aztec "calendar stone" was never intended or used as a calendar. His study of Aztec hieroglyphs leads him to the conclusion that the stone was an altar of the Mexican sun god, and the characters, hitherto supposed to be signs of the zodiac, are records of Aztec cosmogony and theogony. When they are fully interpreted, he says, we shall know positively what progress the Aztecs had made in science and religion.

Platinum and Iridium in Maine.

The list of metals now found in native condition in Maine comprises copper, silver, gold, antimony, bismuth, platinum, and iridium. The last two have recently been found in the Rangeley Lake region, associated with gold, by Mr. R. B. King, of Portland. In reporting upon some of the specimens furnished by Mr. King, the State Chemist, Mr. F. L. Bartlett, says:

"My analysis proved the compound to be gold, platinum, and iridium, and possibly osmium and some others of the rarer metals, although no tests were made for anything but gold, platinum, and iridium, the quantity not being large enough to operate on in testing for other metals, which at best occur only in minute quantities, yet usually associated with the platinum ores."

Mr. King also submitted for analysis some peculiar black sand, suspected to contain tin. It proved to be menaccanite or titaniferous iron, containing over twenty-five per cent of titanium. The finding of so many rare elements together, adds Mr. Bartlett, is interesting, and calls for further exploration. Platinum is a rare and valuable metal, and it appears to be quite abundant in the sands from Rangeley; it is not at all improbable that it may yet be worked to advantage in this region.

SOME NEW ELECTRICAL MACHINERY.

We give engravings of electric light machinery lately perfected by H. S. Maxim, M.E., of this city.

Fig. 1 represents a double current machine, so constructed that it furnishes two separate currents entirely independent of each other, that may be used to produce two large electric lights, or may be coupled for quantity in one very large light, or may be coupled for tension in one strong current of great electromotive force. It is, therefore, not only well calculated for the electric light, but makes an admirable machine for scientific and experimental purposes. The Maxim machines of this kind are called dynamo-magneto-electrical, as they convert dynamic energy through the agency of magnets into electrical energy. In the construction of these machines great care is required to so arrange and proportion the parts that the greatest possible amount of the energy consumed appears in the electrical current. Not only must the current be accurately measured, but the power employed to produce it must also be measured.

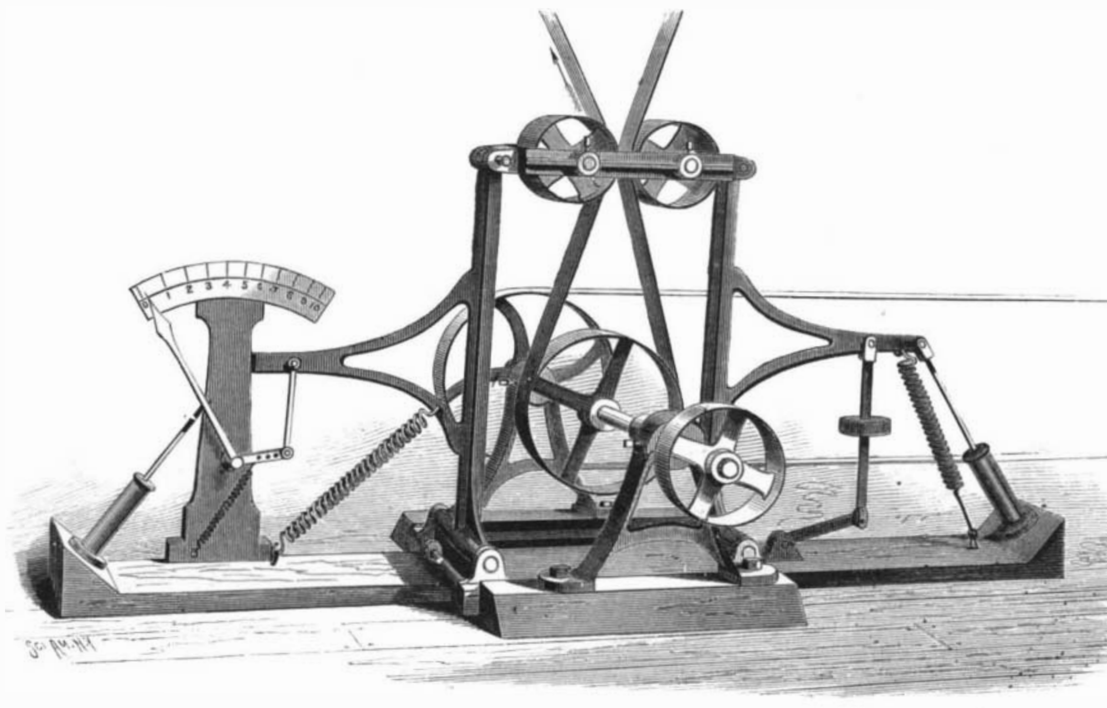

Fig. 1.—MAXIM'S DYNAMOMETER.

