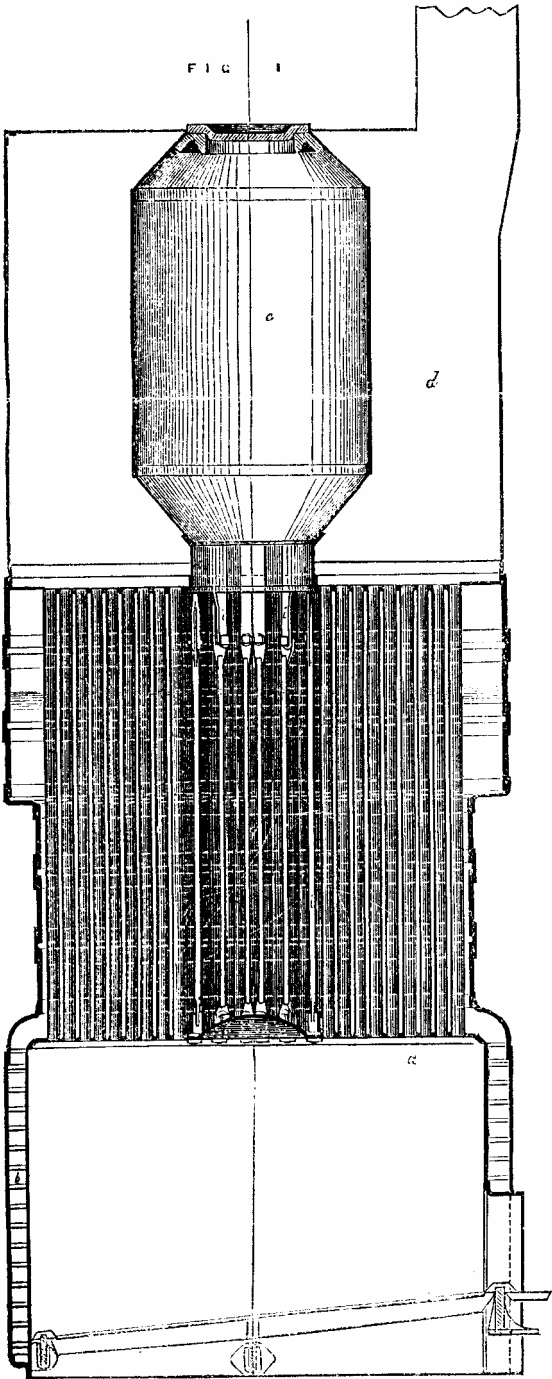


THE MACHINERY OF THE WINANS YACHT.

It is often assumed that it is exceedingly difficult to describe machinery without the aid of drawings. The assumption is we think erroneous. Nothing is more easy than to describe mechanism, provided the writer clearly understands that which he describes. It is merely a question of words. The real difficulty lies in imparting to the reader an accurate conception of the things described, and this difficulty increases in a rapid ratio with their novelty. Now the arrangements of the machinery of the Winans yacht are in many respects unique, and as Messrs. Winans do not for the present, at least, wish to make these public in the fullest sense, we feel that the task of description which we have undertaken is by no means one easy of execution. But although we do not feel ourselves at liberty to publish working drawings to which we have been courteously afforded access, we have had placed at our disposal sketches, which will we trust enable our readers to comprehend all the more important features of, possibly, the most remarkable engines and boilers which have ever been placed on board ship.

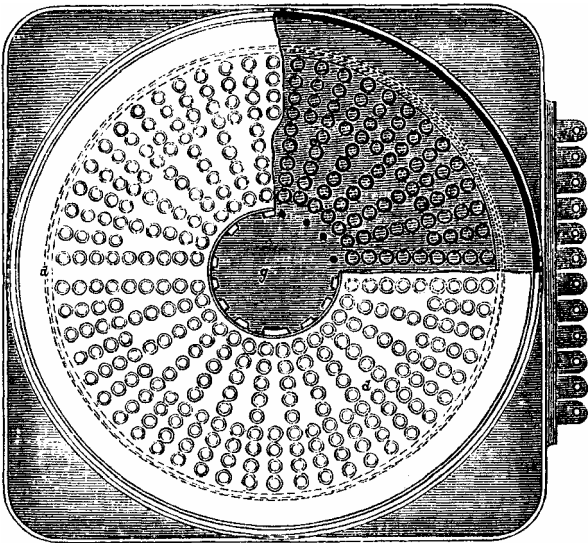
The boilers of the Ross Winans are four in number, and the general principle of their construction will be understood from the accompanying engraving. Each boiler consists of a rectangular fire-box, composed of an inner and outer shell, with a four inch water space between. The internal box is 9ft. long and 4ft. wide, made, as is the outer shell, of half-inch Lowmoor plates—the tube sheet excepted—stayed with 1½in. staybolts, screwed and rivetted, spaced 4½in. from centre to centre. On top of this box are fitted two drums, 4ft. in diameter and 5ft. high, of ¾in. Lowmoor plates double rivetted. Each drum is traversed by 120 tubes 2¼in. diameter outside. The top of the internal fire-box forms the lower tube-plate, which is ¾in. thick. The upper tube-plate forms the top of the drum. The arrangement of the tubes is peculiar, as will be seen from the engraving, which represents a boiler of small size



