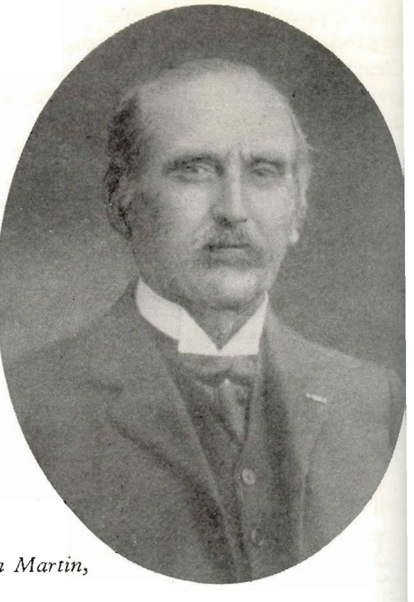
William Hamilton Martin

Some of the achievements of a Scot who spent his working life in Holland are recalled. Besides designing numerous interesting steam engines and marine boiler plants Martin laid out and equipped the well known de Schelde establishment at Flushing and was its managing director until his death in 1917. Evidence of his farsightedness is to be seen today at Flushing



William Hamilton Martin, 1850-1917

In going back over the earlier days of marine engineering progress it clearly emerges that the shipping world owed a great debt last century to Britain. So many of the great names of the profession, as well as the leading firms, were British : Blechynden, Kirk, Marshall, McFarlane Grey, Loftus Perkins, Tweedy, Yarrow, to mention a few ; others will come to mind. The Continent was not slow to follow, however, and some of her earlier marine engineers also made important contributions to general progress. Like the British industry marine engineering in Europe had modest beginnings, and interesting stories of development and progress could equally be told of how France, Germany, Holland, Italy and the Scandinavian countries got started and progressed technically in the world of ships and their machinery.

In some of the foreign countries mentioned men from Britain played a decisive part. Notably, was not Mr. Wain a Scot, we can confidently believe some of our Clydeside and Danish readers will be recalling as they read that statement—and, of course, there were others, whose names are not so deservedly perpetuated in this second half of the twentieth century. One such marine engineer who has always interested us is William Hamilton Martin. As an orphan of twelve he went to Holland from his native Glasgow in 1862, *and at a surprisingly youthful age began to play a part in Dutch marine engineering. His early start as a designer was admittedly due to unusual circumstances for the uncle with whom he went to live in Rotterdam—one David Christie—owned a steam engine manufacturing works and Martin entered his drawing office at the age of fifteen. Five years after settling in Rotterdam Martin's uncle died but the young Glaswegian had already shown such technical ability and maturity that he had no difficulty in obtaining a designer's post in the engine works of Burgerhout & Kraak, of Rotterdam. (It might be interpolated that the Burgerhout establishment survived as shipbuilders and marine engineers until the depression of the late twenties and early thirties. The last notable event in the firm's engineering career was to aquire a licence to build the Nobel two-stroke marine diesel engine. Although they built a satisfactory engine, we recorded in* 1928, *the venture did not save the firm. They were absorbed by one of their local competitors shortly afterwards.)*

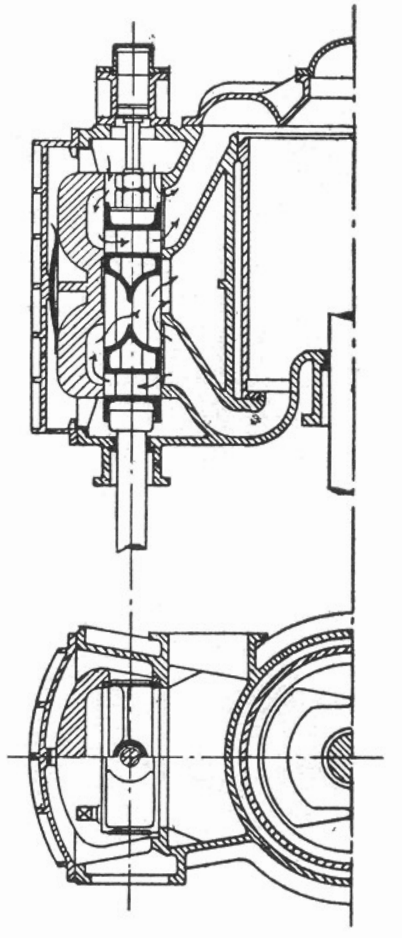
Martin studied technical matters from the outset of his career and became convinced that higher piston speeds provided the key to more compact, more competitive and generally more efficient steam engines. He therefore set about putting his belief to the test of commercial design and manufacture. This progressive attitude to marine engineering, manifested so early, was to dominate his outlook and actions throughout his long professional life. Entering marine engineering during the formative years of that industry in the Netherlands, a man of Martin's vision and resourcefulness had a great opportunity. He took it with both hands. Martin was never content to follow, to work in a groove whatever the returns might have been commercially, although he was never unmindful of the more mundane side to marine engineering and shipbuilding.

We have long admired this little-known Scot who carved his career in Holland, and we have discussed his work on many occasions with his son, Mr. W. Hamilton Martin, M.R.I.N.A., M.I. Mar.E. When we projected the idea of noting the passing of this journal's eightieth birthday with some historical articles we felt that one on William Hamilton Martin the elder would be appropriate and interesting to many. We accordingly invited Mr. W. Hamilton Martin to prepare some material and loan us some illustrations relating to his late father. What follows is based upon his notes; he starts his story at the beginning of his father's career—around 1867*—when he was left to make his way in a comparatively strange country. He had, in fact, just joined the staff of Burgerhout & Kraak as a designer—a cub one perhaps, but full of ideas and confidence.*

* * * * * *

A SUITABLE tugboat engine was badly needed in Holland at that time and this young Scotsman soon applied himself to the task of designing such an engine. He produced a high-pressure diagonal single-crank two-cylinder engine with a single boss eccentric ; it took steam from a high-pressure boiler. These engines showed such a degree of suitability that they not only became widely adopted for the service for which they had been designed but also for self-propelled lighters, smaller passenger steamers, ferries, harbour-inspection and customs launches, etc. These compact engines only took up two or three frames spaces and the boss-eccentric valve gear gave quick engine response when manœuvring in restricted and busy waterways. Martin's original auxiliary starting valve on the cylinders of these engines was pedal-operated by the captain. This feature gave a certain and powerful start from any crank angle and eliminated the " dead centre effect " of the conventional single-crank engine. The engine speed was high, making for a compact unit, while fuel consumption was much improved over what the owners of these smaller craft were used to, and withal upkeep and maintenance were both reasonable.

