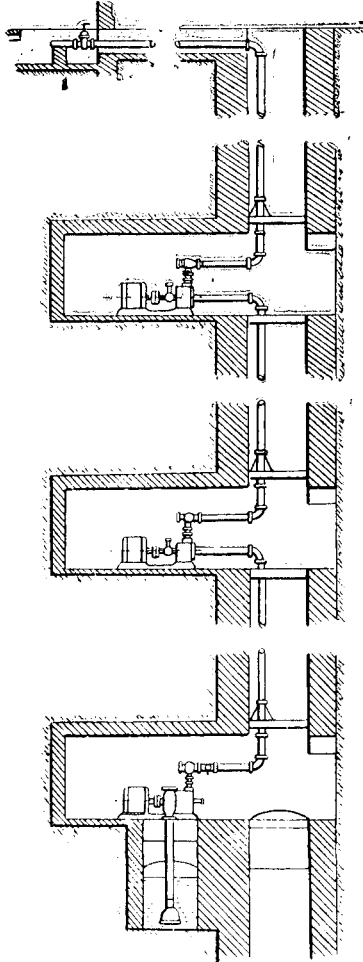


current, and the pumps, with electric motors combined, are placed in chambers down the shaft as shown in the sectional sketch. The lowest pump draws its water out of the sump and discharges directly into its delivery-pipe, which is connected with the suction end of a second (or middle) pump 500 ft. higher up the shaft, no lodgment for the water being necessary. The middle pump in like manner delivers directly into the third or top pump. By this means the column of water is entirely unbroken and constantly flowing steadily onward.

These pumps have been working for nearly five years, delivering about 1,000 gallons per minute against a total head of nearly 1,500 ft. To those whose experience is chiefly confined to the single-acting bucket and plunger pumps it may be pointed out that the quantity named is approximately that which would be raised by a 22 in. set, having a stroke of 10 ft. and working six strokes per minute.



Sectional Sketch of High-lift Centrifugal Pumps in series.

The results given by the plant just named are said to be highly satisfactory not only as regards immunity from frequent breakdowns and their consequent stoppages, with the resultant heavy bills for repairs, &c., but also in coal-consumption, a saving of from 15 to 20 per cent. being effected as compared with the consumption required for the best of the former installations.

The cost of maintenance appears to be very light; the pumps are opened out and cleaned about three times a year, the work occupying about four hours on each occasion. The engineer in charge reports that "there is, happily, no sign at all of wear from unclean water in any working-part of the pumps where one was quite prepared to find it. Their durability makes them compare most favourably with plunger pumps, the valves of which constantly require repair and renewal. The consumption of lubricating-oil is negligible, the machines are small, and their installation underground as simple as possible."

As a recent example, reference may be made to the installation of a combined pump and motor at a coal-mine in Scotland. This pump was constructed to deliver 400 gallons per minute against a total head of 250 ft. when running at a velocity of 850 revolutions per minute. The volume named is equal to the capacity of an ordinary single-acting mine-pump of 15 in. diameter, with a stroke of $7\frac{1}{2}$ ft. and making seven strokes per minute. Such a pump and motor as that just described would occupy a ground-space of 10 ft. 3 in. by 3 ft. 6 in., the height being under 4 ft., the weight $4\frac{1}{2}$ tons, and the cost in England about £400.* This is, of course, exclusive of engine, dynamo, and connections; but the small space occupied, absence of pump-rods, suitability for raising dirty water, and the simplicity as well as the very moderate cost of these pumps are features which cannot fail to command attention.

I have to thank Messrs. Palmer and Co., engineers, Wellington, for the information which has enabled me to give the forgoing description.

* The cost of a belt-driven pump of the same capacity is about £120 less.