with a single instead of a double drum, and is nearly identical with that used on board the cigar boat built at Havre. A considerable body of "solid water" is left in the centre of the drum to secure circulation, the water descending here and rising between the tubes, and thus, it is anticipated, overcoming one of the most weighty of objections usually urged against boilers with vertical tubes. The upper and lower tube-plates are stayed together by a number of 1½in. rods, so fitted that they can be easily unhooked when necessary. A man can then descend within the vacant space and scale the top of the fire-box, the tubes being disposed radially to permit this. In order to provide for the expansion of the tubes, the upper tube sheet is made only ¾in. thick, and a clear space of four inches is suffered to intervene between the tubes and any fixed point, that the plate may be enabled to follow them by its own elasticity as they contract and

expand. The tubes are secured by drifting and the expanding mandril. As the water stands very high in the drums, steam room is provided in the shape of two domes, very similar in every respect to that shown at e, in Fig. 1. These domes are enclosed within a single smoke-box, connecting the drums above as the fire-box does below; and it is clear that the steam within them must be more or less superheated. As the evaporative power of each boiler is very considerable, however, and the demand for steam

FIG. 2.

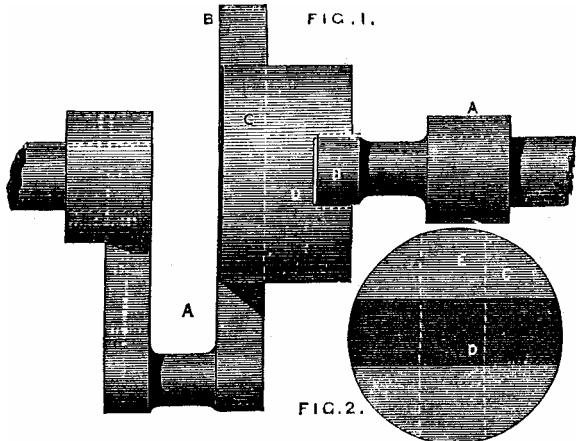


great, it is never suffered to remain sufficiently long within the dome to be much raised in temperature. A superheating apparatus is therefore provided, which we have not shown in the engraving. It consists of a couple of coils of tubing carried round each dome within the smoke-box. Outside these coils is fitted a cylindrical damper or ring, open above and below. Its action is such that when dropped on to the tube-plate, the coils are fully protected from the action of the heated currents within the box; but when raised the coils are left exposed to their action, the gases being compelled to circulate round the coils before they can escape to the smoke-stack. The dampers are raised or lowered by hand-wheels and screws in the boiler room, and by adjusting them properly any required degree of heat, from that just sufficient to dry the steam, up to 500 deg., or thereabouts, may be imparted to it. It will be understood that the coils form the steam pipe from each drum. The boilers are arranged in pairs, one pair at each end of the boiler room, and the furnaces are therefore fired fore and aft. The grate bars are of cast iron, 9ft. long, each in a single piece, without a central support. They are about 3in. wide on the upper faces, which are channelled to retain ashes. We need hardly say that were they not of immense depth, bars such as these would infallibly come down in a very short time. Water ash-pans are provided to guard against such an occurrence, and no trouble is anticipated. Up to the present time not more than 17½ lb. of Welsh coal have been burned per foot of grate per hour with the natural draught, and this the bars have stood very well. Whether they will maintain their character when the 5ft. fan,* which we have already referred to, is at work, and 40 lb. of coal are being burned per foot per hour, remains to be seen. As there are no dead-plates, and the fire-doors open rather high up in the boxes, the fires could not easily be cleaned in the ordinary way. The bars are therefore fitted with an arrangement by which they may, each separately, be caused to rock in order to break up clinker. The fire-doors are of the folding pattern, of great width, and lined with fire-clay lumps placed in boxes. Each drum is fitted with a distinct safety valve held down by a weighted lever, and the waste steam from each boiler enters a single escape pipe concealed within the smoke stack. There are thus four escape pipes, two within each funnel, rising larboard and