About this time Martin had replaced the old high-pressure workshop engine at the factory by a much smaller jet-condensing engine running at 200 r.p.m. This took up no more than a quarter of the space and consumed half the coal of its predecessor, which ran at 40 r.p.m. Although this stationary engine was looked at askance for a time, it gained favour when its reliability and economy were established. At that time, however, marine engineering was not in a very advanced state in the Netherlands and it was uphill work for the firm and its young designer to " put over " advanced designs. As Martin's reputation as an engine designer and boiler constructor grew, however, the young go-ahead Scot met influential people and more important work came his way.



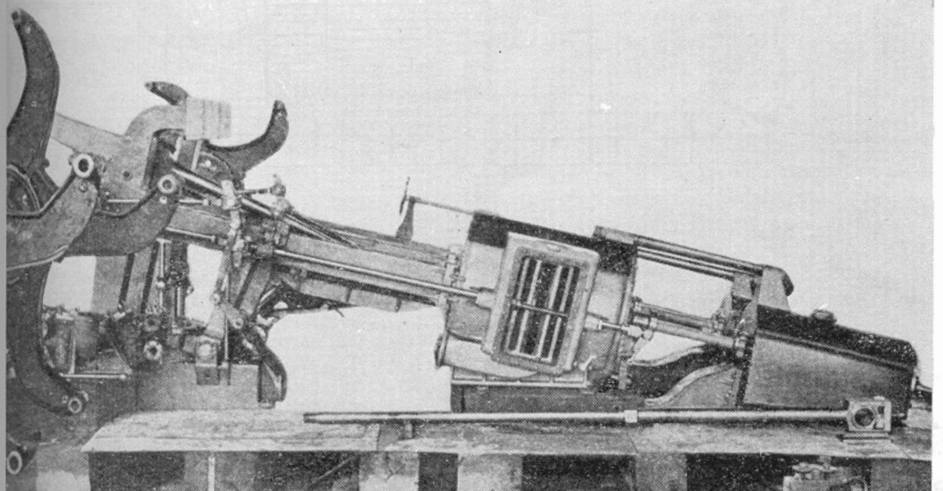
Balanced double-opening slide valve, of which Martin was co-patentee with the late James Andrews in 1899. The example shown is for an auxiliary engine but many hundreds were also fitted to the main engines of naval and mercantile vessels. The invention, and a later form, had an exceptionally long period of application and is probably the idea with which the name of Martin is most frequently associated

A great opportunity

In 1875 he was commissoned to undertake the responsible task of planning, laying-out, constructing and putting into operation a new shipbuilding and engineering works on the site of the derelict former naval dockyard at Flushing. With this undertaking Martin was given his great opportunity; he was asked to become its engineer-in-chief and managing director, a position he accepted and held until his death about forty years later. After taking up this important appointment Martin became a member of the Institution of Naval Architects and the Institution of Mechanical Engineers, and he often found time to attend their summer meetings although he never had spare time enough to prepare the papers he could have contributed to both.

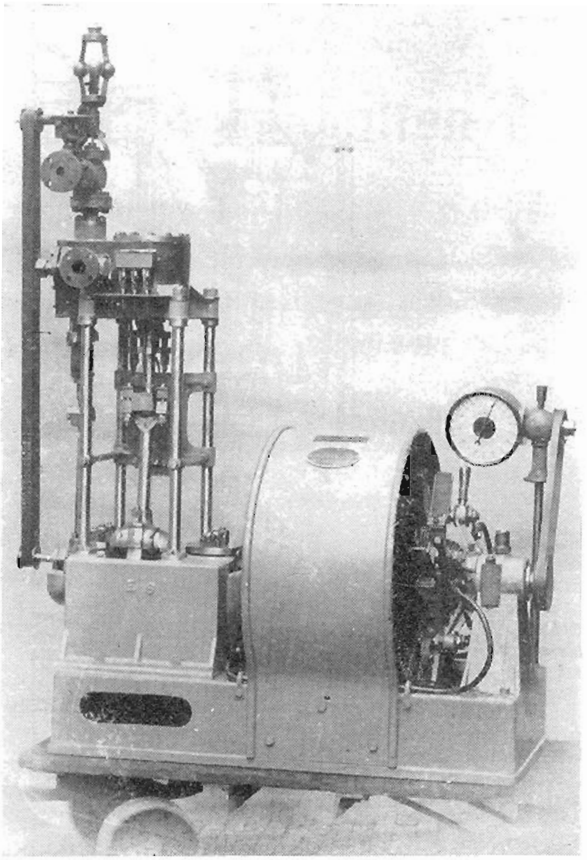
With his progressive outlook Martin naturally had to have the most modern engine and boiler shops, with the best shipyard equipment and latest machine tools of the day. One of his gravest difficulties was to provide for the firm an adequate labour force. It was also hard to find foremen and draughtsmen who were prepared to come to this then outlying port on the island of Walcheren, on the River Scheldt, but he managed to succeed.

Taking a broad view of matters, Martin decided to design and have erected his engine shop, boiler shop and other departments without using outside assistance. This was a formidable undertaking for he planned shops of what seemed unheard-of dimensions for those days. His foresight proved right, however, for they served their purpose

