Reproduced from
"The Yachting World and Marine Motor Journal," August, 1907.
"Summer Number."

1712 SAVERY'S ENGINES 1907

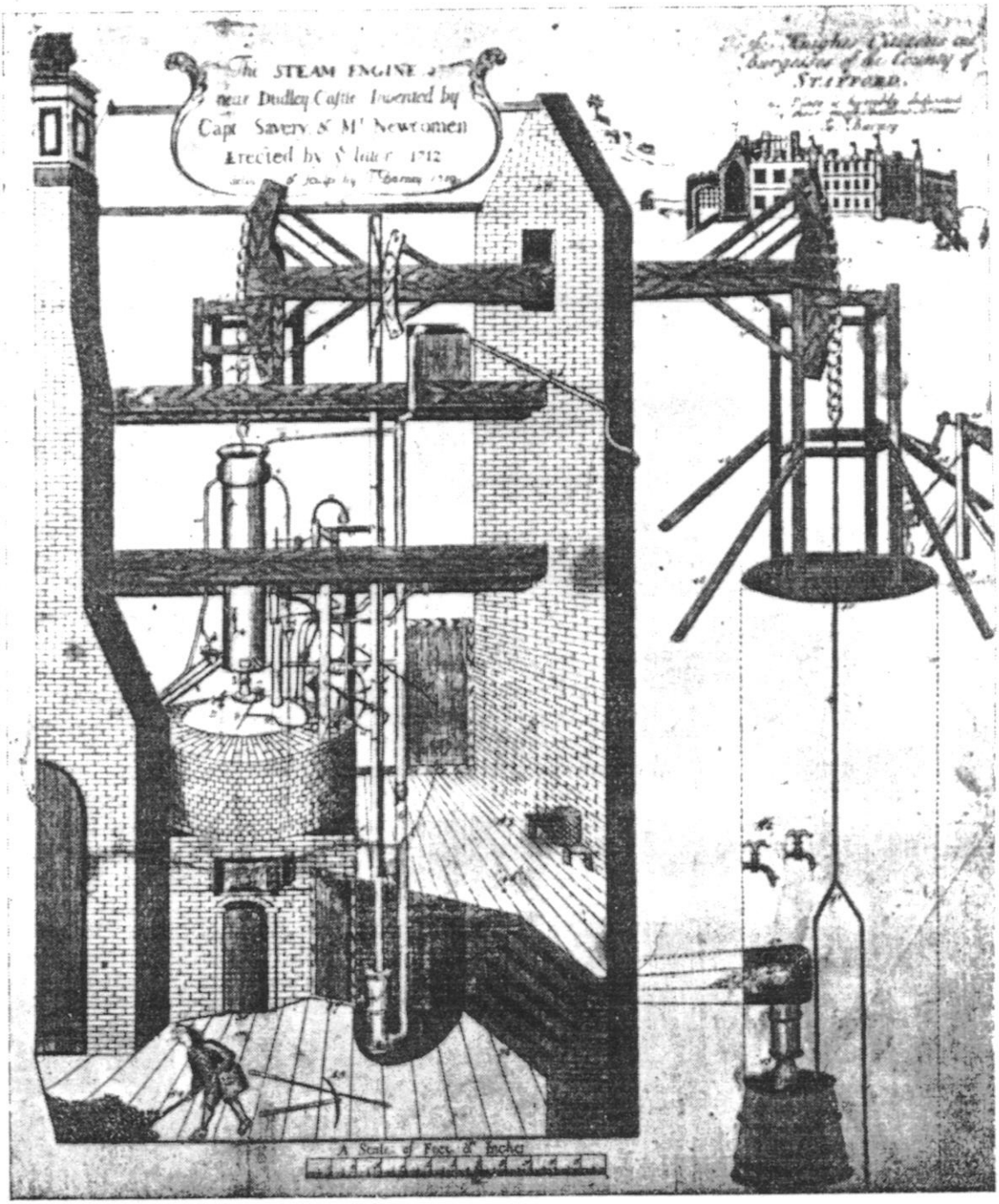
ONE never hears the origin of steam power spoken of without a sense of expectant resignation, for someone better read than informed is sure to chime in "The steam engine, did you say? Two thousand years old at the very least," as if we had not all seen and marvelled at the stupidity of Hero's hollow metal negro head with the jet of steam issuing from its lips to play upon a vaned wheel. As if a plain windmill were not far more efficient and far less costly. You shall be lucky, too, if this fatuous instance be not followed up by some disquisition on the Chinese steam toys described by M. l'Abbè Huc, and the whim-whams cribbed from these by Father Verbiest, and that progenitor of all the breed of engineering professors, Roger Bacon. At this stage it is odds but some other sciolist mentions the toddy-begotten experiment of a former Marquis of Worcester, which one now feels certain, more than justified his imprisonment in the Tower. And so one is constrained to hear once more all about the contrivances of M. Vaucanson and every other useless whim up to the time of James Watt. Just here the fount of expositor-knowledge usually dries up, and with it, by merciful Providence, the crackling of thorns under the pot—of steam.

