cubic feet of steam room, and 6.25 square feet of horizontal surface of water. The furnace had, for every horse power, 8.5 square feet of fire surface, 7∙83 square feet of flue surface, and .867 square foot of fire grate. The total steam produced per minute was about 62.95 feet per horse power ; of this 30.58 feet were used in moving the piston, 8.92 feet wasted to fill the extra space in the cylinder, and 23.45 condensed on the surface of the cylinder.

Mr Farey has given an excellent description and investigation of this engine, with two plates taken with his wonted fidelity and beauty, from the original drawings.

Mr Smeaton also constructed a portable fire-engine, for the purpose of being used to draw water from termporary excavations, shafts, quarries, &c., so framed as to require no erection of a building, and to be easily removed from place to place. The fire is wholly within the boiler. The framing of the engine is constructed of timber, trussed and arranged in such a manner as to con tain within it every kind of strain whatever which the force of the machine and the resistance may produce. The details of this engine are given in his reports, from which we extract the following drawings and descriptions :

Fig. 30 contains a side view of the engine and boiler. AB is the pit or shaft. CC is the upright of the foundation walls on each side of the pit, for supporting the groundsill *c* across the pit, upon which one side of the engine-frame is raised. DD is the foundation wall for sup porting the groundsill *d,* upon which the other side is raised ; E the foundation wall for supporting the boiler, and forming the ash-hole. F is the boiler, *f t*he firedoor, *g* the chimney, S the steam-pipe, *p* the puppet-clack, *r* the feeding-pipe funnel, *z* the manhole, G the cylinder, H the main pump spear, I the jackhead-pump, by the continuation whereof, *kkk,* the water, is conveyed into L, the injection-cistern. M is a wheel serving instead of the great beam, *m* a rim of a smaller diameter, attached to the former, for working the jackhead-pump I, and plug-frame Q. *a a* are pulleys to bring their chains into a convenient place

for working. The wheel is stopped at the end of its intended stroke, which is to be 6½ feet stop and stop, by means of the two iron fids *bb,* which, reaching out on each side of the great rim, stop against two strong iron pins *e e* which are fixed into a cross beam S, framed into the piece T, and the whole firmly bolted together, as shown in the design. N is the injection-pipe, *n* the injection-cock, and *x* the piston water-cock. O is the hot well. R is a stage for the person to stand upon who hands the engine. PP are the two main beams or sleepers, upon which the cylinder is seated upon its bottom and bolted down. The whole is kept from springing or flying off by an iron strap.

The waste water pipes are omitted to prevent confu sion. Fig. 31 shows a section of the boiler, cylinder, and pipes, with the working-gear, to a larger scale, the whole being divested of the framing in order to render every thing more distinct.

The boiler is supposed to he turned one quarter round from its true position, in order that the most material parts may be brought into one view. It is also to be noted, that every vessel or pipe is supposed to be cut right through the middle, in order to show the con tents, and that the section is not confined to any particular plane ; but, for the more perfect explaining of the principal figure, it will be best to begin with the little plan at the righthand corner of the figure. A B C D is a plan of the cylinder bottom, bolted down upon the two main beams AB and CD ; the dotted circle EF shows the extremity of the bottom flanch of the cylinder, and the circle GH, the diameter of the cylinder within ; the hole I answers the steam-pipe and regulator, and the hole K the eduction or sinking-pipe, and the circle LM its flanch; the circle NO shows the size and position of the regulator-plate, and the dotted circle PQ the size of the receiver in which the sliding-valve of the regulator R works, and in this position is open ; ST is the lever by which it is worked, and when that is brought forward into the position SV, then the valve covers the aperture of the regula tor. In the principal figure A is the boiler, and B the fire place which is of cast iron, and of a spherical form, and placed in the interior of the boiler. The coals are intro­duced by the large pipe C, and the smoke is conducted by the curved pipe D into the funnel or chimney E. The ashes fall through the grate S and the wide pipe F, into the ash-holes below. The other appendages of the boiler, are a cock for emptying it, marked T, two