The annual meetings of the Institution opened at the Society of Arts on Wednesday. There was a very full attendance, and the business had been transacted, the Chairman—the Right Hon. Dalrymple Hay, Bart., K.C.B., D.C.L., F.R.S., Vice-President—delivered the opening address. After referring to the late Mr. Henry Laird, the Chairman gave an interesting account of the birth and growth of our Naval Architecture. He illustrated his remarks by twenty or thirty slides, and concluded with a few words on the importance of scientific research in all parts of the world.

Mr.ắm. 16, 1894. 213

THE ENGINEER.

INSTITUTION OF NAVAL ARCHITECTS.

In the capture of the Burn, the first occasion on which French observers, the most laborious of all, were collaborators in many scientific inquiries, Mr. White, distinguished father to mourn his loss. It is early death deprived the Navy of a man of such intellect. He was followed on May 9th by Mr. Henry Laird, who was known wherever British shipping shows our flag, and at Birkenhead yard, both of them and McGregor Laird. As colleagues you will expect me to allude. When, by Sebastopol, Director of Transports in the Abyssinian warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin ing warships, there is a mittin in...
Sovereign, and he gave the following among other figures—

**Inclinations on Each Side of the Vertical.**

<table>
<thead>
<tr>
<th>Class</th>
<th>Max. Deg.</th>
<th>Mean Deg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Royal Sovereign</td>
<td>7</td>
<td>15.5</td>
</tr>
<tr>
<td>Empress of India</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>Invincible</td>
<td>28</td>
<td>12</td>
</tr>
<tr>
<td>Nelson</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Rodney</td>
<td>6.2</td>
<td>9</td>
</tr>
</tbody>
</table>

In order to illustrate the general character of the motion of the large ships, the gradual increase in amplitude, attitude, attainment of a maximum inclination, and subsequent gradual decrease, Fig. 11 has been prepared from a series of actual observations. One point in the accumulation of rolling under the trying conditions of synchronism is the apparent suddenness with which comparatively large angles of inclination may be accumulated. Here, again, theoretical investigation anticipates observation. Apart from the action of resistance, the passage of each synchronising wave should add an equal amount to about three times its maximum range of oscillation. In the long, low swell which synchronised with the Royal Sovereign class, the maximum slope was about 8 deg., only, corresponding to an increment in range, apart from resistance, of more than 9 deg. for each wave, apart from resistance. There would be four waves passing in a minute; and it is easy to understand how in short a time considerable angles of rolling may be reached, especially in a slow moving ship, where resistance acquires no great moment until there is a good swell. When the Royal Sovereign and Empress of India were placed beam on to the wind and a series of nearly regular waves of synchronisation occurred with the Royal Sovereign class, the maximum slope was about 9 deg., and maximum—occasionally reached—18 deg. With the swell two points before the beam the mean inclination was about 5 deg., and the maximum 10 deg. With swell four points before the beam the mean inclination was about 4 deg., and maximum 09 deg. He then proceeded to deal with the Resolution.

The Resolution, a newly commissioned ship, left Plymouth at 2 p.m. on December 19th last to join the Channel Squadron at Gibraltar. On December 23rd, at 9 a.m., she arrived at Queenstown. According to the newspaper accounts, the ship had been seriously strained during her voyage owing to angles of 30 deg., or 40 deg. from the vertical. Dangerous leaks had been developed, and she could only be kept afloat by continuous pumping. Considerable repairs were said to be required, and it was alleged that she was in such a state that she could barely proceed without risk as far as Plymouth or Portsmouth before being taken in hand. Graphic accounts followed of the terrible weather which had been encountered, of the unsatisfactory behaviour of the ship, the great discomforts suffered by all on board, and the immense quantities of water which were said to have passed down into engine-rooms and stoke-holes. In short, the impression was produced, and possibly still remains in many minds, that the Resolution had a narrow escape from disaster, and her behaviour was considered the more unsatisfactory seeing that the torpedo inclination to the vertical was about 9 deg., and maximum—occasionally reached—18 deg. With the swell two points before the beam the mean inclination was about 5 deg., and the maximum 10 deg. With swell four points before the beam the mean inclination was about 4 deg., and maximum 09 deg. He then proceeded to deal with the Resolution.

The Resolution, a newly commissioned ship, left Plymouth at 2 p.m. on December 19th last to join the Channel Squadron at Gibraltar. On December 23rd, at 9 a.m., she arrived at Queenstown. According to the newspaper accounts, the ship had been seriously strained during her voyage owing to angles of 30 deg., or 40 deg. from the vertical. Dangerous leaks had been developed, and she could only be kept afloat by continuous pumping. Considerable repairs were said to be required, and it was alleged that she was in such a state that she could barely proceed without risk as far as Plymouth or Portsmouth before being taken in hand. Graphic accounts followed of the terrible weather which had been encountered, of the unsatisfactory behaviour of the ship, the great discomforts suffered by all on board, and the immense quantities of water which were said to have passed down into engine-rooms and stoke-holes. In short, the impression was produced, and possibly still remains in many minds, that the Resolution had a narrow escape from disaster, and her behaviour was considered the more unsatisfactory seeing that the torpedo inclination to the vertical was about 9 deg., and maximum—occasionally reached—18 deg. With the swell two points before the beam the mean inclination was about 5 deg., and the maximum 10 deg. With swell four points before the beam the mean inclination was about 4 deg., and maximum 09 deg. He then proceeded to deal with the Resolution.