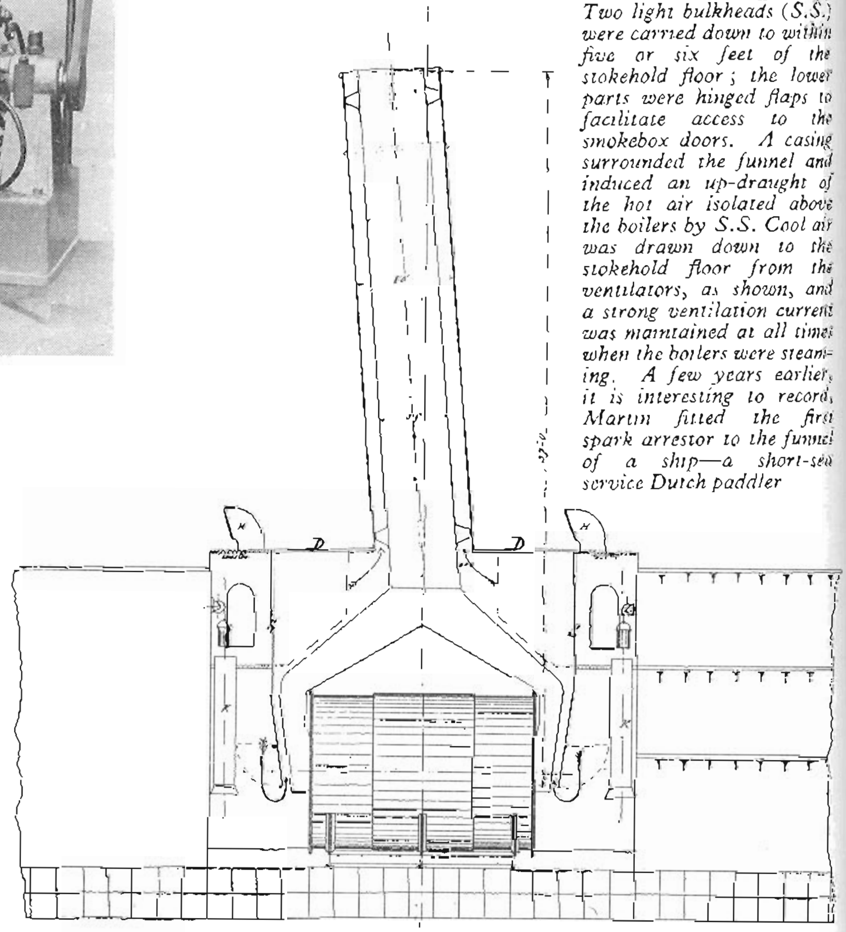


Diagonal tandem-type quadruple-expansion paddle engine built at Flushing in 1888. It developed over 650 i.h.p. at 35 r.p.m., the boiler pressure being 200 lb. per sq. in.; forced draught was used. Martin's balanced slide valves and push-type diagonal reversing cylinder were fitted. The simple form of radial arms for the five-float paddle wheels were of cast steel, to Martin's design very well throughout his lifetime in most cases. He was engaged on building three new glass-roofed engine shops just before the first war, and others followed in 1916. These were of a size and machining capacity which sufficed down to the present time. He installed a unique 150-ton hammerhead travelling crane which he himself designed and had erected in 1913. This runs along the front of the three engine shops at Flushing on 600 ft. of rails and still serves the fitting-out quay at the de Schelde establishment.

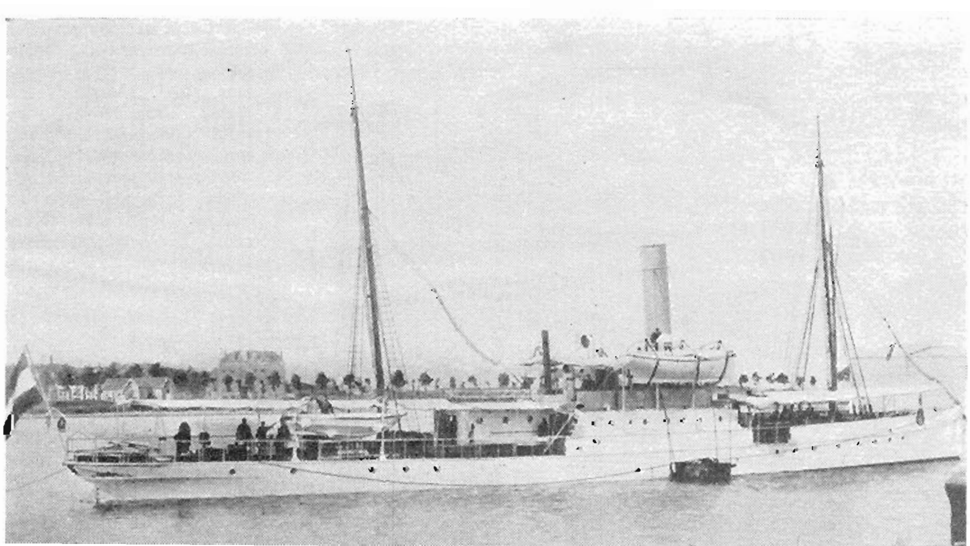
Horizontal boring and milling machines of the largest size and capacity, to take complete steam engine bedplates, turbine and gearcasings, condensers, diesel engine cylinders and crankcases, frames, shipyard steel castings and other large items were installed in due course so as to keep the



High-speed lightweight auxiliary engine and directly-coupled Willem Smit dynamo produced in 1893 for the Dutch government vessels 'Argus' (below) and 'Cycloop'. The engine was of the bobweight balanced type