starboard as close as possible to the funnel sides. The safety valves are loaded to 150 lb. per inch, and as it is clear that it is out of the question to attempt to raise steam at this pressure from sea-water we need hardly say that the engines are fitted with surface condensers. But the action of vertical boilers, heavily fired and supplied with water thus obtained, has been found very unsatisfactory. To say nothing of corrosion, the grease carried over from the engines induces priming, and the water becomes after a time exceedingly foul. To obviate these defects Messrs. Winans have adopted a system of auxiliary supply, which is novel so far as we are aware. Auxiliary boilers intended to supply the water wasted as steam at the safety valves. &c., have long been in use. On board the Ross Winans such expedients have been dispensed with, thus:—Round the base of each funnel is fitted a water casing, 4ft. high and 2in. wide. A pipe from the top of each, communicates with the condenser through a box containing a valve loaded to about 1 lb. pressure per inch. A second pipe from the sea communicates with the interior of the casing through the same box. The action of the apparatus is very simple. As soon as the pressure within the condenser falls sufficiently, the air within the casing will overcome the load on the valve to which we have referred, and will commence to flow into the condenser until the pressure assimilates in both as nearly as the loaded valve will permit. Thus, if we assume the pressure within the condenser to be 2 lb., that within the casing will be 3 lb. only. Water will then rise from the sea, and would, were it permitted, first fill the casing and then flow into the condenser. In order to prevent this a ball-cock is fitted in the valve box. When the casing is two-thirds full, this closes, and the water is then evaporated by the heat of the funnel plates; the steam passing over to the condenser and thence finding its way

* We inadvertently gave the diameter of this fan in our last impression as being 4ft.

as water to the boiler. At first sight it would appear that a 2in. water space would quickly become choked up with deposit under such conditions. But it must be remembered that little salt is deposited until the degree of saturation reaches ⅔. It is not the common salt which is to be feared, but the sulphates of lime and magnesia. The throwing down of the former depending on the degree of saturation alone, can always be prevented by regularly blowing off the solution as it approaches the point of saturation. But the throwing down of the latter is practically independent of the degree of saturation and absolutely dependent on the temperature; while this remains below 212 deg., very little deposit is thrown down. But the temperature within the casing can never reach 200 deg., thanks to the approximate vacuum, and thus there is very little danger that the casing will suffer from incrustation. To get rid of the common salt, it must be blown off frequently, and this is effected by simply holding down by hand the valve on the pipe leading to the condenser while the sea cock is similarly opened. The pressure will then quickly rise within the casing, and its contents will be expelled. On again releasing the valves it will immediately fill to the proper height, and evaporation will go on as before. As each casing will present about 50ft. of heating surface, much more water will be produced than can be required to make up for waste, and as all this will be sent to the main boilers, these last can be scummed without intermission, and it is anticipated that the feed will thus be kept so pure that, with the aid of the superheaters, perfectly dry and clean steam will at all times be supplied to the engines. Opinions may differ as to the merits of the entire arrangement, but it cannot be denied that it is eminently ingenious, and that it apparently overcomes all objections urged against water casings as once used on board the Great Eastern.

