

means of a long pipe of one inch diameter, with the bottom of his little cylinder of four inches diameter and 30 inches long. This pipe had a stop-cock, and the globe was immersed in a vessel of cold water. When the piston was at the top, and the cylinder filled with strong steam, he turned the cock. It was scarcely turned, nay he did not think it completely turned, when the sides of his cylinder (only strong tin-plate) were crushed together like an empty bladder. This surprised and delighted him. A new cylinder was immediately made of brass, sufficiently thick, and nicely bored. When the experiment was repeated with this cylinder, the condensation was so rapid, that he could not say that any time was expended in it. But the most valuable discovery was, that the vacuum in the cylinder was, as he hoped, almost perfect. Mr Watt found, that when he used water in the boiler purged of air by long boiling, nothing that was very sensibly inferior to the pressure of the atmosphere on the piston could hinder it from coming quite down to the bottom of the cylinder. This alone was gaining a great deal, for in most engines the remaining elasticity of the steam was not less than one-eighth of the atmospherical pressure, and therefore took away one-eighth of the power of the engine.

55. Having gained this capital point, Mr Watt found many difficulties to struggle with before he could get the machine to continue its motion. The water produced from the condensed steam, and the air which was extricated from it, or which penetrated through unavoidable leaks, behoved to accumulate in the condensing vessel, and could not be avoided in any way similar to that adopted in Newcomen's engine. He took another method: He applied pumps to extract both, which were worked by the great beam. The contrivance is easy to any good mechanic; only we must observe, that the piston of the water-pump must be under the surface of the water in the condenser, that the water