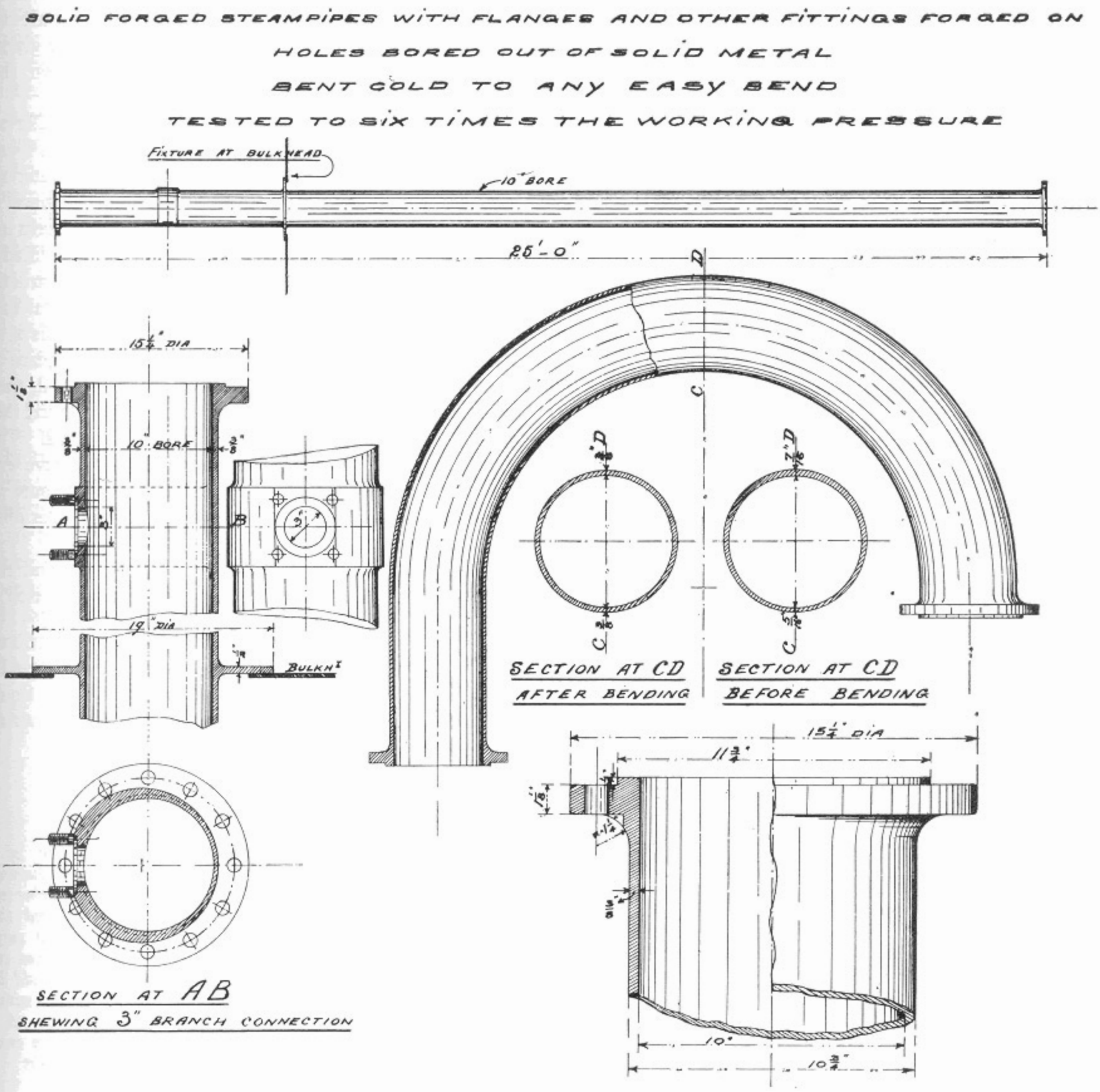
Around 1890 W. H. Martin patented this ingenious method of stokehold ventilation without the need for fans, and many vessels demonstrated its efficiency. Two light bulkheads (S.S.) were carried down to within five or six feet of the stokehold floor; the lower parts were hinged flaps to facilitate access to the smokebox doors. A casing surrounded the funnel and induced an up-draught of the hot air isolated above the boilers by S.S. Cool air was drawn down to the stokehold floor from the ventilators, as shown, and a strong ventilation current was maintained at all times when the boilers were steaming. A few years earlier, it is interesting to record, Martin fitted the first spark arrestor to the funnel of a ship—a short-sea service Dutch paddler



One of the lightweight, shallow-draught anti-opium smuggling vessels of 1893, the 'Argus'. They were built and engined by de Schelde, being provided with special lightweight, balanced triple-expansion engines as briefly described in this article plant abreast of development, and 100-ton overhead travelling cranes were installed in the later 100-ft.-span engine shops, with ample headroom to handle large workpieces up to 45 ft. height under the crane rails. But that was in a later stage of the firm's history.

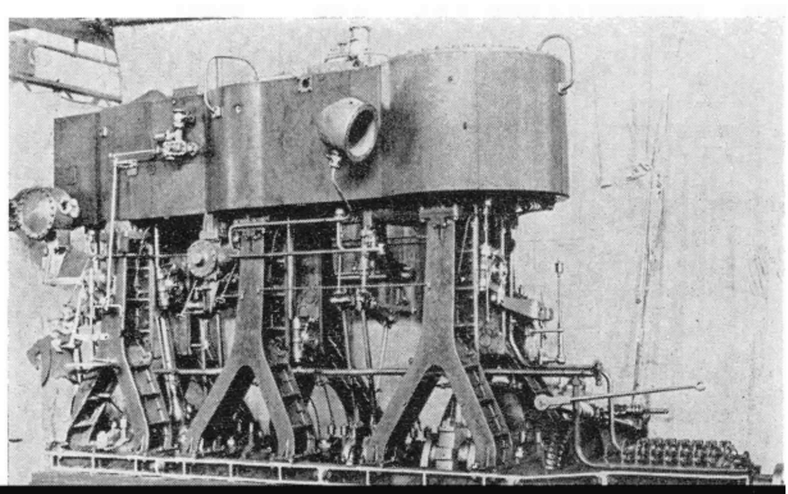
With his efficient works Martin managed to achieve a substantial turnover on a moderate capital and he contrived throughout his lifetime to keep the workshops equipped with the most modern machine tools available. He was the first to introduce hydraulic riveting and flanging of boiler-plates into Holland, installing a 150-ton Fielding & Platt machine for this purpose and later a 150-ton Breuer Schumacher steam-hydraulic flanging press. He was amongst the first to use treble-riveted seams on boiler shells. Shell plates of 1½ in. and over 39 ft. long were rolled at Flushing many years ago. Furnace apertures and manholes were cut by Harvey & Hulse machines, and all flanged ends of shell and combustion chamber plating were scarf-milled. Shell plates up to 2 in. were bent cold in the shipyard he also ran, and not annealed, although this could be done on plates bent and flanged hot.

In later years Martin was turning out 50 40-ton boilers a year, mostly for ships built at neighbouring yards. The ships generally came up to Flushing to be engined and



Martin's own sketch of the solid-forged and fully machined steam pipes he evolved in 1899. They could be bent cold to easy radii and the use of expansion joints was thus avoided. By carefully arranging the eccentric boring of pipes to be bent the final result was a pipe section of even thickness, as shown. Bulkhead flanges, as well as end ones, were integral

The column construction of this Martin-designed triple-expansion naval engine of 1899 will be noted; it developed 5,000 i.h.p. at 140 r.p.m. and had his design of balanced slide and throttle valves as well as his push-type reversing cylinder



boilered, a series of standard triple engines (1,000 1,250 and 1,500 i.h.p.) being the "bread-and-butter line", supplementing the firm's own naval and mercantile construction work.