Your somniferous pedant always knows all about the unpractical toys, the dull, inconsequent essays of any constructive science, which, obviously stupid when considered in any

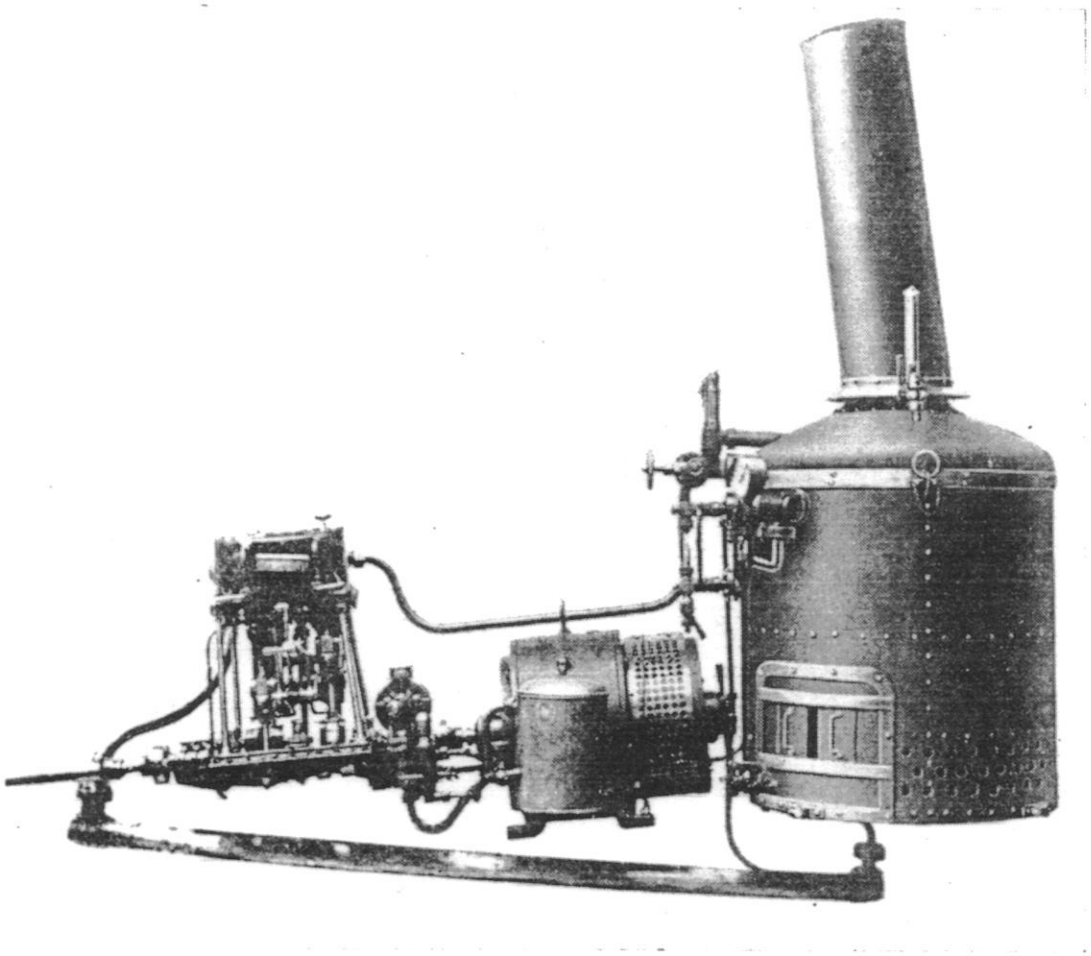
light, rather hindered than helped its development. But just as invariably he is silent as to the era and authors of its first practical workings, so it happens that in discussions of this kind one seldom or never hears the name of Captain Savery, or the fact that with one Master Newcomen he built at Tipton, in Staffordshire, the first practical working steam engine of which we have any clear record, as early as 1710, half a century before James Watt or that other great Cornish mine captain, Trevithic, got any engine to work.

That engine, which drove a pumping plant, we see picturesquely depicted on page 3, thinking as we look at it, no doubt, what a huge fortune these pioneers must have made out of their invention, crude as it seems. Only just then, remember, the great South Sea Bubble was gaily expanding. And when in the history of great industrial inventions has the contemporary bauble failed to appear? We imaginative Englishmen must have our Eldorados, whether in Orsk or Oroya, and the method is just the same, whether "the nature of the enterprise cannot now be disclosed" or we merely register without articles. Thus invention must fair sit sorrowing or go borrowing, or both; and this being so, nothing seems more certain than that the partners in this first steam engineering business made no great amount of money out of it.

But still, for such men and such enterprises, the sufficiency which gives "the glory of going on, and not to die," is seldom lacking, and for their successors what richer heritage can there be than hereditary skill and craftsmanship, and the traditions of the best work of their generation, faithfully preserved for nearly two centuries? These are indeed priceless, for, unlike the fortunes that may be lost in one spendthrift decade, having been won, they can never be wholly wasted. So one is not surprised to find that throughout all that time



THE STEAM ENGINE NEAR DUDLEY CASTLE,
invented by Captain Savery and Mr. Newcomen. Erected 1712.



