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THE TRIUMPH COMPOUND STEAM-ENGINE.

THE steam-engine shown in the accompanying illustrations is of a novel and ingenious design. The aim of the builders has been to produce a valveless compound engine, and that they have succeeded admirably in designing and building such a machine is admitted by all whose experience with steam-engines enables them to judge.

through the cylinder casting, it is evident that the omission of the valves has not led to troublesome complications in other directions.

In the illustrations, Fig. 1 is a vertical longitudinal section through the engine, Fig. 2 is a vertical cross-section through the same, Fig. 3 is a horizontal cross-section through the live-steam ports, and Fig. 4 is a horizontal cross-section through the expansion parts.

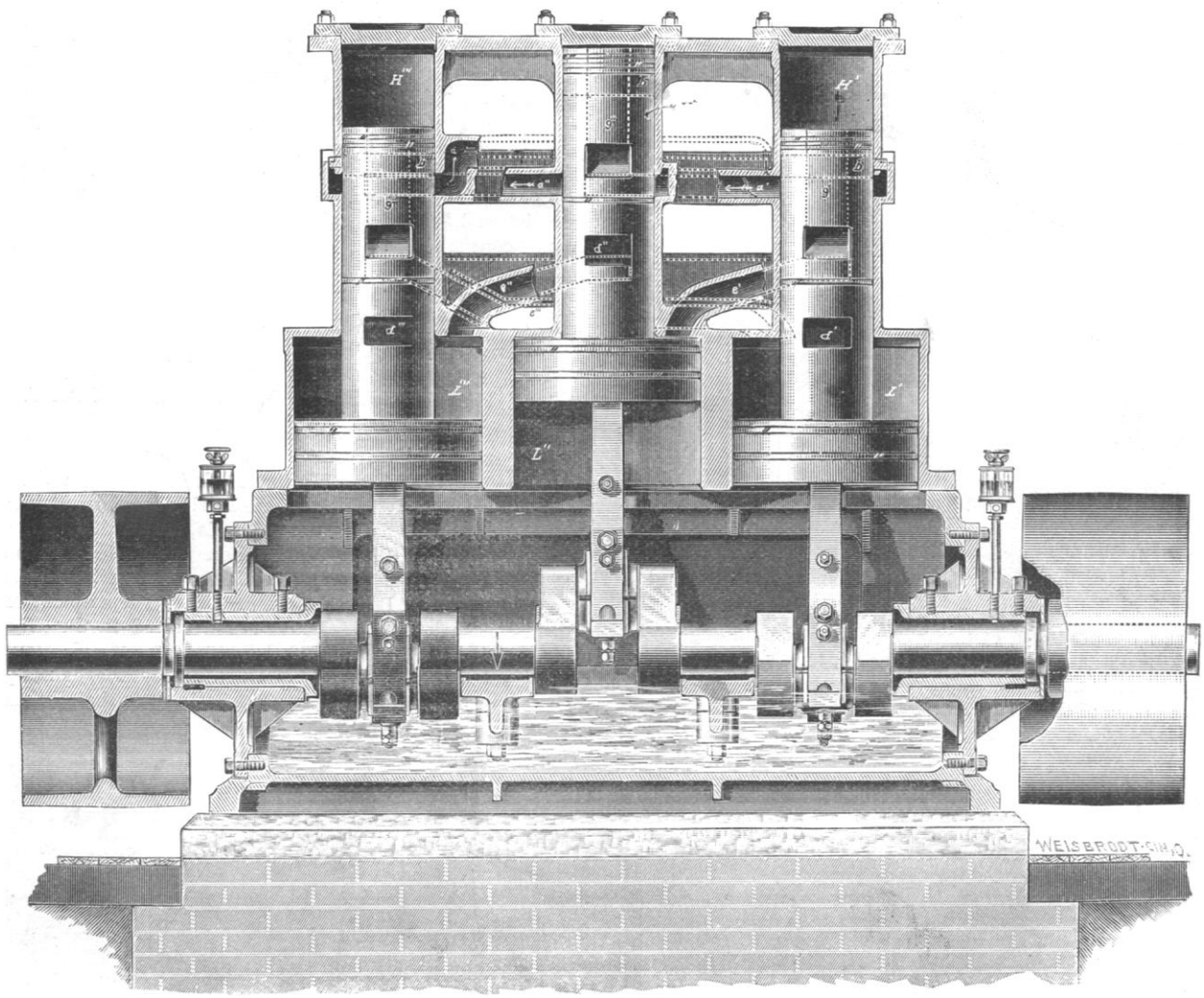

FIG. 1.—TRIUMPH COMPOUND VALVELESS STEAM-ENGINE.

