to tap at 5 o'clock, when the consumption of electric energy was 1,680 kilowatt hours, equivalent to 0.257 E.H.P. years, equal to 0.100 E.H.P. years per 2,000 lbs. of steel.

It will be noted here that, starting entirely with nearly carbonless scrap iron, the first product obtained is soft steel; to produce high carbon steel this has to be carburized by suitable additions. Consequently, the metal has to be kept longer in the furnace to produce high carbon steel than low carbon steel, and the consumption of electric energy is greater in the former than in the latter case. This is just the reverse of the method of working at

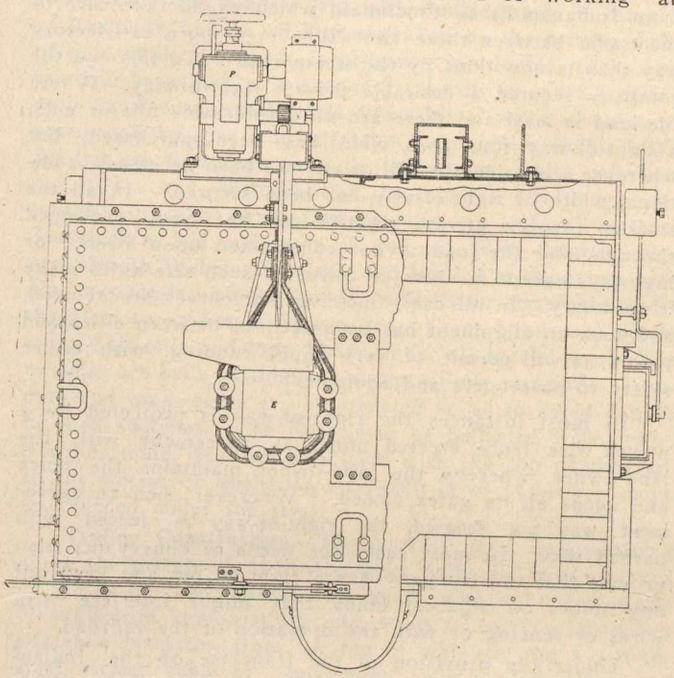

Fig. 5. Plan.

Gysinge, where the time taken in producing soft steel is longer than for high carbon steel. The methods of working, however, in each case depend more upon the materials available than any other consideration, and there would be no difficulty in making high carbon steel without recarburizing, by melting down a suitable mixture of pig iron and scrap in the La Praz furnace; and on the other hand, pure scrap could be melted down in the Gysinge furnace and recarburized at the end of the operation, if desired.

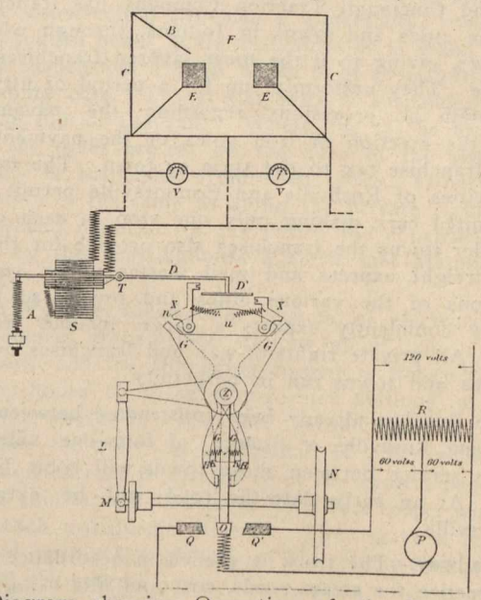

Fig. 6. Diagram showing Operation of the Regulation of the Electrodes.

Cost of Production.