THE 20-I.H.P. C.S.C. SAVERY ENGINE, QUICK STEAMING BOILER, AND COUPLED DYNAMO, for alternative electric light generation, as fitted to the Hon. Richard Strutt's launch.

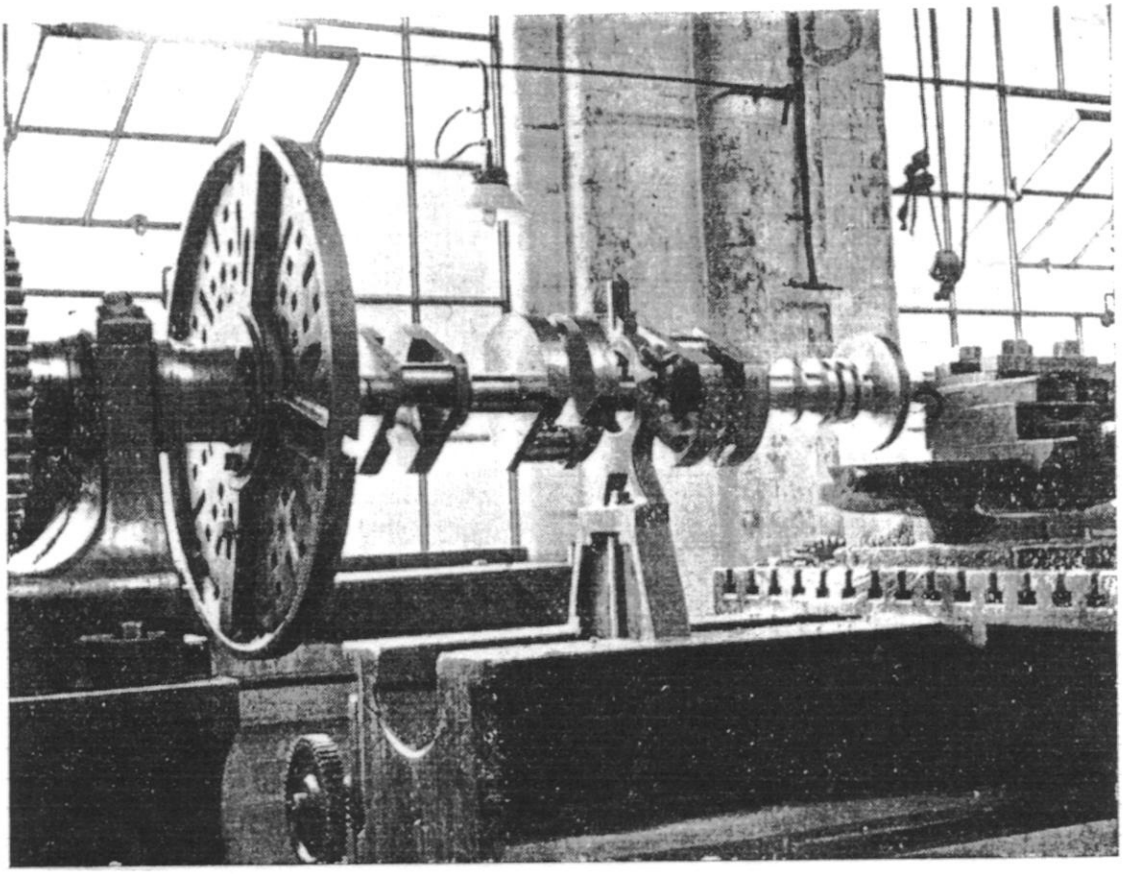
this original engineering enterprise has preserved its identity, and with it the name of Savery; nor that to-day more than ever, its traditions are fulfilled in the finest and most elaborate work.

Hitherto the Newcomen Works have been carried on at Tipton, but some little time ago the Messrs. Savery decided to remove to Birmingham. The new works, it is true, are of no very great size, but, in view of the quality of their product, are, I think, to the full as interesting as any of the great acreages where engines and machinery of all sorts are turned out upon a more or less conventional pattern. Indeed, the very exigencies of production on a huge scale demand a certain conventionality, owing to the cost of altering the slightest detail. And where the product resembles so many thousands of oleographs, one loses interest, however much one ma admire the specimens. On the other hand, your engine artist, like any other, needs only his studio, so to speak the shape of a comparatively small works, where, surrounde by the latest and finest tools of his craft, he can impress his individuality upon each piece he turns out. Withal, on his limited output, he can be just as keenly competitive. He can individualise, specialise, and experiment in advance of the immediate moment, at far less cost, for this does not entail the disorganisation of his comparatively small plant, nor any extensive—and prohibitive—scrapping of patterns. In a word, so circumstanced, he can best undertake the work of a specialist. And the specialist is wanted in engineering to-day more urgently than ever.

