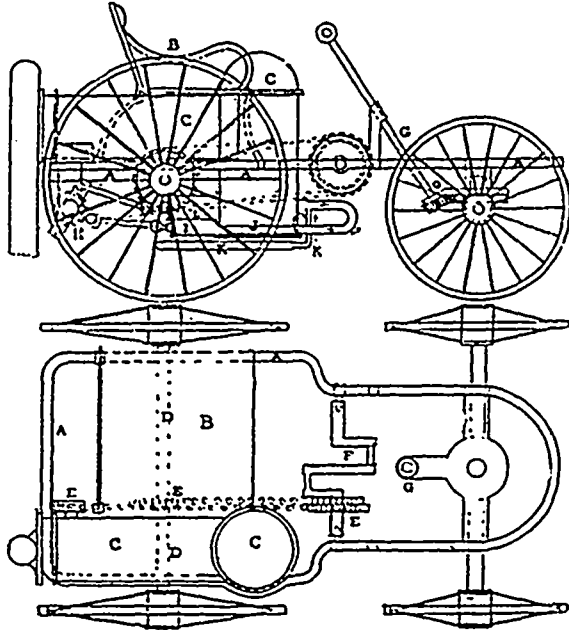


planing machine, and by the putting of the leading screw into lathes, and it was there, too, that the famous calculating machine was made for Charles Babbage. Wilkinson got the idea of building a light motorcycle from seeing the heavy steam carriage at the great exhibition of 1862. It only weighed a hundred weight. Mr. Wilkinson is still working at the motorcycle problem, and hopes to make as great an advance in the future as he did in the past.



The cut above gives a rough idea of this early vehicle. *A*, gas tubing frame. *B*, seats for two. *C*, steam generator fitted with tubes. The vertical ends the tubes when in coils, the horizontal part when straight tubes, and the flame sucked through by the exhaust steam at the end of generator. *D*, driving axle. *E*, pitch chain wheels and chains for driving from the engines to the pedal crank, and further by another chain to driving axle *D*. *F*, pedal crank to assist at starting, or hills, or in case of breakdown. *G*, steering gear. *H*, engine crank, with chain wheel at end *E*. *I*, air pump for forcing air with the petroleum into the generator. *J*, tube for air blast, connected with air pump *I*. *K*, petroleum tube connected under the seat with the oil supply. The oil is sucked up by the air blast *J*. *L*, engines, double cylinder.

IRON MANUFACTURE.*

BY WM. SMAILL, B.A., SC.

The three principal forms in which iron is in general use are cast iron, steel and wrought iron. These differ from one another in the amount and conditions of the contained carbon. It is a well known fact that iron has been known to the world for about 5,000 years. Even to-day in the uncivilized and semi-civilized portions of the world we can find the crude and ancient forms of manufacture that were in use in those ages. The open fires built on a hillside or some windy, exposed position, come first, then the low open mud furnaces using forced blast, the pneumatic apparatus being of many different kinds: Skins sewn into bags for bellows were trodden on by the workers' feet; bamboo tubes, with pistons packed with feathers or leather and operated by manual labor. These many forms and varieties of open fires lead up to the Catalan forge and American bloomery, the blast being generally supplied by the water trompe.

All these methods produced wrought iron, or iron of a steely nature from the ore direct. They are practically only of historical interest, being very wasteful in fuel and iron, requiring very pure ores and charcoal for fuel; their capacity was so small that they are not in the least suited to meet the enormous demands now made for iron. With few exceptions, all the iron at the present day is obtained by the production of pig iron, which is afterwards converted into wrought iron or steel. When we bring an iron ore into contact with carbon, at a high temperature, either in the form of solid carbon or a gaseous compound, first, we get the ore reduced to a metallic, spongy mass of wrought iron; if exposed to the action long enough and at a sufficient temperature, the iron becomes carburized to such a degree that it becomes fusible and is known as cast iron. To carry out this operation on a manufacturing basis, we must first have a considerable-sized furnace, and the substitution of earthy fluxes, instead of iron, for the removal of the impurities of ore and fuel. By proper variation of the ore, fluxes, fuel, blast, heat of furnace, etc., the reduction of the ore, carburization of the iron, and combination of the metalloids with the iron, may be made to range through greatly varying limits, and products which differ greatly both in chemical composition and physical properties are obtained under the name of pig-iron.

Charcoal was the fuel used in all the earlier operations for the production of iron in all its forms. In England the consumption of wood was so great, and forests were being denuded so rapidly, that an Act was passed in 1581 restraining its use to very limited sections of the country. The first to use mineral fuel in a blast furnace was Lord Dudley, about 1620. He found it worked satisfactorily, and obtained a patent of monopoly for 31 years, but his furnace and plant were destroyed by the men, who were opposed to such innovations. This experience deterred others from using coal, and it was not till nearly a century afterwards, when people became again alarmed at the increasing demand and growing scarcity of home timber, that the use of coal became general.

About 1785 an ironmaster by the name of Henry Cort, of Gosport, Eng., after many years of patient research and tiresome experiment, which cost him some \$100,000, patented two inventions: first, the conversion of pig iron into wrought iron, using the flame of pit coal in what is known as the puddling furnace; second, the drawing of the iron into bars, etc., by means of grooved rollers, which operation was previously performed by means of hammer and anvil. Puddling and rolling reduced the cost of labor and manufacture to about one-twentieth, at the same time yielding a much better quality of iron. He was robbed by government officials of his business, property and all income from patents, and died in poverty.

It was remarked by early furnacemen that a furnace would drive better, i.e., make more iron in the same time in winter than in summer. The reason, of course, is the lesser amount of moisture in the air, and it being somewhat condensed, they were supplying more oxygen to the fuel in the furnace, running the blowing machine at the same speed as in warm and damp weather. Then we have various unsuccessful experiments and trials made to cool the air before entering the furnace. At one time it was proposed to pass the air through long pipes containing quick lime to remove the moisture, but this was never tried.

* A paper read before the Applied Science Graduates' Society of McGill University, and published exclusively in THE CANADIAN ENGINEER.