Mechanics.

ANOTHER CHAPTER ON BOILERS.

By P. S. of Toronto.

(Continued from page 223.)

It is now time we should get the engine to work, the steam guage indicates 20 lbs. When she is working we will set down again and make some calculations. I want you to go down to the pumps and let out the air by opening the tap in the plunger-case, stop the outlet with your finger when the plunger comes up and remove it when it goes down, until the water comes out. The drain taps are all open, and now for the steam. I will work her a few strokes with my hand and then will let the eccentric hook fall into its place ; there she goes nicely. Close the drain taps a little, and watch the water gauge, it is oscillating pretty much, the water is driving out the air from the pipes. We will now look at the exhaust ; it leaves the pipe nicely in balls regularly, open the feed tap so that the water will fill the heater pipes, the steam is gaining 25 lbs., while the water gauge has run up to 50 lbs. in ten minutes, our water is down two inches below the line, we will now open the feed tap so that the water may slowly gain in the boiler, we have a good draft, and the steam is going up the boiler, is expanding but it is free, not touching anything, we are now running 30 strokes per minute, our taps are full and running into the tank in 20 minutes, the steam guage shows 50 lbs. the safety is just beginning to blow off, so close the damper. The water gauge is now oscillating between 100 and 150 lbs. every stroke, she is working very nicely, the water in the well is rising and falling every stroke. Our air vessel is six feet high, by 2½ feet diameter ; put your ear to it and you will hear the valves of the pumps open and shut ; see that mark around the air vessel, about ⅜ up, you can see and feel where the water and the air meet, it acts on the water better than any spring could be made had it not been for that spring or air, then we would have burst some of the joints, or burst the pipes because the water does not go into the pipes at an uniform rate, but in squirts. You ask me how much water is each pump pushing into the pipe every stroke, well we will calculate, each pump plunger is 4 inch diameter, and two feet stroke, now 2-4 $=16\times24$ inches$=384$ cubic round inches + by 353·03 the number of round inches in a gallon$=1{\cdot}08$ gallon per stroke for each pump $\times2=2{\cdot}16\times30$ the number of strokes per minute$=64{\cdot}8$ gallons per minute $\times60=3888$ gallons per hour besides pushing along 1,500 yds. of water in the 4-inch pipes and rising 150 feet above the fall of the water in the well. We now find by closing our dampers, we have reduced our steam to 25 lbs., and yet she is going on the same rate, we have opened our steam valve in proportion. I would rather do so than keep up the steam to 50 lbs. and keep the dampers open so much, so as to allow the fire to burn gently and naturally, than to give full draft, to a smaller boiler and engine ; we will run on less fuel ; you see we are feeding with water at 150 Fah, all the time just enough to keep the water in the boiler ¾-inch below the water line, or ¼ above the upper tubes, by so doing we congenerate steam faster and with safety, because the fire does not touch these tubes, but only the gas, about 500 Fah., in the smoke box and about 350 Fah., at the chimney, while the steam in the boiler is about 275 Fah. You say to me, that is strange, the engine is now working with 25 lbs. of steam, and moving a pressure of water at 120 lbs. on the square inch. I would like to see you calculate the power of the engine, we will do so after we have oiled her a little.