Thus, when I visited these works recently, I did not see, nor expect to see—with the exception of certain remarkably fine high-speed tools and a more comprehensive assortment of jigs and limit gauges than one usually finds in the average engineering works—more than the ordinary range of familiar

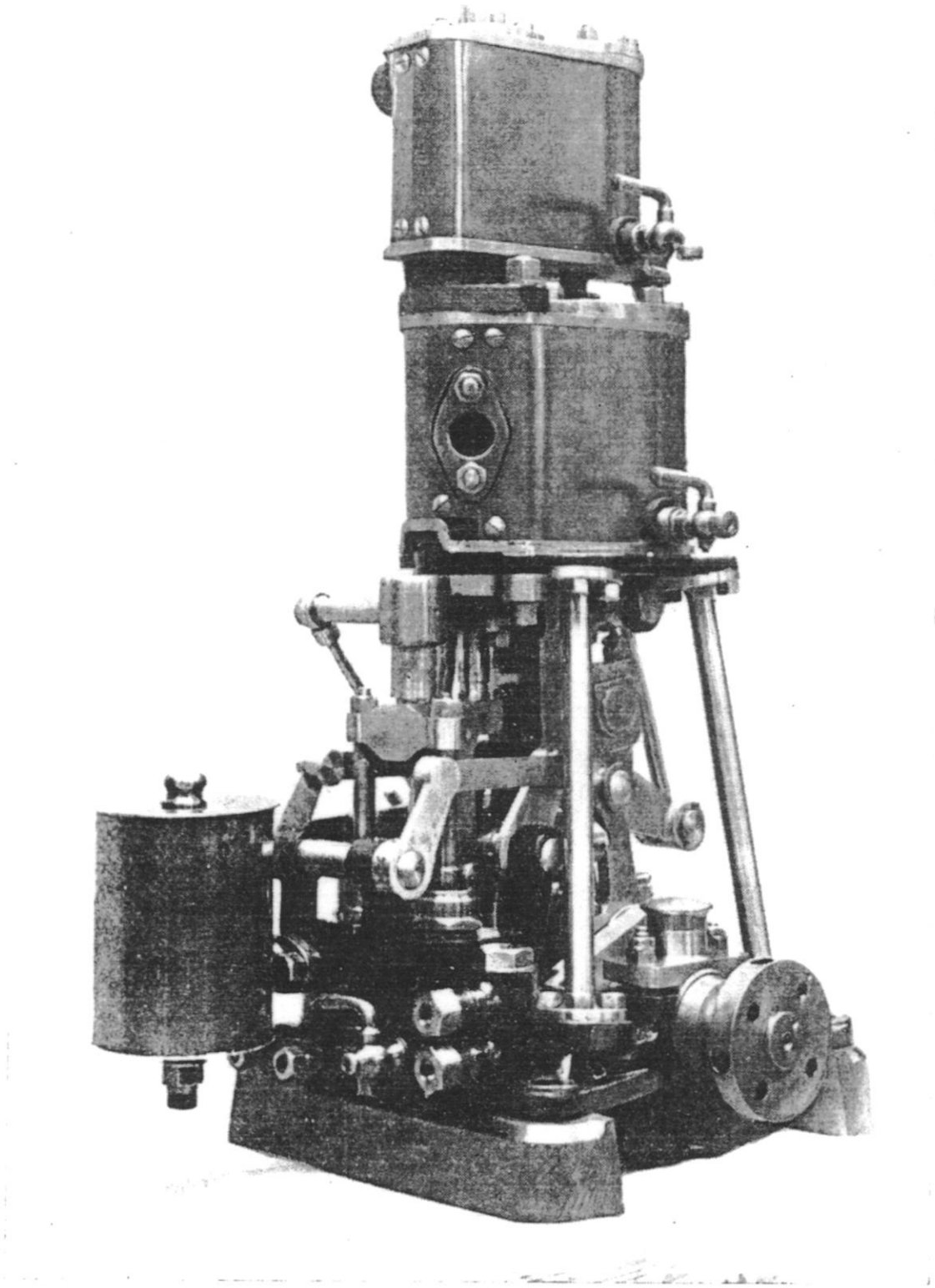
machine tools that, in combination with those just mentioned, are required for turning out work with that ultra-precision of fit in the smallest detail which is perhaps the dominant note of Messrs. Savery's productions. Therefore, without wasting time in describing the more or less familiar means, I need only say that I have not seen the result surpassed in the making of any internal combustion motor. Indeed, I regard it as only a further proof of their artistry that they, unlike the majority of steam engineers, should have recognised the essential necessity for at least equal refinement.

But among the many concrete proofs of all I have said that I saw at the Newcomen Works, I do not think I could take a more characteristic example than the 20-i.h.p. C.S.C. engine (page 4) which the Messrs. Savery have recently constructed for the Hon. Richard Strutt's launch, built by Messrs. Gill and Son, of Rochester. This was certainly one of the most beautifully made and efficient little engines I have yet seen. In the mass, it was like any other of its type, except that it had the Savery-Joy valve gear. There are, however, many points about both engine and valve gear—if I may be allowed to separate them for the purpose of discussion—which, both in design and construction, I think will appeal to the layman almost as much as to the engineer. Taking the valve gear first, the great feature is its extreme compactness, for the whole motion takes place within the limits of five cubic inches. But this compactness, combined as it is with extreme rapidity of reciprocating motion, in which all parts are alternately in compression and tension from eight to fifteen times in a second, obviously requires extremely studied design for all the jointing. Thus a combination of thickness and shortness with extreme narrowness is essential; indeed, it is the only one that affords sufficient strength and convenience for dismounting.