Mr. Maxim has constructed a peculiar dynamometer, shown in Fig. 2, to measure the power consumed in these machines. It is driven from above by a large pulley, not shown. The two small pulleys that hold the belt together are mounted on a vibrating frame, pivoted at the bottom and operating freely. The belt for driving the machine is run from either pulley of the countershaft. When no load is on, the pull on both sides of the belt is the same, and there is no tendency to move the framework in either direction; but whenever anything offers resistance to the rotation of the countershaft, one side of the belt is pulled, while the other is correspondingly slackened. This, of course, draws the pulleys in the direction of the taut side, and just in proportion to the difference in the stress between the taut and slack sides of the belt. The greater the resistance to the rotation of the countershaft, the greater will be the deflection of the framework carrying the small pulleys. A weight and spring are provided for pulling against the belt. Dash pots at each end prevent a too rapid motion of the parts. The pointer is so connected with the frame that it moves through a considerable distance, so that a small fraction of a horse power may be noted.

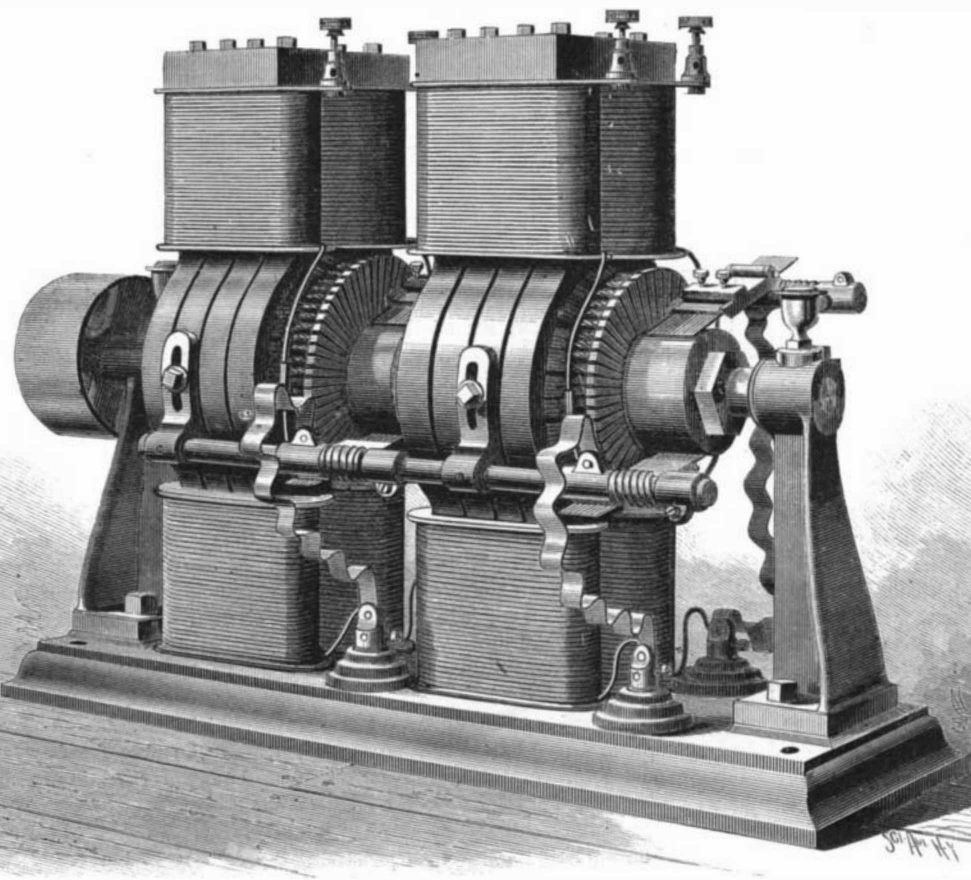

Fig. 2.—MAXIM'S DYNAMO-ELECTRIC MACHINE.

In experimenting with the electric light in connection with this delicate dynamometer the following phenomena have been noticed: When two carbons, carefully filed to the shape ordinarily assumed in the process of consumption, were placed in a lamp and the machine started, the recorded power would go up to four (horse power). If they were drawn apart in the attempt to diminish this power, the light would go out; but when they became considerably heated, the power required would drop down in some cases to 1·75, only to remain for a few moments, when a slight evolution of gases would diminish the resistance in the voltaic arc, and the pointer would go up to 2·50, while a hissing sound would be produced and a considerable augmentation of the flame of the arc.

At times, when the light was perfectly steady and the play of the voltaic arc was confined to the points of the carbons, with no hissing and very little flame, the power required was the lowest. An iron wire touched to the positive carbon for only a moment would keep the pointer up to 4 for fully half a minute. It was found that pure carbons caused but little variation, while metallic vapors in the flame required the most power. Every fluctuation of the flame or change in the pitch of the note emitted was accompanied by a corresponding fluctuation in the power required to operate the