The engines of the yacht consist of three vertical cylinders 24in. diameter and 4ft. stroke, which put in motion a three-throw crank shaft, the cranks being disposed at angles of 120 deg. from each other. The general arrangement of the engines may be thus described:—Six transverse vertical frames of plate iron extend from the lower to the upper skin of the ship, to which they are attached by angle iron rings which run all round stiffening the hull. The frames are about 6ft. wide and half an inch thick. Between each pair is bolted a cylinder, the valve chest standing to the starboard side. The cylinders are jacketed all round and the covers are cast hollow and take steam from the jackets. The pistons are packed on a system invented by Mr. Winans, which has, we believe, been used by him in locomotive practice in the States with much success. Within an ordinary brass packing ring is fitted a second ring, sawn through in one place to permit it to follow the packing ring. It is made about the same as the brass ring in thickness, and is forcibly impelled outwards by a spring of unusual strength. A number of set screws in the upper plate of the piston can be brought to bear on the edges of both rings. The object of the arrangement is easily explained. When the piston has been introduced into the cylinder the set screws are turned and the rings released. The spring then forces the packing hard against the cylinder, and were it allowed to continue to act much power would be wasted in friction, and the packing rings would be quickly worn out. As soon, however, as the packing has been fairly brought into contact with the cylinder, the screws are turned and the rings set fast, the piston then virtually becoming a solid block. So long as, friction exists it continues to wear, but a point is at last reached at which the piston moves within the cylinder without sensible friction and yet remains steam-tight. It is possible that if the expansion of the piston and cylinder was precisely the same in amount for each, and that no dirt or grit ever came over in the steam, a piston thus arranged would work without further wear for years. These conditions cannot of course be attained, but in practice we understand that the piston has given much satisfaction. When it begins to leak—and now and then months will elapse before leakage takes place—it is only necessary first to slack back all the screws, and then to tighten them up again. The spring will then drive out the packing once more, and the operation may be repeated until it is worn out. In the locomotives built by Mr. Winans this can be effected by bringing the piston to the front of the cylinder and removing screw caps in the lid. The advantage claimed for these pistons is that the



packing rings cannot be driven in by high-pressure steam, a matter of some importance in the present instance. Each piston is fitted with two steel piston rods, which rise at opposite sides of the crank shaft. This shaft extends from end to end of the ship, exactly in the line of her axis. In the engine-room it is 7½in. diameter, which it retains until it has reached the second bulkhead from either end, when it increases to 8½in., and finally to 16 in. where it passes through the main stuffing-boxes. It is clear that it would be impossible to make a shaft 230ft. long dead straight, and therefore it is cut across at each end of the engine, so that the halves can shift for themselves. This renders the arrangements within the engine-room

very peculiar. They may best be explained by stating that each piston has a crank shaft to itself. On top of each cylinder between the glands of the stuffing-boxes is fitted a bearing about 30in. long. This bearing carries an equal length of shaft, on each end of which is fitted a crank and counter crank. The piston rods, rising one at either side of this long bearing, lay hold of a cross-head working in slides in the side frames; from the centre of this cross-head rises a flat rod, which lays hold of a second cross-head also moving in slides in the frames. From each end of this upper cross-head a connecting rod descends to the crank shaft. The arrangement may be understood by supposing a table engine with the crank shaft above instead of below the cylinder. The first cross-head is used to steady the piston rods, which would vibrate considerably if they reached directly to the upper cross-head. The link rod, as we may call it, connecting the upper and lower cross-heads, is jointed transversely to the upper one rigidly to the other, and thus little variations in the length of the side connecting rods throws no strain on the piston rods or guides. We have yet to couple together the three distinct crank shafts, and these again with the two screw shafts. This is effected very ingeniously by an arrangement which will be best understood from the accompanying engraving. Two contiguous cranks are shown by A, A, Fig. 3. Each carries a counter crank; B C is a plain disc of cast iron, about 3ft. in diameter and some 12in. or 14in. deep. In each side of this a slot is planed out as deep as the centre crank is thick—say four inches. These slots are shown at D E, in Fig. 4, which is a front view of the coupling disc isolated. These slots receive the counter cranks, and it is obvious that the arrangement is such that the cranks may move away from each other longitudinally, or one may be higher than the other, or, in short, distortion of any kind may occur within reasonable limits, without throwing the least strain on the machinery. The entire affair is very simple and practical, the bearing surfaces are large, and efficient arrangements have been made for supplying them with oil. The engraving shows a right-angled coupling. In that actually employed, however, on board the yacht, although the slots in the disc are cut at right angles, the counter-crank eyes project to one side, so that the main cranks are really at angles of 120 deg., although that made by the counter-crank is but 90 deg.; a point which of course does not in the slightest degree affect the principles involved. The bearings in the connecting rod ends, both at the crossheads and the cranks, are so arranged that the brasses are to some extent self-adjusting.