The engine shown, which is built by the Triumph Compound Engine Company of Cincinnati, has three high and three low pressure cylinders, each with single-acting pistons. Each high-pressure piston controls the steam-supply to its own cylinder and that of one of the low-pressure cylinders. The exhaust is also controlled in the same manner; so that the high-pressure pistons do double duty, acting as pistons and as valves. As the latter office is performed by means of passages through the piston-heads and

H' H'' H''' are high-pressure and L' L'' L''' are low-pressure cylinders, and the pistons acting in each will be referred to by the same letters. The pistons are connected directly to the shaft by connecting-rods without the intervention of piston rods; and the cranks are set at an angle of 120 degrees with each other, in which position all the moving parts are perfectly balanced.

Pistons H'' and L'' are shown on the upper centre, pistons H' and L' being 120 degrees in advance, and pistons H''' and L''' 120

degrees in the rear. In this position, live steam is admitted from the main steam-pipe a (Fig. 3), thence through ports b', pipe a', and port g'', to cylinder H''; and at the same instant steam which has

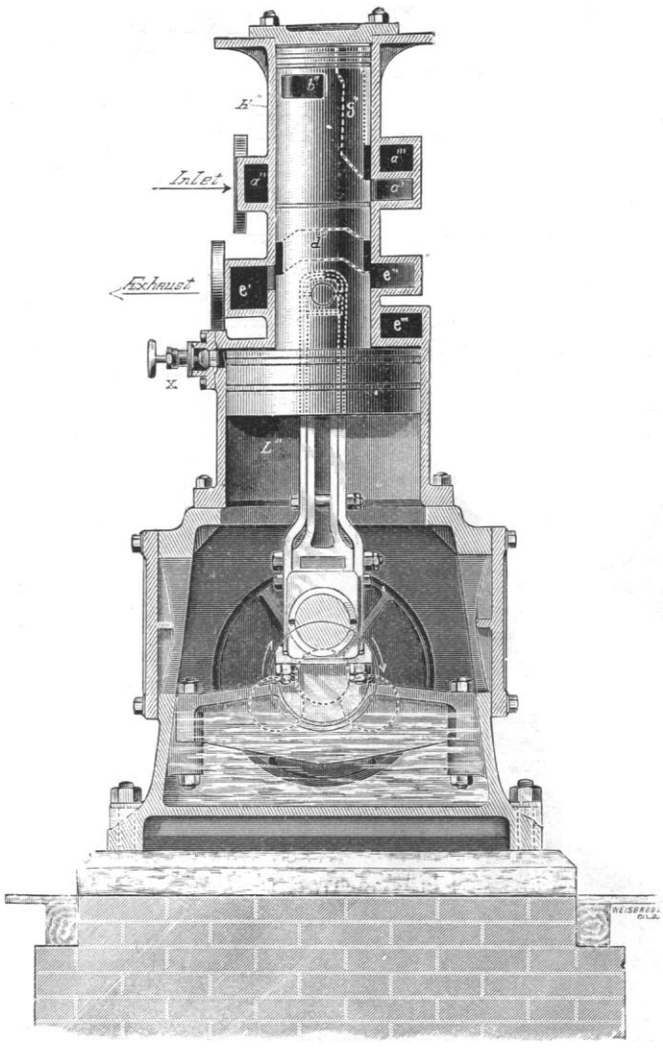

FIG. 2.

been partly expanded in cylinder H' passes down through port g' (Figs. 1 and 3) and pipe e', to cylinder L'', thus admitting live and low-pressure steam on one set of pistons at the same moment. Under the action of the steam, pistons H'' and L'' move downward,

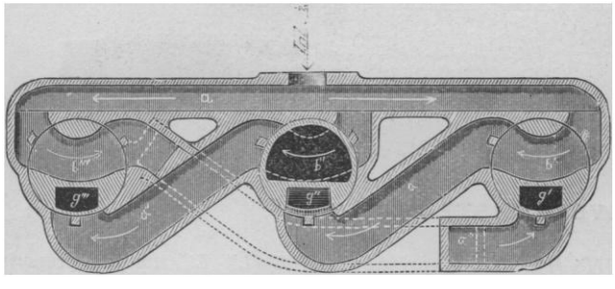

FIG. 3.