EIGHTEEN-INCH BREAK LATHE

turning up the Crankshaft of the 80-I.H.P. triple engine, the total weight in the rough bloom being 15 cwt.; turned in the finished state, $2\frac{3}{4}$ cwt.



SAVERY TANDEM LAUNCH-ENGINE with concealed valve-gear.

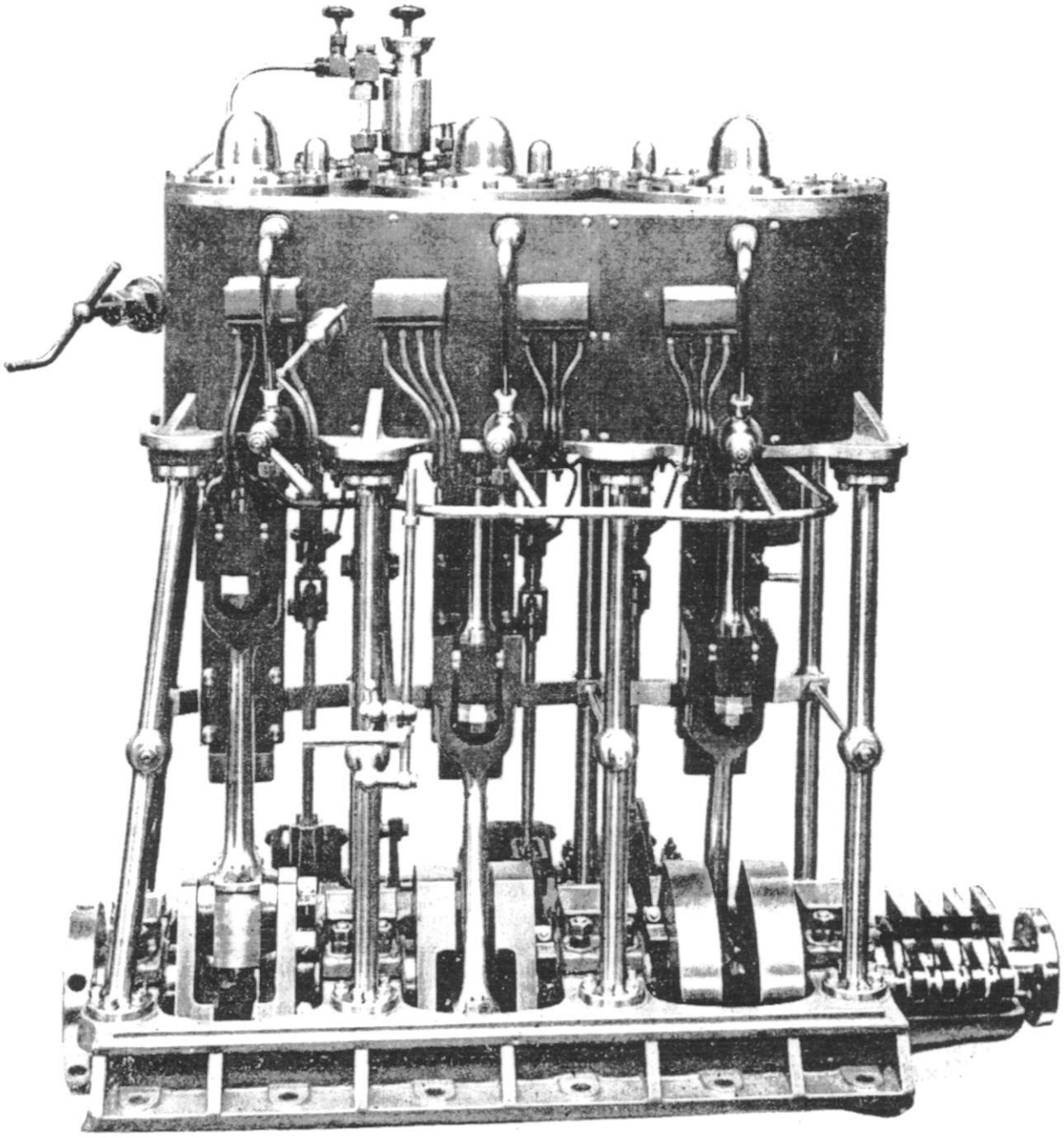
So we find in this engine that the joint pins are unusually thick and short, with a quick taper, so that the slightest blow with a small piece of wood is sufficient to loosen them. It follows, of course, that the transverse areas of the connecting rod-ends in the valve gear are extremely wide, and that the rods themselves—which are accurately machined from stampings—are of more than usually deep section. And, as has been said, extremely accurate fitting to a limit of a millimetre is the key of the construction.