We have now fairly come to the valve gear, which is utterly unlike anything heretofore fitted on board ship, as far as we are aware. The main slide valves are of the ordinary locomotive pattern, working within valve chests on the starboard side of the cylinders, and receiving their motion directly from a rocking shaft overhead, carried in bearings attached to the main frames. This rocking shaft is driven as follows:—Down the starboard side of the engine-room, between the cylinders and the starting platform, runs what we may term a counter shaft, parallel with the screw shaft, and nearly on the same level. This shaft carries the eccentrics, two for each cylinder; one being employed to work the main slide valve, the other, a gridiron cut-off valve, working, not on the back of the main valve as usual, but on a diaphragm or plate dividing the valve chest into two distinct chambers. The eccentric rods rise to the arms of the rocking shaft at an angle fixed in the case of the main slide, but variable in that of the cut-off valve. The lead of the cut-off will therefore be right while the engine is going ahead, wrong when going astern, as will be seen presently. The rod from the cut-off eccentric lays hold of a block sliding in a curved box link which constitutes one arm of the second rocking shaft. To the other end is attached the rod connecting the link with the gridiron valve. A screw passes through the block, and is put in motion by a hand wheel at that end of the link next the shaft. Being close to the centre it has little motion, and can be altered while the engine is running with the greatest ease. By shifting the position of the slide in this link the point of cut-off is varied at will. The arrangements are the same for all three cylinders. We have next to consider the means by which the counter shaft is put in motion.

On the forward end of the main shaft, and between the last engine frame and the bulkhead, is keyed a spur wheel about 3ft. 6in. in diameter and 12in. or 14in. wide on the face, geared with wood, the cogs being secured each by a couple of bolts passing through and screwed up behind the rim. The counter-shaft carries a wheel similar—as far as regards the gearing—in every respect save that it has cast iron cogs. It is obvious that these wheels being geared together, the counter-shaft with the eccentrics would be caused to revolve when the engines moved; and the effect of the arrangement would then be the same as though the eccentrics were keyed on the main shaft. Thus far no provision is made for reversing. The link being excluded, two systems remained available for the purpose. In the first, the eccentrics being loose might be caused to make half a revolution in the way that reversing is habitually effected even in the present day, on board the majority of paddle-wheel steamers. In the second, the driven wheel on the counter-shaft might be made loose, and the shaft caused to perform half a revolution within it, with precisely the same effect. This is the arrangement actually adopted, and the partial rotation of the shaft is effected very ingeniously. The cast-iron wheel really constitutes a semi-rotatory engine; that is to say, a rotatory engine with a fixed instead of a movable steam stop, which stop answers the purpose of the snug commonly employed to drive loose eccentrics. Thus, let us suppose that the engines are going ahead, the piston of this rotary engine, rigidly attached to the counter-shaft, will then bear against one side of the fixed stop, and be driven by it. If now it is wished to reverse, it is only necessary to admit steam between the piston and the stop, the former will then make the requisite part of a revolution, and with it the eccentrics on the counter-shaft, and the piston will then bear against the opposite side of the fixed stop, and be driven as before, but in the oppo-

site direction. The entire arrangement is much more simple than may be supposed from this description, but we feel that without numerous drawings it would be hopeless to attempt to convey a just idea of the elegance of invention—if we may use the phrase—displayed at every turn in the design of this valve gear. The system of packing adopted is very peculiar, and is such that the pressure of the steam brings the surfaces into contact and makes the joints tight. The admission of steam is regulated by a slide valve worked by a hand-wheel, conveniently located on the starting platform.

As the pressure is great, it has been deemed advisable to adopt some expedient for reducing the friction of the slide valves. The purpose is effected by casting cavities in their faces, into which oil is forced, under a pressure of about 200 lb. per inch, by a pump worked by the engine. The oil, which escapes by partially lifting the valve from its seat, being returned to the tank from which the pump draws. We may add that a subsidiary valve is placed lower down in the box than the grid valve, and by opening this, steam is admitted continuously to the main valve chest, no special cut-off then taking place.

The steam on leaving the cylinder enters a surface condenser disposed horizontally on the larboard side of the engine-room. This condenser is a cast iron cylinder, 3ft. 6in. in diameter, containing a great number of brass tubes, $\frac{3}{4}$ in. in diameter and 13ft. long, packed at each end with india-rubber. There are two air and circulating pumps driven by horizontal arms from the auxiliary cross-heads of the outer cylinders. These pumps have a stroke of 4ft. and a diameter of 8in. They have solid gasket packed pistons, and they act the double part of circulating and exhausting pumps—exhausting below the pistons and circulating above. The steam passes through the tubes, the water outside. The cylinders are each provided with a very elegant water trap to keep the jackets free, and the collected water is of course returned to the condenser, and thence to the boilers. Two large plunger feed pumps are driven from the countershaft.