Torpedo boat machinery

In 1887 Martin fitted forced draught to the small torpedo-service craft *Mercuur*, engined by a triple-expansion unit. His talent at that time had developed particularly in the designing of torpedo boat engines, these ranging from small 450 i.h.p. compound sets (around 1884) up to the 10,000 i.h.p. four-cylinder triple-expansion twin-screw installations for the Schelde-Yarrow-type destroyers of as late as 1910—perhaps the ultimate in naval steam reciprocating machinery in Holland. All these installations had Martin's push-type steam reversing cylinder, which gave instant engine response, and his ingenious balanced slide valves.

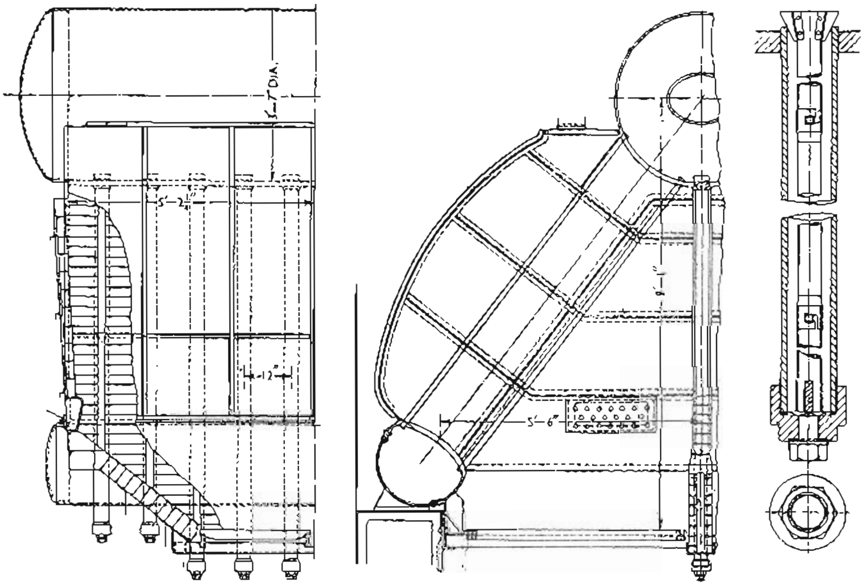
In 1890 Martin built some quadruple-expansion-engined passenger liners with 200 lb. boiler pressure. By 1898 his quadruples were using 210 lb. per sq. in. working pressure and the following year they were up to 225 lb. He would have gone to 250 lb. pressure in the interests of economy but this was rather too high for Scotch boilers he felt at the time. A tandem quadruple-compound diagonal steam engine for a paddle boat of 650 i.h.p. had been built in 1888 with 200 lb. working pressure and running at 35 r.p.m., an advanced and novel engine of his which performed successfully.

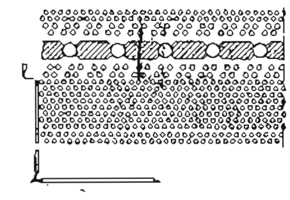
Water-tube boilers

Meanwhile Martin had taken a lively interest in water-tube boiler development, appreciating from the early nineties that as pressures increased and lower weights were sought such boilers were logical, especially for naval work. He fitted a modified Schelde-Yarrow water-tube boiler in Dutch cruisers, torpedo-boats and fast cross-channel vessels over a period of years. These were provided with his own water-cooled division wall in the furnaces which offered several advantages which Martin believed would result in this feature being widely adopted. These boilers had no down-comers and the fuel lay right across from division wall to the water-pockets, without any side-bricks. The water-wall consisted of specially shaped bricks, with veed ends, fitted partially around 3½ in. (at 12 in. pitch) Field tubes so that the combustion gases could heat the tubes which in turn protected the brickwork and kept it relatively cool. The division wall reached down into the ashpit and it was possible to clean one half of the furnace while steaming was maintained on the other half. A drawing from a contribution to an Institution of Mechanical Engineers' paper is given here and makes clear the modification introduced on these early Dutch-built Yarrow boilers.

In 1901 the British Admiralty formed a boiler committee, presided over by Vice-Admiral Sir Compton Domville, for investigating the various types of available water-tube boiler and reporting on their possible use in H.M. naval ships. It was arranged for the committee to visit the works in Flushing and Martin showed the members his modified Schelde-Yarrow boilers in various stages of construction. The committee then proceeded to the Dutch naval base at Den Helder and were shown the results of the trials of the battle-ship *Honingin Regentes*, which had taken place in August 1901. These trials had been most successful, the designed speed having been exceeded by nearly a knot and the designed i.h.p. (10,000) by 1,200 on a four-hour trial. The boilers, with Martin's modification incorporated, gave every satisfaction and although the designed air-pressure under the bars had never been exceeded the horsepower obtained per sq. ft. of grate surface was as high as 27.

Martin's cruiser engines of that period and rather later were of very light but sturdy design and used cast steel-





Naval water-tube boiler of modified Yarrow type built at Flushing around 1894. The combustion chamber was divided by a Field-tube wall and the greatly increased radiant heating surface gave good steaming and improved circulation. One half of the grate could be cleaned at a time, an advantage with powerful hand-fired installations. A broadly similar design was used in cross-channel service, with natural draught

inverted Y-type webbed columns. Piston rods and cross-heads were single forgings so that both the rod and the crosshead pin could be bored out. Piston valve rods, crosshead-pins and crankshafts were of 4/5 per cent nickel steel. The link-motion had two ahead and one astern eccentrics so as to avoid offset rods. The push-type reversing cylinder, already mentioned ensured foolproof and quick manœuvring.

Solid-forged steam piping

An interesting feature in that era was that all Martin's steam-piping was of solid-forged mild steel hollow-bored (trepanned) type, being hydraulically tested to 1,500 lb. per sq. in. Flanges were integral and were given long and strong fillets with male and female spigots. It is interesting to note that these special pipes were bent cold. All expansion troubles, leakage, breaking of flanges and bursts were eliminated by the use of such—admittedly more expensive—steam piping. The increased cost was, at the turn of the century, approximately £2 per ft. for a 6 in. diameter steam pipe but it was well worth the extra cost in ensuring trouble-free operation in naval ships. The inventor's own sketch of one of these pipes is included with this article.