Yet one sees many an apparently good-looking and well-built engine which is nevertheless noisy, troublesome, and short-lived in working, because the balance of moving parts has not been duly sought for and obtained. Balance, indeed, is the great secret of successful steam-engine design, other things being equal; especially in the valve gear, on the one hand, and the pistons, connecting rods and crank shaft on the other. But one has only to stand by a Savery engine when running at its top speed, and to test it with sudden variations of speed as I did, to be assured, from its noiselessness and the absence of vibration, that the perfection of mechanical balance, as well as steam effort has been achieved. Personally, I consider that Messrs. Savery's choice of the Joy valve gear and their modification thereof lends itself to this result; but other contributory factors undoubtedly are the size and length of all glands, bearings, and steadies.

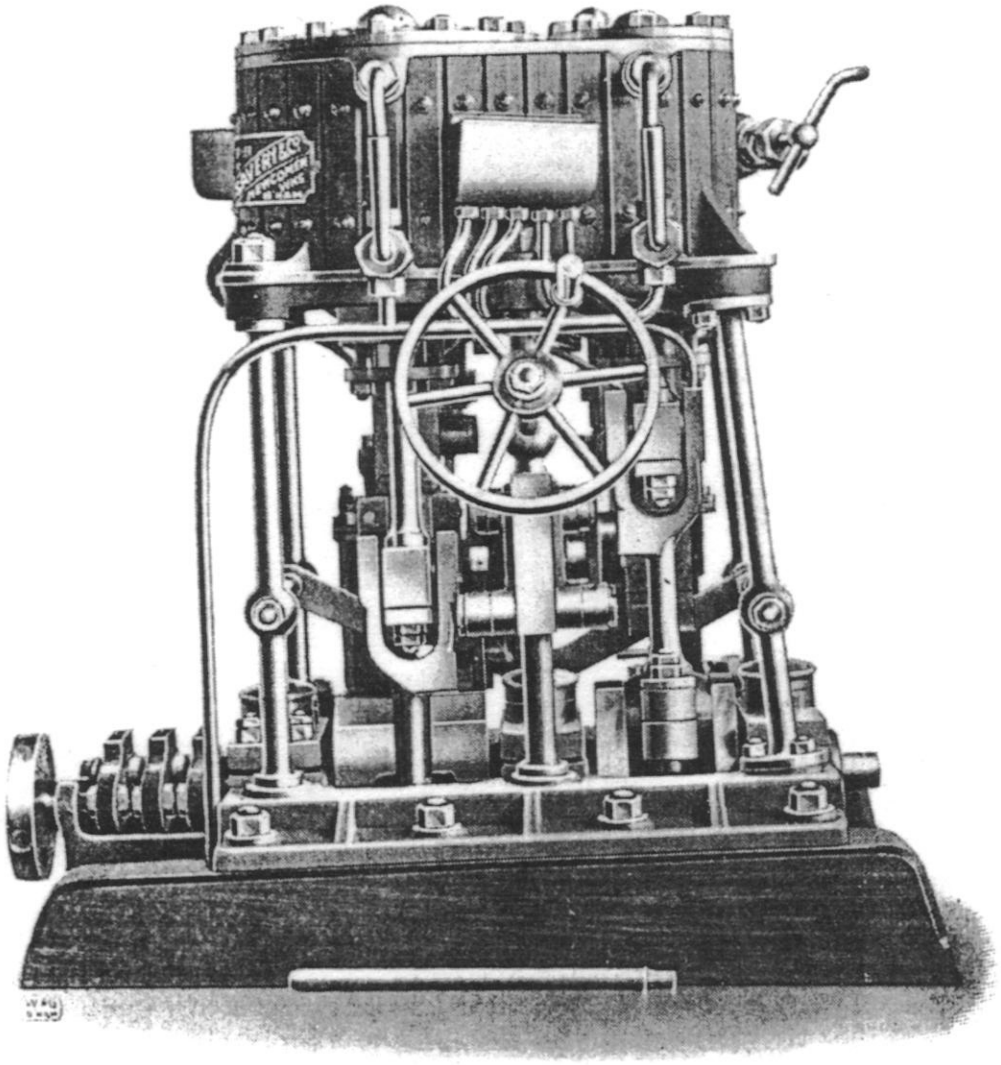
Lightness of parts is another important factor; and in this connection we note that the piston valves are machined out of solid steel for the sake of lightness. Yet the great difficulty with either these or the D type is not only to combine, but to maintain accuracy of fit with absolute freedom of movement, especially when, as in this case, closeness of fit is pushed to the limit. Theoretically, it

seems easy; practice, however, under the working conditions, which have to be reckoned with at high and suddenly varying speeds, tells a different tale. Nevertheless, Messrs. Savery have overcome the difficulty by practically floating the valves, and thus leaving them free to compensate themselves throughout their motion, finding their own way, so to speak, in the following manner: The valve rods, at their attachments, upper and lower, each carry two washerlike bushes, formed converse and concave, the former—which are butted up against the waist of the piston valve—being seated in the latter. In these circumstances, of course, the piston valve faces, which are deeply case-hardened, find their own seating at all times. And, in taking farewell of this subject, I would point out that the cut-off at all speeds is so sharp that the exhaust could not be distinguished by ear from the rhythmical poppings of a well-silenced internal combustion motor.