live steam being admitted until the upper edge of port g'' (Fig. 1) passes the lower edge of pipe a', at which point it is cut off, and expands in this cylinder until the lower edge of port g'' passes the upper edge of pipe e'', at which point it passes to cylinder L'''. At the same moment live steam passes from a through port b' (Fig. 3), pipe a'', and port g''' (Figs. 1 and 3), to cylinder H'''. At this point also, piston H', moving upward, closes the connection between cylinders H' and L'', and the steam expands in L'' for the remainder of the stroke. As piston L'' reaches the lower centre, port d' (Fig. 1) comes opposite pipe e', and the exhaust steam passes through this connection into pipe e (Fig. 4), which communicates with the atmosphere or condenser. When piston H' reaches the upper centre, live steam passes from a (Fig. 3) through port b''', pipe a''', and port g', to cylinder H', and the partly expanded steam passes from cylinder H''' down through port g''' (Fig. 1) and pipe e''' to cylinder L'. Cylinder L''' exhausts through pipe e'' and port d'' into e, and cylinder L' through pipe e''' and port d''' into e.

The valve X (Fig. 2) is merely a live-steam connection with the low-pressure cylinders for heating up and starting. Thus, with the exception of the cut-off, each set of pistons controls the steam in the cylinder next preceding, in the order of rotation, and, when acting as a valve, is at or near its maximum speed; while the pistons in the preceding cylinders are at or near their slowest speed. This simple expedient controls the steam in this engine in a manner unexcelled by any valve device.

All lubrication is automatic, consisting of a sight-feed lubricator on the steam-pipe, a drop-sight-feed cup on each end-bearing of the shaft, and a mixture of oil and water in the crank-case, perfectly lubricating all parts within. The cylinders are cast in one piece, and bored at the same time on a tool especially designed for the purpose, by which means they are made absolutely parallel, and the danger of leaky joints is avoided. The bearings for the shaft are bored out after being bolted in place, insuring perfect alignment; and all wearing surfaces are exceptionally large, so that internal friction is reduced to a minimum. The only adjustments consist of two keys in the connecting-rods, which take up all the wear in both boxes. The pressure being always downwards, these adjustments are seldom necessary; and the engine, it is claimed, will run indefinitely without stoppage, and with but little attendance.

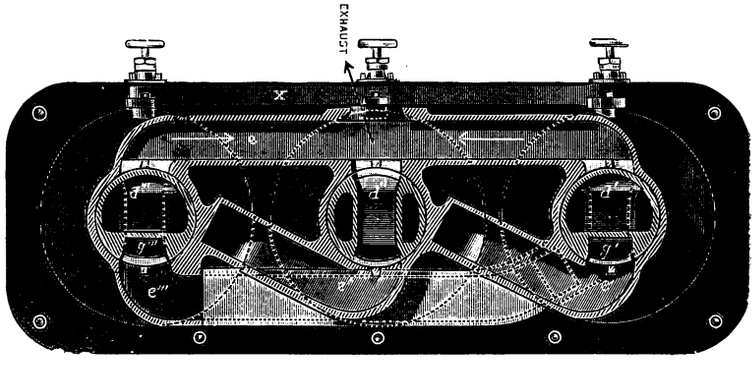

FIG. 4.

THE TENSILE STRENGTH OF SHEET ZINC.

So little has been published about the strength of zinc, that any contribution to this question must be welcome. The most careful tests which Professor Martens made on some zinc sheets supplied by the Schlesische Actien-Gesellschaft für Bergbau und Zinkhüttenbetrieb at Lipine, in Silesia, on behalf of these works, hence, deserve all the more attention. These tests, according to *Engineering* of Jan. 31, were carried out at the Royal Technical Testing Station at Berlin, of the mechanical department of which Professor Martens is chief, and are described in the official reports of that institution, 1889, IV.

The reputation of zinc as a structural material is not particularly good, and these tests do not tend to show that the metal deserves a better name for constancy and reliability of its mechanical properties. A great many tests had to be made to arrive at fair averages. The test samples were five sheets, supplied by the Silesia mills of the above works, two specimens from foreign works; and finally eleven sheets rolled before Professor Martens