All the engines built at Flushing at that time had Martin balanced slide valves. This was brought out by him in 1875, long before patents existed in Holland and a sketch of one is included. Subsequently the idea was patented in the U.K. and elsewhere and sold as the Martin & Andrews balanced slide valve; perhaps it was better known to older seagoing engineers as the " matchbox " valve. Today 85 years later it is still used in broadly the original form the modern British derivative being the well-known Andrews & Cameron valve.

With all his water-tube boilers Martin supplied a testing cabinet with which could be found the salt content, acidity and suitability of the feed. A water-feed oil-gauge, capable of indicating the slightest trace of oil in the feed, and enabling the engineer to keep it within safe limits and telling him when to clean his feed filters, was part of this equipment which really anticipated what is provided today. A de Schelde 300 lb. per sq. in. works test water-tube boiler was used in those early days for testing tubes in radiant-type superheaters and a condenser was available for testing tubes of various kinds. There was also a works' engine for testing Martin's own designs of metallic rod packing at high superheats, testing various lubricating oils, etc.—all this before the turn of the century, when it is often assumed that little research work and testing was done in marine engineering establishments.

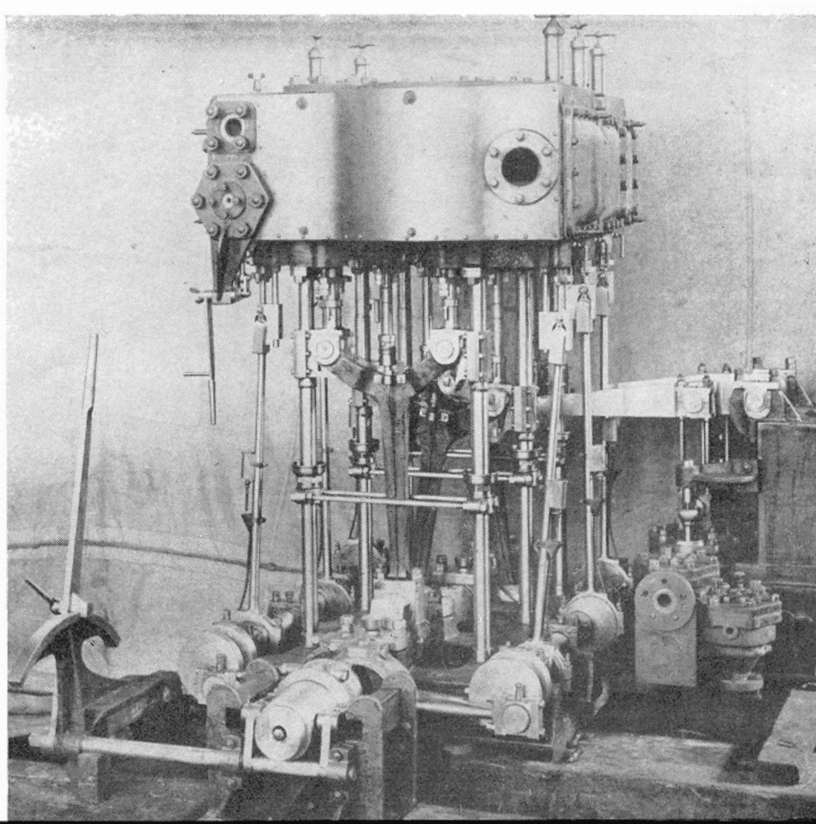
Multiple-expansion designs

In 1888 Martin found opportunity to investigate the possibilities of using multiple expansions by designing and constructing a six-fold-expansion engine. He called it a sextuple-compound engine, and it is illustrated here. It had its cylinders in two lines of three in a compact block on either side of the single three-throw crankshaft. Each pair of adjacent cylinders transmitted power by means of a yoked Y-shaped cast steel connecting rod onto one of the cranks. The balanced slide valves mentioned were naturally used, each being actuated by an eccentric-rod from an eccentric fitted to one of the shafts to either side of the centrally-placed crankshaft. These shafts were driven from a boss-eccentric on the forward end of the crankshaft by means of the designer's ingenious multi-crank driving gear, which gave a smooth, continuous and silent drive. (In 1910 Mr. Kloos the engineering director of Werkspoor adopted a similar multi-crank rod drive for the camshaft of his first seagoing diesel installation in the motorship *Vulcanus*. This feature was used on subsequent Werkspoor four-stroke marine diesel engines down the years.)

The main particulars of this unusual high-economy steam engine are worth giving :

Cylinder No.	1	2	3	4	5	6
Cylinder dia., in in.	7	8	$9\frac{1}{2}$	$11\frac{3}{4}$	15	20
Cylinder ratio	1·00	1·13	1·85	2·80	4·60	8·20

The engine produced 150 i.h.p. at 200 r.p.m. and used steam at a boiler pressure of 220 lb. per sq. in. It was installed in a small short-service passenger vessel running



The celebrated Martin sextuple-expansion engine of 1888, now preserved in the entrance hall at the Flushing offices of the de Schelde company. The six cylinders were arranged in two rows over a three-throw crankshaft, forked connecting rods being used. This ingenious engine had two eccentric shafts and a high degree of economy was maintained over sixty years of hard service to and from Rotterdam. She was one of seven similar craft and it is a great pity that comparative performance data relating to the sextuple-expansion-engined ship and her conventionally-powered sisters have not been preserved.

This unique marine steam engine has fortunately been preserved in good mechanical condition and given a resting place in the entrance hall of the Royal de Schelde Company's head office at Flushing. It gave sixty years of good service—from 1889 to 1949—and its smoothness of operation and, according to Martin, economy in fuel consumption were always better than the results achieved by all the other ships of this particular passenger fleet. It is a most fitting and characteristic reminder of the enterprising pioneering of its creator.

