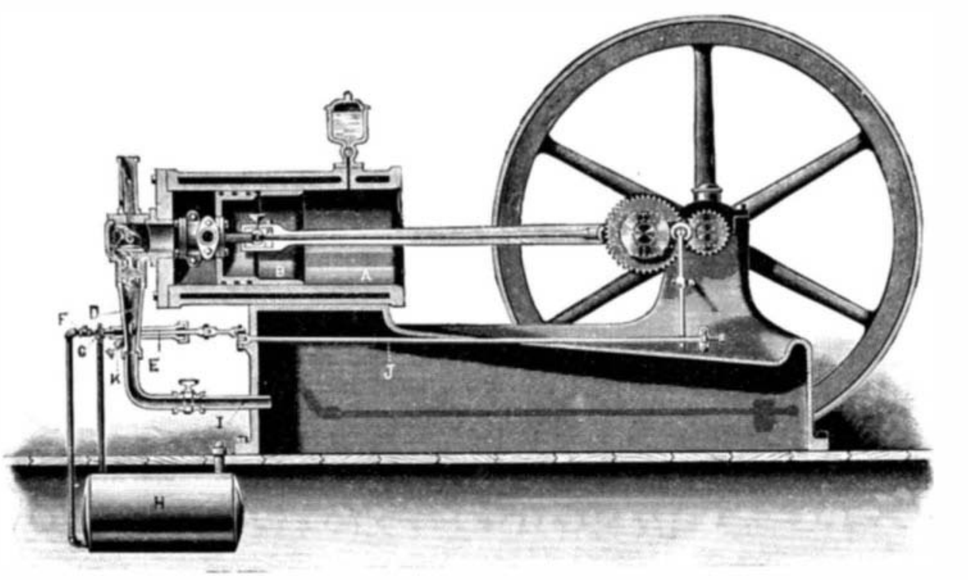
AN IMPROVED GAS ENGINE.

The facility with which an engine run by gas or gasoline can be set up and run in almost any location, being always ready for work, yet costing nothing for attendance and not using any fuel except when it is at work, always carries great weight in aiding the introduction of these most convenient motors. The Improved Charter gas engine, shown in perspective and in section in the accompanying illustrations, is for gasoline, coal gas, natural gas, or producer gas, and it has been perfected by years of experience, until it is deemed to be about as simple and effective as it is possible to make such an engine. In its construction all weak and delicate parts have been avoided, making it economical, automatic, safe and clean, while it is, as with all engines of its class, always ready for work. It develops full power at once and does not increase insurance, while the cost of running is in exact proportion to the work done. The supply tank, as will be seen, is lower than the engine, so that as soon as the latter stops work the oil in the pipe flows back to the tank. The engine will work equally well on manufactured or natural gas, calling only for the attachment of a gas valve and requiring no change in the engine. As to the economy of its work, the engine uses only one gallon of 74° gasoline in ten hours to the indicated horse power when doing full work. The price of the gasoline varies from 7 to 13 cents per gallon, according to the quantity bought and location of the purchaser, but with an average price of ten cents a gallon, the cost of running the engine would be only one cent per hour for each indicated horse power. The engine is so simple in construction and operation that an unskilled hand can always see at a glance whether it is working right and give it all the attention needed.

