fuel is burned ; *g g,* small pipes for showing the height of the water in the boiler ; *h,* a pipe for supplying the boiler with water as its contents pass off in the form of steam; *ss, a* steam-pipe for the purpose of conveying the steam to the top of the cylinder. The appendages of the cylinder are, *p* the piston, fitting accurately the in side of the cylinder, surrounded with hemp packing, soaked with tallow and oil, so as to be steam-tight; the casing, *cccc,* which excludes the cold air of the atmosphere from entering into the cylinder to cool it down at the expense of afterwards heating it by the steam ; and, instead of allowing it to enter at the top of the cylinder at A, and press down the piston, as in Newcomen’s engine, the hot steam is substituted, which, being of an elasticity equal to the atmosphere, presses it, with a force equal to the atmosphere, towards the bottom of the cylinder. After reaching the bottom of the cylin der, the handle of the valve *v1* is raised so as to make an opening for the steam to enter below as well as above the piston ; which equilibrium of upward and down ward pressure allows the piston once more to rise, in consequence of a counterbalancing weight connected to the top of the piston-rod *r* ; and this opening of what is called the steam-valve r' continues until the piston once more reaches the top of the cylinder, when it is closed. The eduction valve *v2,* which is nt that moment opened, permits the steam to escape suddenly into the condenser, when it becomes water, and leaves the space be low the cylinder vacuous, so as to give free space for the piston to be carried down into the cylinder by the pressure of the steam resting always on the top of the piston. These, the casing, piston, piston-rod, steam valve, eduction-valve, and communicating passages, are appendages of the second great member of the machine, the cylinder, by which the power of the steam is applied to give the required motion to whatever solid machinery may be placed in connexion with the piston-rod. The appendages of the condenser **C** of Mr Watt are as follows. First of βΙΙ, a large cistern, *wwww,* of cold water is pro vided, and furnished continually with fresh supplies of cold water either from a running stream or by means of a pump *m n,* wrought by the engine itself. In this is placed the condensing chamber *C x x,* wholly surrounded by the cold water, but perfectly empty, excepting that a small jet of cold water from the exterior is admitted through a regulated aperture to play in the inside, by which injection it has always been observed that the condensation of the steam is more efficient than when a casing of metal intervenes between the cold water and the stenm. The eduction-pipe *e ee,* conducts the steam out of the cylinder by the valve v2 into the condenser *x x,* where it is reduced hack into the water from which it had been originally generated. Now, it must be obvious on a little consideration, that the water which is injected into the condenser must rapidly accumulate there, becoming at the same time warmed by contact with the steam, so as to impede the process of condensation, and ultimately tilling up the interior of the condensing chamber, which should be kept vacuous; and further, that the steam itself, becoming reconverted into water, would in a short period of time accumulate in the condenser and choke it up. Hence a principal and essential appendage of the con denser is a large pump called the condenser-pump, which is essential to its longcontinued efficient action, and which withdraws a portion of the accumulated warmed water from the interior of the condenser, and keeps it vacuous; and because there is generally air in combina­tion with the water, and because also air is very apt to insinuate itself by many chinks or crevices into the con denser, this clearing-pump must be capable of pumping out air as well as water. This appendage of the conden ser, represented in the preceding figure by *y y,* is gen­

erally termed the “ air-pump ;" a name which imperfectly expresses the functions of the said condenser-pump.

Fire being placed under the boiler, its heat, communicated to the water, rapidly expands that water, and rarefies it into steam, by the addition of six times more than its usual supply of heat. This combination of heat and water, forming the steam, rushes along the steam-pipe into the cylinder casing, and is admitted into the interior of the machine, filling all its chambers and pipes with steam; hut that portion of the steam which is in communication with the condenser being instantly chilled by the jet of cold water and the cold sides of the vessels in the cold well, is condensed, and then the valve *v*2 being closed so as to admit no more steam into the condenser, and the valve *v1* closed so as to admit no more steam into the lower part of the cylinder below the piston, there remains the elastic force of the steam above, pressing it to wards the bottom of the cylinder with a force proportioned to the pressure of the steam and the extent of the cylinder. Thus a moving power is generated in the cylinder by the steam, which may be conveyed through the piston-rod *r,* and applied through various mechanism of application to the performance of the required work. The steam which has thus pressed down the piston is now admitted below to neutralize the force of that which remains ; and having thus done its duty, is once more annihilated by the opening of the communication into the condenser, into which it rushes, and being almost instantly deprived of the caloric which gave it power and magnitude, there remains nothing except the few spoonfuls of water from which all that volume of steam had arisen, now lying inert at the bottom of the cylinder. This dead water is not yet cold. It is evident that in the primary generation of steam in the boiler, the supply of water must be rapidly diminished by this boiling off, and that this water must somehow be supplied. Now here lies an improvement : this waste, instead of being supplied by cold water, may be better replenished with the water of the condenser, which is highly heated in condensing the steam from the cylinder.

Mr Watt's Engine was first used as a substitute for the engine, of Newcomen in pumping up water or draining mines: in 1788 it had attained the form which we have given in the following figure. The engine is represented in fig 41 as contained within the walls of a building, the anterior portion of which is removed to show the machine. The boiler stands on the left of the figure, on the outside of the building; and on the right of the figure, also on the outside of the house, are the large pumps, by which the water is raised, and the work of the engine performed. Nearly in the centre of the building stands the cylinder with its appendages, and below these are the cold well and condensing apparatus.

Beginning with the apparatus for generating steam ; on the left of the figure, H is the boiler, of what is called the waggon shape, set in a furnace of brickwork imme­diately over the fire, which rests on the firebars at *ρ,* leaving a very deep ashpit below ; the flame passes away under the concave bottom of the boiler to the further end, and there, instead of proceeding at once up the chimney, returns by o on the left side of the boiler, through the brick channel or flue, giving out additional heat to the water, and after passing across the front of the boiler, proceeds along the righthand flue *o* to the chimney. The draught of the chimney is regulated by means of the damper r, which descends into die flue or is raised out of it in any degree by the attendant, and so permits the air to rush with greater or less ease up the chimney. A tube *t,* regulated by a stopcock, comes from a small pump U on the righthand side of the figure, which raises the warm water discharged by the air-pump, and sends it into the boiler so as to replenish its waste ; this pipe and pump