The main crank shaft has a diameter of $7\frac{1}{4}$ in. in the engine-room and through the saloons fore and aft, until it reaches the second bulkhead at each end of the ship, where it increases to 8in., passing through thrust bearings supported by the bulkheads. These thrust bearings are carried in gimbals, so that it matters very little whether the shaft is or is not in line. The thrust is taken through exceedingly short and stout springs, to avoid shock or strain in the engine-room. The propeller bosses are, as we have already stated, 4ft. in diameter, and they are each intended to carry nine true screw blades. Each blade has a flat foot, by which it is attached to the boss by bolts having nuts within slots in the boss. The pitch can be varied by changing the blades, and so can the number of the blades. The diameter of the complete screws will be 22ft., and they are intended to make from forty to fifty-five revolutions per minute, according to the pitch, when the vessel is at full speed. The velocity corresponding to piston speeds of 320ft. to 440ft. per minute. The engines were actually run while the ship lay on the stocks, at seventy-five revolutions per minute. The shaft is supported in a self-adjusting bearing in each bulkhead, and of course passes through stuffing-boxes, so contrived that the packing may be tightened from either side of the bulkhead. In the ends of the ship eight powerful screw bolts are fitted in such a way that should the shaft break they can be brought to bear hard against the boss, locking it, and thus preventing the screw from thrashing about. Pipes are also fitted here for supplying water to the lignum vitro bearings if necessary. The bearings in the engine-room are all made of a particular brass alloy, which Mr. Winans has found to answer his purpose even better than white metal.

We have yet to describe a very singular device which we have illustrated in another page. This is the ballast engine, and its purpose will be easily understood. If we suppose the screws to be held fast and the engines put in motion, the whole vessel would obviously revolve on her axis. The propeller blades must, however, under all circumstances revolve with more ease than the hull. Still as this has no keel, and partial rotation does not affect her displacement, the action of the engines would cause her to list either way as the engines ran ahead or astern. To prevent this a mass of ballast is shifted larboard or starboard at will, to bring her into proper trim. As will be seen, the ballast engine is a very curious affair. A horizontal cylinder 24in. in diameter and 5ft. stroke, contains a piston, which is connected with the weight suspended by an arm from the crank shaft bearings close up to the after bulkhead. The valve placed within the steam chest, and used for the admission of steam to and from this cylinder, is an ordinary slide valve, so connected with the reversing apparatus of the main engines that when these are reversed the slide valve is also simultaneously reversed, and remains in a fixed position, ready open for the admission of steam on one side and its discharge from the other side of the piston, until the propelling engines are again reversed, when this valve is again simultaneously reversed and placed in its proper position open and ready for the admission of steam to and its discharge from the proper side of the piston respectively. The steam is taken from the main steam pipe, and thus, when the throttle valve is either closed or open, steam is simultaneously shut off from or admitted to the steam chest of the ballast engine, and a proportionate increase or diminution of pressure is secured, so that when the propelling engines are stopped by shutting off the steam the weight falls back to its vertical or central position, and when steam is admitted to the propelling engines it is moved either one way or the other to a greater or less distance from its central position corresponding to the pressure of the steam used, so as to counteract the tendency to list. As the different forces which tend to careen the vessel vary in intensity at different times, it is necessary that the pressure in the cylinder should also be varied, while the pressure in the steam chest and pipes of the engines remains the same. To accomplish this, two valves *a b*, Fig. 11 (page 180), of the spindle form, one, *b*, slightly larger than the other, are placed