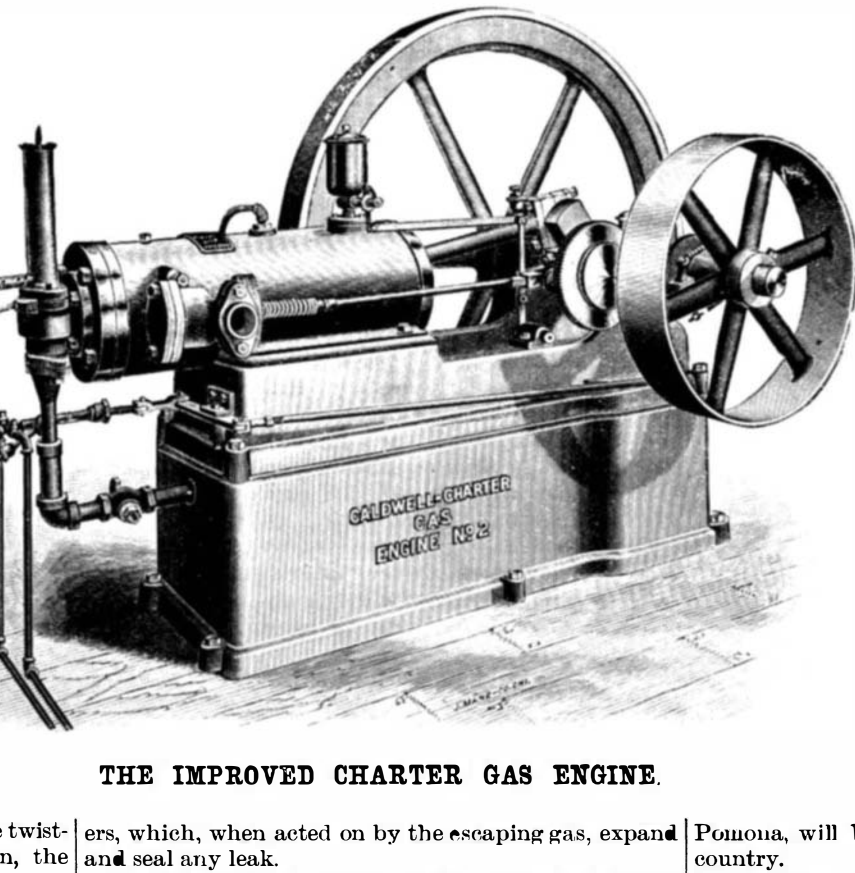


THE IMPROVED CHARTER GAS ENGINE—SECTIONAL VIEW.

Instead of attempting to govern the exact charges of gasoline, which has proved so difficult because so delicate in engines, the Improved Charter engine is so constructed that a simple pump draws from the tank a charge of gasoline much greater in quantity than is required for carbureting the present charge of air. The pump remains open or at its outstroke during the time the air is being drawn into the cylinder past the nozzle or pipe. This pipe or nozzle is connected to the gasoline chamber in the pump, and the throttle valve so regulates the gasoline that the air can only carry a fixed quantity with it. The gasoline which remains in the pump and its valve chamber is immediately forced out of the way of the nozzle in the air pipe, and the surplus returned to the tank. In this way all delicate regulation is avoided. It will readily be seen that should there be any slight wear to the pump mechanism, such wear will not affect the working of engine, as the quantity of gasoline will always be more than sufficient to supply the small amount needed.

In the sectional view, A is the cylinder, B the piston, C the inlet valve to cylinder, D mixing chamber, E is gasoline pump, F and G check valves, one opening inward, the other outward, H is the gasoline supply tank, I is the air suction pipe, J is a connecting rod coupled to the gasoline pump and operated by the governor, K the supply regulating valve. The oilers are automatic, requiring no attention except filling of cups, and the construction insures perfect and permanent alignment of engine. All wearing parts are of materials best suited for service required.

The sole manufacturers are H. W. Caldwell & Son, Washington and Union Streets, Chicago, Ill.



THE IMPROVED CHARTER GAS ENGINE.

How to Draw Microscopical Objects.

There has always been a certain amount of difficulty attending the use of the camera lucida or Beale's neutral tint reflector for the above purpose. The twisting of the head into an uncomfortable position, the great fatigue to the eyes, and the by no means easy task of viewing both image and pencil at the same time, add to the troubles of making a faithful likeness of the object on paper.

To those especially who do not possess a camera lucida or Beale's instrument, and to microscopists generally, I recommend the following arrangement of ordinary apparatus: The microscope body is placed in a horizontal position, and the mirror removed from its substage attachment. The microscope slide having been placed on the stage, the illuminant (lamplight for choice) is "condensed" on the slide by means of a "bull's eye" in the same way as for photomicrography. Care must be taken to "center" the light. The concave mirror is then attached to the front of the eyepiece of the microscope by a piece of thin wood or a spring, and has its surface at an angle of about 45° with the plane of the anterior glass of the ocular. The image is thus projected on to the paper beneath. No distortion will occur if the outer ring of light is perfectly circular. A dark cloth, such as photographers use, is thrown over the draughtsman's head, and also the body of the microscope, and all light excluded save that through the microscope lenses. Any section can thus be easily, rapidly, and comfortably drawn, and accurate representations of objects magnified up to 500–600 diameters can be obtained.—*A. Hopewell Smith, in Jour. Br. Dental Asso.*

Fluorine.

BY HENRI MOISSAN.