Challenge to a designer

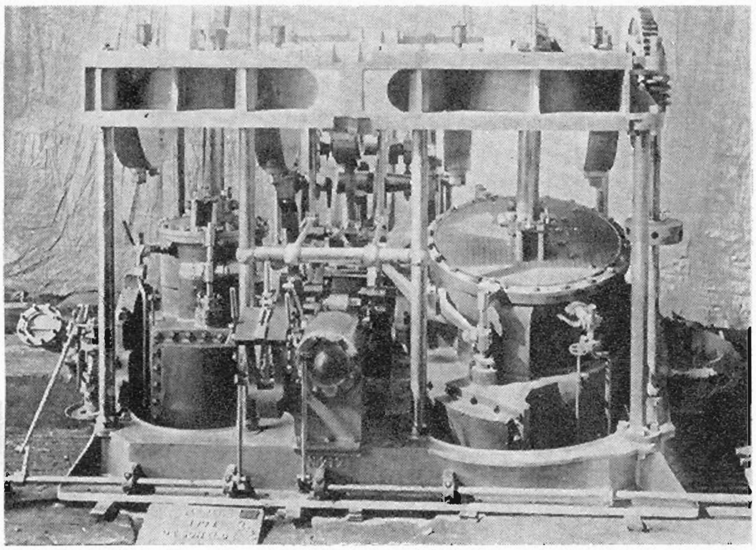
Some time after Martin produced this interesting engine two fast policing vessels were needed by the Dutch East Indies colonial government to combat opium smuggling. Martin undertook to construct and engine these smuggler-catchers, which were the *Argus* and *Cycloop*. The conditions specified were very stringent indeed but this was regarded as a challenge to his designing and practical talent.

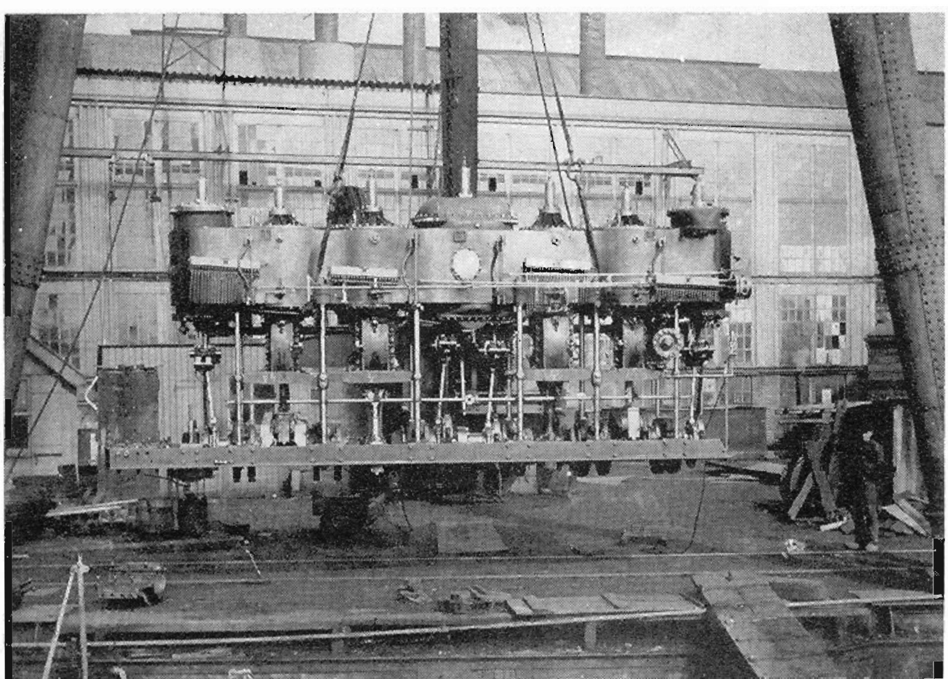
A side of Martin's interest and versatility not yet mentioned here was his knowledge of shipbuilding and naval architecture. When the proposal for these two special small high-speed craft came along, therefore, he regarded the resistance and propulsion aspects of the problem as a particularly agreeable exercise, to be tackled promptly and thoroughly. Experiment tank facilities were, needless to say, not very extensive in Holand or elsewhere in 1892/93 so Martin set about carrying out his own " tank " experiments. A series of paraffin-wax models were towed in the de Schelde fitting-out dock at Flushing and as a result of these perhaps rough-and-ready comparative tests the lines of the proposed vessels were determined; a hull form with slightly hollow waterlines forward and a fine run to assist propeller performance was decided upon and in due course de Schelde got the contract to build the two opium catchers, one of which is illustrated here. Severe penalties were written into the contract Not only had the ships to be fast, light yet strongly built, but they had to have high economy (i.e. good steaming radius) at cruising speed. The government specified that a top speed of 16 knots had to be attained and the draught had not to exceed 8 ft. They also had to be capable of remaining at sea for twelve days when steaming at 12 knots. The penalty for failure on either score was simple : the ships would be rejected and no payment of any amount would be made to the builders.

Martin put forward a vessel 188 ft. long on the waterline by 23 ft. broad by 12 ft. depth to the 6 in. keel. His mean draught would be about 6 ft. 9 in. As built the displacement was 381 tons with 40 tons of coal on board but 106 tons of bunkers could be carried. On a 12-days run, steaming at cruising power with a coal consumption of under 9 tons a day for all purposes seems little enough but the ships always managed this and were a success from the day of their acceptance trials.

Weight-saving balanced engine

A special lightweight balanced triple-expansion engine was evolved for these light-scantling vessels, this having hollow-bored crankshaft and connecting rods ; the latter were of oval section, and even the main and large-end bearing bolts were drilled to save weight. The cylinders were: 19 in., 30 in. and 43 in. in diameter by 24 in. stroke, and on trial a top output on one of the vessels of 1,664 i.h.p. was reached at 212 r.p.m. on a steam-pressure at the engine of about 160 lb. per sq. in. These light engines had the patented balanced slide valves already mentioned and Martin's push-type quick-reversing cylinder. A special lightweight balanced single-cylinder dynamo engine was





Martin was always interested in oscillating engines, taking out a patent for improved valve gear actuation for such engines as early as 1885. This compound oscillator of 350 i.h.p. at 42 r.p.m. was built at Flushing for a paddle steamer in 1903. It had Martin's single-eccentric valve gear, his balanced slide valves and the push-type reversing engine

One of the last reciprocating engines for a Dutch destroyer must surely have been this 1910 four-crank triple, balanced on the Yarrow, Schlick and Tweedy principle. The Flushing yard installed two of these 4,000 i.h.p. at 425 r.p.m. engines in the vessel and on trial each developed 5,000 i.h.p. at 525 r.p.m.

produced for the ships by the firm and drove a lightweight Willem Smit dynamo; one of these sets is illustrated.

An interesting feature of the *Argus* and *Cycloop* was the use of a six-bladed propeller—perhaps for the first time on a vessel of any size in day-by-day sea service. Extensive trials with two sizes of propeller were actually made and two-, three-, four-, and six-bladed screws were tried before the decision was taken to adopt such a novel feature. Less vibration and a bigger steaming range were obtained when the six-bladed screw was used, we understand.