Turning now to bearings, glands, and lubrication detail, I note that the first are made of a new type of bronze called Eatonia metal; this being phosphor bronze of a special mixture, which is suddenly chilled after casting by a patented process. The great feature of this bronze is its closely striated grain. The glands, on the other hand, are packed with a special packing composed of hanks of white metal wiring surrounded with graphite powder, the combination being laid together in a loose cotton "stocking" or tube. There are not many points about the lubrication arrangements which differ greatly from conventional practice; but those few are especially worthy of



SAVERY QUICK REVOLUTION TRIPLE EXPANSION ENGINE; non-condensing, for inland waters; made under B.O.T. survey. This engine is of the highest class of manufacture, the whole of the wearing portions being case-hardened and ground. The piston lines are all balanced and exactly the same weight, therefore ensuring the engine running very steady and without the least vibration.



EARLIER PATTERN 18-I.H.P. QUICK REVOLUTION ENGINE, fitted with Pumps driven off the Crossheads direct. The new design of slow-speed pumps overcomes the trouble of the pumps running so fast, as they are driven with Worm gear at a reduced speed. The latter is fitted with wheel reversing or lever, as may be desired.

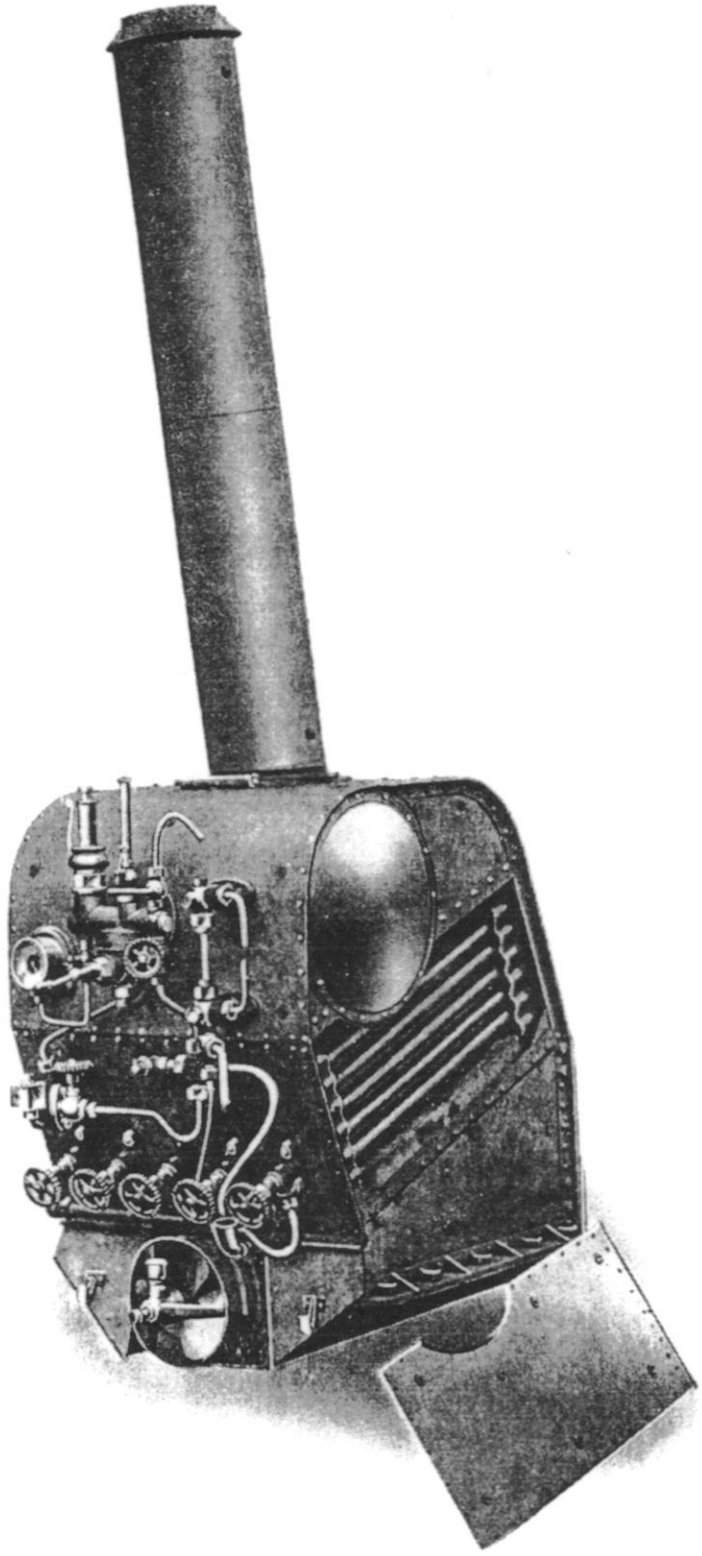
note. For instance, oil pockets are machined in the cross-head slippers; and economy, as well as a certainty of lubrication and avoidance of neglect, is secured from the fact that the oil drips through holes in the cross-head bolts into the forks of the connecting rods, and thence down through counter-borings in the rods into the crank-pin bearings.