I was the first person to obtain the element fluorine in a state of purity, and this I did for the first time in the year 1887. Since then I have considerably enlarged and improved my apparatus, which is now capable of turning out 160 cubic inches of the gas an hour. I obtained this result by passing a strong current of electricity from twenty-six or twenty-eight Bunsen batteries through hydrofluoric acid in which was dissolved a metallic compound, to increase the conductivity. Every part of the apparatus is constructed of platinum with stoppers of flourspar, through which pass the wires conveying the current. The purifying vessels, tubes, and connections are also of the same metal, fastened together by nuts and flanges with lead washers, which, when acted on by the escaping gas, expand and seal any leak.

The tube in which the generation takes place is kept at a temperature of −9° F. by the evaporation of a very volatile organic liquid contained in an outer vessel, and the first member of the purifying series at −58° F. by the same means; the greatest care having to be taken that even the vapor of the refrigerating liquid does not enter any part of the apparatus, or else violent explosions occur.

Fluorine gas is of a yellow color, with a smell resembling bleaching powder. Every precaution has to be used in studying its action on other bodies, both on account of its dangerously irritating action on the eyes and mucous membrane of the operator and its marvelous energy, far exceeding that of anything hitherto discovered. There is hardly a gas, liquid, or solid that it does not attack, usually, with the greatest violence; in fact, its mere contact with any other substance is nearly always signalized by the sudden evolution of intense heat and light and loud detonations.

As a supporter of combustion, fluorine leaves oxygen far behind. Lampblack bursts immediately into brilliant flame and gets red hot in a current of fluorine gas, and charcoal is made to give an interesting exhibition of its porosity, by first filling its interstices with the gas and then burning spontaneously with sparkling scintillations. The diamond, however, is able to withstand its action, even at high temperatures. Silicon, a crystalline substance closely resembling the diamond, gives a very beautiful reaction, showers of brilliant spangles being scattered in all directions from the white hot crystals, which are finally melted. As they do not fuse under 2,190° F., some idea can be formed of the immense energy set free during the combination.

All the metals, with the exception of gold and platinum, are rapidly attacked by fluorine, and even those in less degree. Iron combines in the cold with splendid energy, becoming white hot; and rust, when heated, behaves in a similar manner. Zinc, if slightly warmed, bursts into gorgeous luminosity, accompanied by bright white flames, so intense as to be almost blinding. Mercury is attacked violently in the cold. I once attempted to pass a quantity of the gas into a tube standing over mercury protected by an inert fluid; but when inclining the tube, the two elements came into contact, there was a violent detonation, and the containing vessels were broken to atoms; with silver very little action occurs until 212° F. is reached; at a red heat, however, incandescence is observed, the product melts, and, on cooling, has a sheen like satin. Gold, on heating, forms a volatile fluoride which, when carried to a slightly higher temperature, splits up again into the metal and the gas.

The behavior of liquids with fluorine is usually very energetic, and experiments have to be conducted with much caution. If the gas be passed into the middle of alcohol, the result is very striking; the whole mass is violently agitated, and each bubble, as it appears, becomes incandescent in the middle of the liquid, finally vanishing in flame. If a few drops of chloroform are shaken up in a tube full of fluorine gas, a violent explosion takes place, and the tube is reduced to fragments.

Hydrogen combines fiercely with fluorine, even in the dark, and at −9° F., the issuing stream burning with a blue flame, bordered by red. In every other known case, heat or some form of extraneous energy is required to induce the combination of elementary gases. Oxygen is one of the few bodies that appear to have no affinity for fluorine. Even when they are heated together up to 932° F., nothing is observed to take place between them. If a few drops of water are placed on the floor of the experimenting tube and fluorine gas is passed in, a dark fog is seen surrounding each drop, which presently clears and resolves itself into a characteristic blue vapor, apparently more than an inch in thickness, and which is found to be that most interesting condensed form of oxygen—ozone—in a state of great density.—*Annales de Chimie et de Physique.*

Pomona Electric System.

The power plant of the San Antonio Light and Power Co., of Pomona, will be one of the most interesting in the country.

The power plant will be located, it is said, in the San Antonio canyon, about 15 miles distant from Pomona. At this point is a fall of some 425 feet, with a minimum flow of water of about 1,300 cubic feet per minute, or, approximately, 1,000 hydraulic horse power. This water power will be somewhat expensive to develop, as it is necessary to build a tunnel 1,300 feet long through a spur of San Antonio Peak, which is practically of solid rock.