On this aspect of the subject, Mr. Harbord says: "The consumption in electrodes, when working continuously, was 500 kgs. per week, and 50 per cent. of old material, costing two centimes per kg., was mixed with 50 per cent. of new material, costing 10 centimes per kg., thus costing about 30.00 francs for an output of 30 tons of steel. The average output per 24 hours was four tons; figures furnished by M. Héroult from his book showed an output of 120 tons for 30 days' consecutive work, and he considers that he can make 150 tons in this time. The average time for each charge was nine hours, and there were five men employed on the furnace each shift, including the foreman. In these men are included the ladleman and pitmen. The repairs and renewals are somewhat heavy; burnt dolomite, costing 3 frs. per ton of steel produced, magnesite 1.5 frs., and acid refractories, including roof, about 2.5 frs. per ton, making a total of $1.40 per ton for refractory materials. It is extremely difficult to make a statement showing the cost per ton, as this will necessarily depend upon the price of scrap, labor, and refractories in the district; but as any scrap is suitable for this process, the price of the raw material is never likely to be very high and may, as a rule, be taken to be about the same price as pig iron delivered at the same place. In England, the price of common scrap will vary from 45s. to 60s. per ton, but can generally be bought at about 50s.

The cost, as regards materials and labor, will be practically the same as for a gas-fired Siemens furnace of the same size, making similar steel. Any difference in the cost will be due to the cost of electric energy and electrodes, as compared with the cost of fuel. Repairs will probably be higher, but not sufficiently to affect the cost of production. In a small Siemens furnace of this capacity, the fuel consumed would vary from 1,000 lbs. to 1,800 lbs. of good slack coal, i.e., small coal, per ton of steel produced. Such coal would probably cost $5 to $5.50 per 2,000 lbs., in Canada, and assuming 1,200 lbs. to be used per ton, this would be $3 per ton of steel. The cost of electric energy, at $10 per E.H.P. year, would be $1.53, and electrodes are estimated to cost 20 cents, making a total of $1.73 against $3, so that there is a balance in favor of electric smelting, assuming the cost of materials and labor to be the same.

I think, however, it would be extremely difficult to make steel of such high quality in a basic gas-fired furnace, as with the greatest care the steel is always liable to absorb some sulphur from the gases, and this has a very serious influence on the working qualities of high-class tool steel. This would especially be the case if the process were conducted on the same lines as to the removal and the renewal of the slag, to eliminate the last traces of phosphorus, and working with ordinary scrap, there seems no doubt that the quality of the steel produced in the electric furnace would be superior.

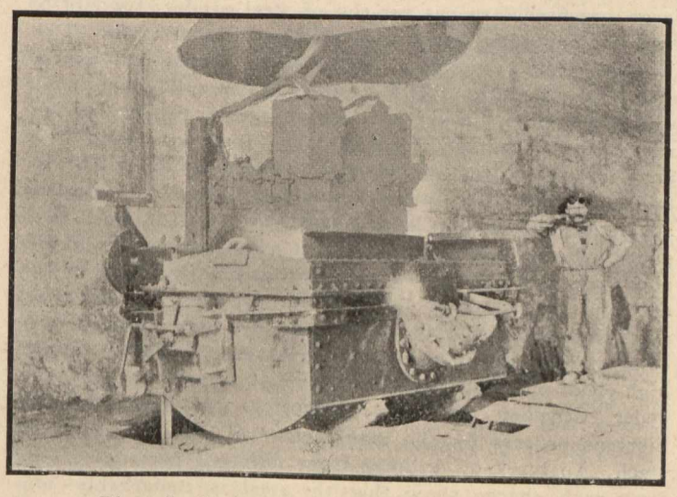

Plate I. General View of Heroult Furnace.

So far as I am aware, there is no Siemens gas-fired furnace working with miscellaneous scrap which is making tool steel of this quality, although it may be possible to do it with specially selected materials. The real comparison, however, should not be made with the Siemens process, but with the crucible process, as it is with crucible steel that electric steel is competing, at all events at present. The advantage in working costs with the electric furnace is so considerable, that under the same conditions as to labor,