THE PULSOMETER.

(See page 332.)

The pulsometer is a most ingeniously modified improvement upon Thomas Savery's ancient fire-engine, patented in 1698. In his case the cylinders were large in diameter, and alternately cooled by outside application or internal jets of cold water. The condensation thus effected produced a vacuum in the cylinder under operation, thereby became filled with water by atmospheric pressure. The steam was then re-admitted upon the surface of the water, which was thus ejected into the rising main. These intermittent admissions of steam and of internal or external condensing water had to be effected by hand, as there was no mechanical motion from which to obtain the opening and closing of the valves.

In the pulsometer this weighty objection to such an arrangement has been skilfully overcome. The peculiar flask-like shape of the working cylinders enables the steam to drive out the water without agitation and with the minimum of condensing surface until momentum has been set up. At the moment when the water has descended as low as the orifice which leads to the discharge, the steam passes through with the water, and ascending instantaneously condenses. A vacuum is thus so rapidly formed in the chamber lately filled with steam, that the steam passes through the admission valve with excessive rapidity. This admission valve is a small ball which continually oscillates upon a sharp edge between two alternative seats. When fully resting in one, it is never raised more than from 1-32 to ⅛ above its alternative seat, and thus is easily drawn over upon the open seating by any accelleration in the passage of the steam. These changes become so rapid, and are completed so instantaneously that in the smaller sizes the alternative opening and closing of the steam valve sounds as rapid as a pulse : hence the name applied to the pump.

The principal drawback to Captain Savery's engine was that the height of lift was directly proportioned to the pressure per square inch of the steam (about 2 feet to every pound), and that owing to the imperfection of boiler-making in those days, the limit of practical pressure was soon reached, and often exceeded with disastrous effects. The principle, of course, still governs the pulsometer ; but on the one hand, the requirements for pumps of low lift, up to 60 or 70 feet, have most enormously increased since Captain Savery's time ; and on the other hand also, high-pressures, even 300 lb. per square inch, are now safely carried as working pressures upon multitubular boilers.

The questi on of the economical use of steam is an important one, as effecting all steam-pumps ; put in a very large proportion of cases the expenditure of a few more hundred-weights of coal in a week, where the gross amount is but small, is but a minor matter of consideration compared with simplicity, practical ease of working, and cheapness of first cost.

The strongest claim the pulsometer has of being a really practical improvement over Captain Savery's engine, and upon this rests the possibility of its being admitted at all into the market, consists in the fact that the greatest ingenuity has been employed, and careful precautions taken against this wasteful condensation. The form of the flask-chambers are specially designed for this purpose, and small drifting air-valves are used in the upper parts of the chambers, so that a considerable quantity of air is taken in with each suction-stroke. There is no doubt that this air will act as a non-conducting medium between the steam and the water, whilst at the same time it is most useful in destroying the shock of the incoming column of water.

The accompanying engravings show the mechanical construction of the pulsometer, and also one mode of applying it to the raising of water. Fig. 1 is a vertical section of the apparatus taken through the centre of the water chamber. Fig. 2 is a corresponding vertical section taken at right angles to fig. 1. The body of the apparatus is divided internally into two chambers, A A, which are separated by a vertical partition cast in one with the outer part. The figure of the body is of a pear-shaped form tapering upwards to the neck, J. The vertical partition extends laterally on each side at the upper part, where it forms the elliptical air-chamber, B, which communicates with the suction. The arrangement of this part is modified, and the partition forms a diaphragm, one side of which communicates with the delivery and the other with the suction. The fluid to be raised flows upwards by the induction passage C, which opens out on either side into the chambers A A. These openings have fitted to them the valves E E. This portion of the arrangement is shown very clearly in the sectional fig. A discharge chamber common to both, leads to the discharge, D, best seen in fig. 2. This chamber is also provided with two valves, F F, according to the purpose to which the pump is being applied. The valves are controlled, as regards the degree of apertures, by the guards G G, and externally the openings at the lower part of the chamber are closed by the covers H A, which are accurately fitted to the openings by planed joints. With this arrangement access is readily had to the interior, when the valves or any other part may require attention. The upper end of the chamber A, is surmounted by a casting termed the neck, J, which is accurately fitted to the face of the chamber and bolted there. The two passages of the chamber A open into a steam-chamber in which the ball-valve L is fitted, and so as to be capable of oscilation between the duplex-valve seats formed at the junction. The cylinder and air chamber are furnished with air-cocks, that may be brought into use when required. The steam for working the pump is admitted through the pipe K, and passes down the side of the neck which is left open, according to the position of the ball-valve, L. In fig. 1 the valve is shown to the left and the steam is entering the right-hand portion of the chamber, as indicated by the descending arrows. Here the steam presses upon the small surface of water in the chamber, and consequently depresses the water but without any agitation, hence there is but a very slight condensation, and the water is driven through the discharge opening and valve into the rising main.

The ejection also of the water from the cylinder, or chamber, is so rapid that it has not time to cool materially the walls of the chamber before the steam is r-eadmitted. This is so much the case that the pulsometer chamber is always too warm to the touch, and is not cooled to the touch by the rise of the water into the chamber. At the same time a large portion of the work is performed by the vacuum from the condensation of the steam. This will give the pulsometer a considerable advantage over those pumps which do not condense their steam at all.

Nevertheless, with these advantages and disadvantages, we have reason to believe that the enconomical working of the pulsometer, though considerably inferior to expansive or condensing pumping engines, may, at least, be taken on a par with the numerous direct-acting non-expansive steam-pumps which have lately flooded the market.

The pulsometer has one or two distinct features of advantage, which as far as we know, no other pumping machine can claim. The first is that it is practically imperishable, as a whole, the main casting being subject to no wear at all. The valves and seatings, which are the only parts subject to wear and deterioration, are all most easily replaced, and are all in separate parts for that purpose. In this way a pulsometer may, after many years' wear, be entirely renewed as to its perishable parts, at an additional cost of about 15 per cent only.

Again the pulsometer requires no packing or lubricating, which of themselves certainly represent a continuous expense, and the requisite frequent attention for ordinary piston-working engines and pumps.

One form of valve much approved of for water are spherical metal ball valves working on circular seatings, with guards attached to the valve-box cover. A valve which proves very serviceable, and which is much liked, is a flat cast-iron disc working on turned hinges and on a circular seating of hickory or hard wood boiled in oil. The wood is fixed with the end grain exposed to wear, and the well known Hawkley's steps are an excellent example of the amount of wear end-wood arranged in that way will stand. The guard of the valve is on the cover, and a wooden plug is fitted into the valve crown to deaden the concussion in working. Another valve, known as "Terreauxs," is made of indiarubber, in which the orifices are crossed indiarubber lips. This valve is most valuable where foreign substances have to be passed through, but is rather apt eventually to split at the end of the lips.

A great advantage to the pulsometer is the absence of any rubbing or wearing surface, such as a piston barrel, for the pulsometer will pump almost anything short of brickbats, as, for instance, water full of sand, grit and chips, mud, sewage, gas-tar, molasses, water mixed with grain, and paper pulp. For pumping acids it may be made from special mixtures of metal which could not be used in pumps which had afterwards to be bored. It might also, as far as we can see, be made of either glass, or stoneware.

The illustration, fig. 3, shows the pulsometer in another speially unique adaptation, viz., as slung in chains for sinking a well or shaft. It is perfectly independent of all fixing, and can be at once put to work without descent into the well by turning on the steam cock at the surface.

The objects to which the pulsometer may be most advantageously applied are exceedingly numerous, but amongst others,