Five-furnace box-type boilers

Not the least interesting item of the machinery specification was the boiler Martin evolved for these special ships. He decided on *five* furnaces, and a conventional Scotch type was discarded in favour of a very light box-type boiler (in the words of Mr. Hamilton Martin's son.) One of the reasons why five furnaces were provided was because it made the work of the short Javanese firemen easier. The boiler was no less than 20 ft. long and about 11 ft. 6 in. in diameter ; total heating surface was 3,260 sq. ft. and grate area 73·7 sq. ft. According to Mr. Martin's recollection the weight of the boiler was no greater than that of the equivalent Belleville water-tube boiler, and the specific weight of the complete power plant with boiler and condenser filled with water was 135 lb. per i.h.p. These interesting little vessels ran very well for many years, returning an Admiralty constant as high as 270, although whether this was a representative service result or a " best " trial figure is not clear from the somewhat diffuse data available.

Building for " the Lloyd "

The Scots managing director of de Schelde in the early years here briefly passed over held the Rotterdam Lloyd company in the highest esteem. From 1882 until his death in 1917 he built no fewer than twenty-two passenger steamships for them. It is recorded that tenders and contracts were brief documents—almost in the form of a long letter on most occasions. Great mutual trust and confidence existed, and the books of the yard were always available to this particular customer. Prices, we understand, were always competitive despite this pleasant arrangement.

William Hamilton Martin, the " Scots Dutchman " died in 1917, but some time before his passing the Netherlands government expressed its appreciation of the services he had rendered to the country's engineering industry in general and to the Dutch navy and mercantile marine in particular, by bestowing on him the Knighthood of the Netherlands Lion. This is a high civil distinction, which is but rarely conferred upon other than Dutch subjects. Needless to say it was greatly appreciated by its recipient.

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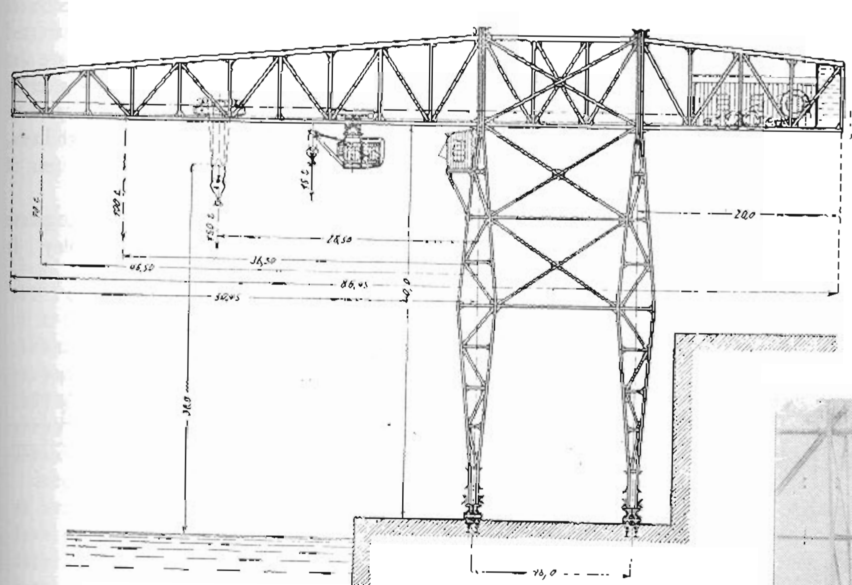
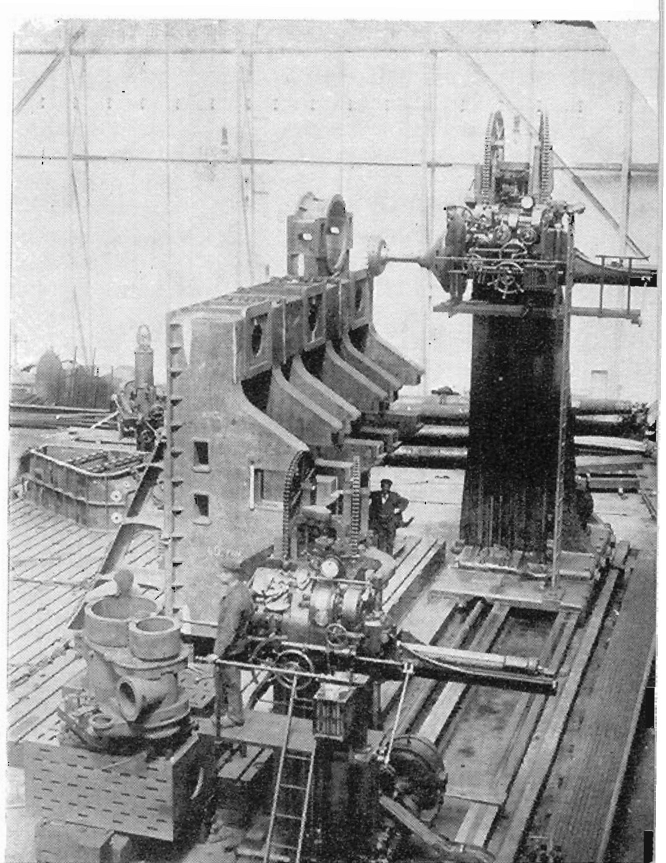
The foregoing does not pretend to be anything approaching a shortened version of a versatile marine engineer's quite unique career—all of it spent in a foreign land. It is not in chronological order, and of necessity much detail and many technical particulars of engines and ships have been omitted because of space considerations. After Martin's death many tributes to him were paid by men who held him in esteem for his personal qualities as well as his many technical and practical achievements. None was more fitting, perhaps, than two sentences from a letter his family received from Sir Archibald Denny. He wrote: We over here look on that beautiful modernly equipped shipyard at Flushing as your Father's monument. Nothing could be a more eloquent proof and reminder for a long time to come of one of the finest engineers and great men in our profession.





Two reminders of Martin's foresight : the 150-ton fitting-out crane erected at Flushing to his ideas and the large horizontal boring and milling machine installed in the engine works in 1913. Note the auxiliary 15-ton " crane within the crane ". The machine shop shown below was provided with an overhead crane of 150 tons capacity. Note that the bedplate photographed in 1913 was being milled, an operation generally associated with a later period for such large units