in the pipe that conveys steam to the actuating cylinder. These valves are enclosed in the chest containing the reversing valve before described which is partitioned so as to form two compartments. One of the valves allows the steam to pass into one compartment which has a direct communication with the actuating cylinder, and the other valve *a* is placed in the partition between the compartments, so as to allow steam to escape from the first compartment into the condenser, through the exhaust pipe *h*. These valves are so placed that their stems which run up through the stuffing boxes *c, c*, in the top of the box are parallel and of the same height. Upon the tops of these valve stems there is placed a cross-bar *d*, which is kept in position horizontally by two bolts or guides *i, i*, which pass through slots in the ends of the cross bar and are screwed into the steam chest, the cross-bar being free to move vertically within certain limits so as to permit these valves to open when the pressure upon them from below is greater than that from above. The top of this cross-bar is made circular, with its concave side upwards, thus forming a curved inclined plane either way from the centre of its length. The requisite pressure is placed upon it for controlling the action of the valves by means of a small steam cylinder *j*, placed vertically at a convenient height above the centre of the cross-bar, and connected with the main steam pipe, so that the same pressure will always be maintained upon the piston that there is in the main steam pipe. The diameter of this cylinder is made somewhat greater than that of the largest of the two valves, and the pressure upon its piston is transmitted to the cross-bar by means of a piston rod having a knuckle joint at the upper end, by which it is connected to the piston *k*, and provided with a roller or small wheel at the lower end, the roller resting on the top of the cross-bar. The lower end of this piston rod is controlled and held in any required position by a screw *o* operating through a bent lever *p*, and the link *q*, Figs. 8 and 9, the screw being under control and actuated as circumstances demand by the attendant. This enables the pressure to be thrown either upon one or the other of the valves, or to be divided between them in any desired proportion; thus, if thrown upon *a*, Fig. 11 (p. 180), the whole pressure in the steam pipe would be allowed and maintained in the actuating cylinder; if thrown upon *b*, the steam would be prevented from entering the actuating cylinder; if thrown half way between *a* and *b* the pressure in the actuating cylinder would be only about half. Thus the pressure of steam within the actuating cylinder may be varied from nought to the full pressure of steam in the main steam pipe of the propelling engines, and the pendent weight may be maintained in any required position.

Fig. 1 is a transverse vertical section taken through the engine-room and showing the ballast engine in side elevation.

Fig. 2 represents an end elevation of the apparatus; Fig. 3 is a plan of the balance weight or cradle; Fig. 4 is a sectional elevation of the cradle, showing the mode by which it may be held in any required position; Fig. 5 is a longitudinal vertical section taken in the line 1, 2, of Fig. 3; Fig. 6 is a transverse vertical section taken in the line 3, 4, of the same figure; Fig. 7 is a plan and sectional view of the rack used for holding the trimming cradle in any given position.

a, a, is the propeller shaft. This is mounted in the plunger blocks and bearings *b, b*, from which is suspended the weight *c, c*, by a pair of vibrating arms *d, d*. The weight *c* is composed of a cast iron cradle, carrying at present twelve tons of lead in pigs. The remaining figures show various views of the valve chest and valves for regulating the admission of steam to the cylinder *e*. Fig. 8 being a front view; Fig. 9 a side view; Fig. 10 a plan view; Fig. 11 a longitudinal vertical section taken in the line 1, 2, of Fig. 9; and Fig. 12 a transverse vertical section taken in the line 3, 4, of Fig. 11. The action of the various parts will be easily understood from what has gone before. It is obvious that from the great size of the cylinders and the pressure of the steam used, the balance-weight might be flung to one side or the other with great force were not special precautions taken to avoid such an event. But by the aid of the equalising valves, &c., the pressure is always kept just sufficient for the required purpose, and the piston is effectually cushioned some time before it reaches either end of its stroke.

We believe that we have now placed before our readers an account of every important feature of the cigar ship. Yet we conclude with a feeling of some regret that space did not permit us to describe more at length the little points of detail in which we find the skill and talent of her designers displayed at every turn. In a word, nothing appears to have been forgotten, and we may add that everything has been worked out complete in the drawing-office. Each plate of her hull was put in place at once and rivetted up without trimming or fitting. Her machinery, in like manner, was put on board almost without the use of a chisel or a file. It has been designed throughout by Messrs. Winans, assisted by Mr. James Murray, of Baltimore, United States, and constructed by Messrs. Jackson and Watkins, of the Canal Ironworks, Poplar. The workmanship is throughout of the very first class.

We have studiously avoided expressing any opinion as to the probable success of the yacht, but we cannot conclude without wishing Messrs. Winans success in their magnificent experiment. They have taken no money from anxious shareholders; the venture is wholly their own, and the very sharp criticisms, not to say ridicule, with which the entire scheme has been visited from certain quarters, display the almost equal absence of good taste and ignorance of mechanical science on the part of authors who have jumped at conclusions instead of waiting for facts. "The foundation of all knowledge is experience," writes Bacon; and we think it best to reserve our judgment until our knowledge of cigar ships has been developed by experiments which have yet to be made.

THE BALLAST ENGINE OF THE WINANS YACHT.

(For description see page 172.)

