is held perfectly horizontal, an equal quantity of mercury lies in both ends; but, on the contrary, when the slightest inclination is given to either end, the mercury instantly preponderates to that lower end, and suddenly changes its inclination in either direction. In practice I have seen this work well.

*Of Condensing Apparatus.—*The parts of the condensing steam-engine which we have hitherto examined, are in all respects identical with those of the high-pressure steam-engine. The characteristic difference consists in the manner in which the steam is disposed of after having produced its effect, and in the apparatus required for the purpose. In the high-pressure steam engine, the steam is discharged from the cylinder simply by allowing the entering steam to press the piston upon the outgoing steam, and force it through the eduction pipe into the open air. Now, it requires considerable force to effect this ; we know that the atmosphere must he pushed away before the steam with a force equal at least to 15 lbs. on each square inch of the surface of the pipe; and, therefore, this amount of the force of the steam, which is a balance for the air, that is, an atmosphere of steam, is consumed or thrown away in this em­ployment. In the condensing steam-engine this atmosphere is saved. The steam is annihilated almost instan­taneously. A vacuum is formed on one side of the piston by this annihilation, and the steam is allowed to employ that part of its force, which formerly was spent in the useless labour of forcing the steam into the air, in forcing the piston through the performance of useful labour.

If, therefore, we take a high-pressure engine, such as we have already described, and if we desire to form it into a condensing steam-engine, we must add to it a large reser voir of cold water, named the cold well, such as is described in one of Watt's steam-engines, in the historical part of this article ; and in this reservoir we must place a close vessel having an aperture or small pipe in it, from which a jet of water shall play and spread over the interior, so as to form a condenser, into which shall be conducted the eduction-pipe, by which the steam is led out of the cylin der. The quantity of cold water thrown into this vessel to cool it, will require to be six or eight times as much as is boiled off in the shape of steam. Attached to the condenser is a blow-through valve, opening outwardly, which allows the whole condenser, before starting the engine, to he filled with steam, so as to blow out at the valve all the air that may have previously got into it. The reader is referred to the historical part of this article for those parts in the description of Mr Watt’s engine, and also to plates, and their descriptions of the parts of steam-engines at the end of the article.

It must already have occurred to the attentive reader, that such a condenser as has now been described could not act efficiently for any considerable time. On the contrary it would rapidly become filled with water; for it is plain that the jet of water entering the condenser will fill it up at last with water; and even were this not the case, it is plain that the whole steam which passes through the engine being turned back into water in the condenser, this water would accumulate and fill the condenser. This water must therefore by some expedient be removed out of the condenser without admit ting the air. And again, it is well known that all water contains a large quantity of air mingled with it, and permanently retained in its pores, but which escapes from it the moment it is placed in a vacuum. Now this air would of itself accumulate rapidly, to such an extent as to fill up the vacuum **of** the condenser and render it inefficient. Air must therefore be removed out of the condenser, along with the accumulations of injection water, and the condensed water of the steam ;

and therefore an air-pump must be provided, capable of removing nir and water from the condenser. This air pump is placed beside the condenser in the cold well, communicating with it by a foot-valve, which permits the air anil water to go out and prevents their return, and delivering that air and water which it removes into another smaller reservoir, named the hot well, from the circumstance that the water withdrawn from the engine has been made warm by contact with the hot steam which it has condensed, and which it does not generally cool to a lower temperature than 80° or 90°.

These appendages of the condenser, the cold well, the injection-pipe, the air-pump, the hot well, the blow through valve, the foot-valve, the delivering valve, &c., are represented in the following diagram, in a usual arrangement.

*a* is the cylinder, *b* the eduction-pipe, *c* the condenser, *h* the blow-through valve, *g* the injection cork anil pipe, *k* the foot-valve, *d* the air-pump, *e* the hot well, *f* the cold water pump.

The reader will find other arrangements of these parts in the plates and their descriptions. The air-pump is generally worked by the great beam of the steam-engine, as in the figure, and is about half the area and half the stroke of the cylinder of the engine.

The cold well requires a continual supply of water, either from a running stream, or to he forced up by a pump like that marked cold-water pump in the figure.

Dry condensation is a subject which has attracted much attention from machinists ; that is to say, it has been considered very desirable to condense the steam without injecting water amongst it. Mr Watt originally condensed in this manner. He merely placed upright pipes among cold water, and letting the steam into them, allowed it to be condensed by simply coming in contact with the inside of these tubes, which thus formed a con denser. The introduction of a jet of cold water was thus avoided, the introduction of air along with the water was also avoided, and thus the air-pump had its duties much diminished. But the efficiency of the engine was found to be very materially impaired ; for the instantaneous annihilation of the steam was not effected, in this process of mere surface condensation, in the efficient way in which it had been by the old system of injection by a *jet d'eau.*

Ον **THE** Rotatory Sτεαμ-Εngινε.

The steam-engine being now most generally used in