As to the larger details of the Savery engines, I may point out that the cylinders are bored and ground in special machinery with the utmost accuracy, and that the crank shafts in all cases are turned out of the solid with balanced webs, as well as that all journals are of ample diameter and as long as they can be made consistent with the maintenance of compactness. Installation length, too, is reduced to motor-like proportions, for even with the dynamo which is included in the marine set (see page 4) I found the length to be only 6-ft. 6-in. from the forward side of the boiler to the propeller shaft coupling. Without the dynamo the set would have been just 2-ft. shorter, which is some inches less than the combined length of the average 20 h.p. internal combustion motor and its reversing clutch. In the matter of weight, too, this plant compares favourably with the weight of a marine motor of good make, including the reversing gear, petrol tank, and fuel—which last items are too often forgotten in these comparisons—for engine, boiler, water, and all only worked out at $8\frac{1}{2}$ cwts., or about $47\frac{1}{2}$ lbs. per h.p.

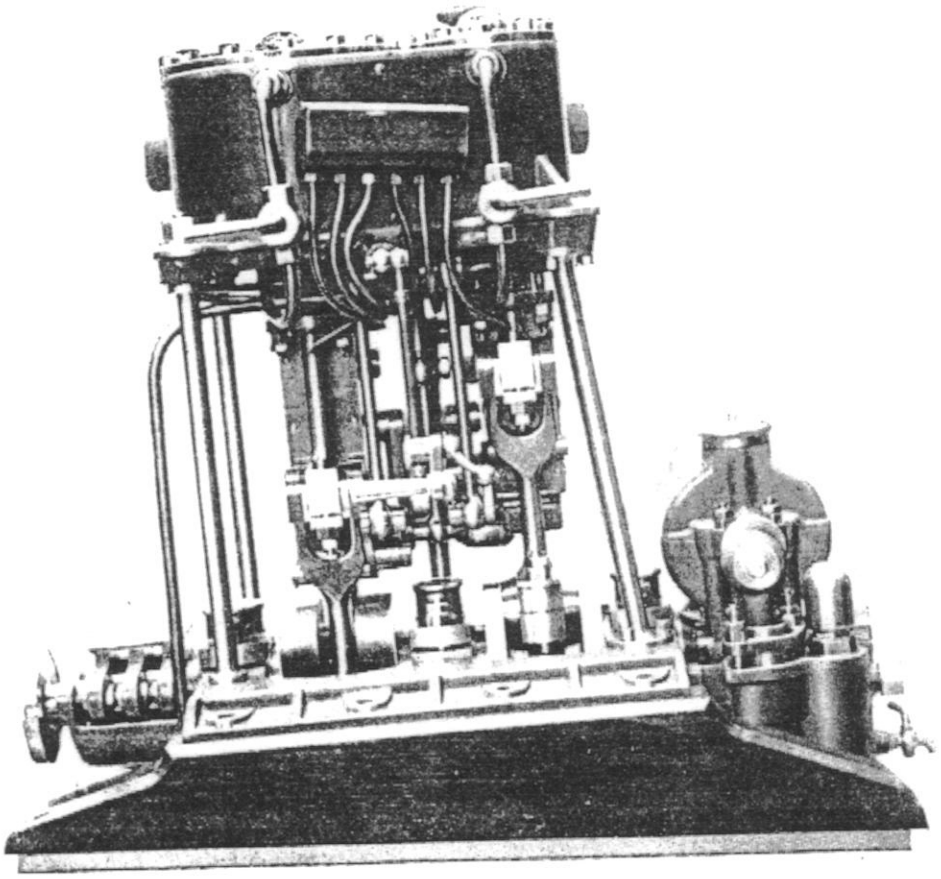
Again, a very neat feature of this engine, which should not be overlooked, is the slow speed water pump, which is driven from an eccentric on a transverse arbour, rotated by skew-gearing from the forward end of the crank shaft, the relative rates of rotation of arbour and crank shaft being 270 r.p.m. and 800 r.p.m. (see page 16).

In conclusion, I should like to draw attention to another of Messrs. Savery's watch-like engines—one of the daintiest of its type I have ever seen; this being the little tandem with concealed valve motion (page 8). This, tall as it looks, is in reality only 20-in. from the underside of the bed-plate to the top of the cylinder caps, and, for all its compactness, there is no great angle of thrust in the connecting rod. These, too, then, and the triple expansion engine (page 11), are sufficient in themselves to bear out all the results of my personal inspection and criticism, just as their design, construction, and finish is more than enough to verify Messrs. Savery's traditional place in the very first flight of contemporary practice.

G. DE H. S.



SAVERY QUICK STEAMING WATER-TUBE BOILER, with forced draught for coal fuel. This is the firm's straight tube type, in which all the tubes are easily removed or examined.



SAVERY'S LATEST TYPE 20-I.H.P ENGINE.