Before we begin to calculate the power of the steam by horse-power, we will have a run down on the railroad of time, and history of the steam engine, and get out at the station of the year 1663, here, we find, the Marquis of Worcester has a square boiler with circular sides, bolted together at the corners, built in with brick-work, the steam from this boiler is carried to the surface of the water in the well by a pipe, which makes a partial vacuum or removes the weight of the air from that part of the surface of the water while the air is pressing on the other part of the surface of the water, and forces the water up the other pipe, for there must have been two employed in this operation ; by this plan you can see what the common pump does when the handle is moved up and down ; it does not do as a great many people think draw the water, it need not, it simply draws up the air from that part of the surface of the water in the pump, and then the pressure of the air on the surface outside nearly 15 lbs. at the level of the sea per square inch, forces the water up above the lower valve, while the bucket or plunger of the pump brings or forces it through another valve into the discharge pipes. If we can raise water within Ontario 28 feet with a common pump, we may consider it pretty good, but down at the sea level it can be raised 50 feet, mark the difference between raising and forcing. By this means, (or engine the marquis calls it), water was raised several feet. Forty years ago from this time, a globe-shaped boiler was made and the steam was directed by a pipe against the fans of a wheel on journals and a crank which worked a steamboat in Spain, and a drug or medicine mill for Dr. Denys Papin in England, who invented the safety valve cylinder and piston. Being assisted by several other doctors and learned men, they produced by the great help of Thomas Newcomb, a Dartsmouth blacksmith, in Devonshire, England, the first atmospheric engine ; in the year 1705 the engine was used in one of the mines there for pumping out the water. This engine or cylinder only took steam under the piston and pushed it up and then it was condensed by a jet of water let in, which made a partial vacuum, the weight of the air or atmosphere pushed it down, which worked the pump by the beam fastened to the piston rod. In the year 1710 one of those engines was erected in a coal mine in Warwickshire, which employed 500 horses costing £900 per year. The steam and water taps had to be opened and shut by hand, many plans were invented and improvements made. Springs and weights soon took the place of the hands. In the year 1767, Mr. Smeaton, Mr. Brighton, and others made the safety valve lever and weight. They made a cylinder and pump 18 inches diameter each, and made the beam longer on the pump side than the piston, so as to give a longer stroke to the pump and get 10½ lbs. on the square inch on the piston, and when the water, condensed steam came out of the cylinder, it was 180 Fah. and by this means the latent heat of the steam was discovered, or better understood, that is, one gallon of water raised into steam 15 lbs., 252 Fah. will heat 5½ gallons of water from 32° up to 212°, or in other words, will heat nearly 6½ gallons of water up to boiling point. In the year 1774, Mr. Smeaton put in in Long Brenton Coal Mine a 52 inch diameter cylinder and ten feet stroke ; all over Europe men's minds were working about the steam invention ; in fact they had the steam engine on the brain, and, was foretold by many what great feats would be accomplished by it, in our day, as we tell what will be done by future men with electricity and other powers hidden by nature from our view. In the year 1736, James Watt was born in Greenock ; at the age of eighteen he was apprenticed to a mathematical instrument maker and repairer. In those days it meant such as colleges, doctors and land surveyors. Instruments clock-work, cutlery, ship's compasses, quadrants, etc. And in the year 1757, he was appointed and admitted into the Glasgow College University as Mathematical Instrument Maker. In the year 1759, he had to repair a modal of Dr. Papin's engine, which led him to suggest improvements. In 1763, he also had to repair one of Newcomb's engine models, which led him to make experiments, by first making a separate condensing cylinder and letting the steam into it by a valve whereby the piston cylinder was cooled by the jet of water, but formed a vacuum at once and increased the speed of the engine, it then occurred to him if he put a cover on the top with a stuffing box, he could make the piston move up and down by steam, increase the pressure of the steam to two atmospheres, and also increase the speed, here he got on, as he said, the weak side of nature or her laws. To work his condensing cylinder, he had to put in an air pump which he did, and it worked well. His next move was to make a large engine (protected by his patent) for one of the Cornish mines, to draw up the water, it worked well, but he wanted more power, to draw up the water with such a heavy pump rod in a deep mine ; he then thought if he could get the steam on the top of the piston, to draw it up, instead of in the bottom, to put it down, he might do better and besides he had to force the water up through a pipe attached to the pump, the weight of the pump plunger and rod would help do so ; here he was forced to try what he could do with a cover ; on this being done he was led to think about a different shape valve for admitting the steam into the cylinder (during all this time he had many friends in the college, Dr. Dick, Dr. Black, Mr. John Robinson and other professors gave him good suggestions). Instead of a piece of chain attached to connect the piston rod and the beam, he was forced to invent and make the parallel motion which required such a mathematical mind as he had to work out. Here we see him working and thinking about the slide valve and the cylinder, how to let the steam in and out at the same time. Mr. Gainsborough, Mr. Hornblower and others, disputing with him about the right of his patent ; at this point he was obliged to invert and make the equilibrium valve, now used in mine engines, that is, to let the steam from the upper part of the piston, to the lower part to balance the weight of the pump rods in the