The Resolution, a newly commissioned ship, left Plymouth at 2 p.m. on December 19th last to join the Channel Squadron at Gibraltar. On December 23rd, at 9 a.m., she arrived at Queenstown. According to the newspaper accounts, the ship had been seriously strained during her voyage owing to angles of 30 deg., or 40 deg. from the vertical. Dangerous leaks had been developed, and she could only be kept afloat by continuous pumping. Considerable repairs were said to be required, and it was alleged that she was in such a state that she could barely proceed without risk as far as Plymouth or Portsmouth before being taken in hand. Graphic accounts followed of the terrible weather which had been encountered, of the unsatisfactory behaviour of the ship, the great discomforts suffered by all on board, and the immense quantities of water which were said to have passed down into engine-rooms and stoke-holes. In short, the impression was produced, and possibly still remains in many minds, that the Resolution had a narrow escape from disaster, and her behaviour was considered the more unsatisfactory seeing that the torpedo inclination to the vertical was about 9 deg., and maximum—occasionally reached—18 deg. With the swell two points before the beam the mean inclination was about 5 deg., and the maximum 10 deg. With swell four points before the beam the mean inclination was about 4 deg., and maximum 09 deg. He then proceeded to deal with the Resolution.

The Resolution, a newly commissioned ship, left Plymouth at 2 p.m. on December 19th last to join the Channel Squadron at Gibraltar. On December 23rd, at 9 a.m., she arrived at Queenstown. According to the newspaper accounts, the ship had been seriously strained during her voyage owing to angles of 30 deg., or 40 deg. from the vertical. Dangerous leaks had been developed, and she could only be kept afloat by continuous pumping. Considerable repairs were said to be required, and it was alleged that she was in such a state that she could barely proceed without risk as far as Plymouth or Portsmouth before being taken in hand. Graphic accounts followed of the terrible weather which had been encountered, of the unsatisfactory behaviour of the ship, the great discomforts suffered by all on board, and the immense quantities of water which were said to have passed down into engine-rooms and stoke-holes. In short, the impression was produced, and possibly still remains in many minds, that the Resolution had a narrow escape from disaster, and her behaviour was considered the more unsatisfactory seeing that the torpedo inclination to the vertical was about 9 deg., and maximum—occasionally reached—18 deg. With the swell two points before the beam the mean inclination was about 5 deg., and the maximum 10 deg. With swell four points before the beam the mean inclination was about 4 deg., and maximum 09 deg. He then proceeded to deal with the Resolution.

The Resolution, a newly commissioned ship, left Plymouth at 2 p.m. on December 19th last to join the Channel Squadron at Gibraltar. On December 23rd, at 9 a.m., she arrived at Queenstown. According to the newspaper accounts, the ship had been seriously strained during her voyage owing to angles of 30 deg., or 40 deg. from the vertical. Dangerous leaks had been developed, and she could only be kept afloat by continuous pumping. Considerable repairs were said to be required, and it was alleged that she was in such a state that she could barely proceed without risk as far as Plymouth or Portsmouth before being taken in hand. Graphic accounts followed of the terrible weather which had been encountered, of the unsatisfactory behaviour of the ship, the great discomforts suffered by all on board, and the immense quantities of water which were said to have passed down into engine-rooms and stoke-holes. In short, the impression was produced, and possibly still remains in many minds, that the Resolution had a narrow escape from disaster, and her behaviour was considered the more unsatisfactory seeing that the torpedo inclination to the vertical was about 9 deg., and maximum—occasionally reached—18 deg. With the swell two points before the beam the mean inclination was about 5 deg., and the maximum 10 deg. With swell four points before the beam the mean inclination was about 4 deg., and maximum 09 deg. He then proceeded to deal with the Resolution.

The Resolution, a newly commissioned ship, left Plymouth at 2 p.m. on December 19th last to join the Channel Squadron at Gibraltar. On December 23rd, at 9 a.m., she arrived at Queenstown. According to the newspaper accounts, the ship had been seriously strained during her voyage owing to angles of 30 deg., or 40 deg. from the vertical. Dangerous leaks had been developed, and she could only be kept afloat by continuous pumping. Considerable repairs were said to be required, and it was alleged that she was in such a state that she could barely proceed without risk as far as Plymouth or Portsmouth before being taken in hand. Graphic accounts followed of the terrible weather which had been encountered, of the unsatisfactory behaviour of the ship, the great discomforts suffered by all on board, and the immense quantities of water which were said to have passed down into engine-rooms and stoke-holes. In short, the impression was produced, and possibly still remains in many minds, that the Resolution had a narrow escape from disaster, and her behaviour was considered the more unsatisfactory seeing that the torpedo inclination to the vertical was about 9 deg., and maximum—occasionally reached—18 deg. With the swell two points before the beam the mean inclination was about 5 deg., and the maximum 10 deg. With swell four points before the beam the mean inclination was about 4 deg., and maximum 09 deg. He then proceeded to deal with the Resolution.
wind freshened during the night. By 8 a.m. on December 20th it was a whole gale, with enormous squalls, and the ship was rolling away in waves of such magnitude that the care possible under the circumstances. Accurate measurements of the waves at 8 a.m. on December 21st were as follows: The wave heights were obtained by horizon observations which were corrected to represent probably more nearly correct. Heights of 22 ft. were obtained from the hawse to crest, and lengths of 300 ft. from crest to crest. The exceptional strength of the waves was indicated by the fact that extensive observations have fixed the average height of large Atlantic storm waves at one twentieth of the length, so that waves 22 ft. high would be over 2000 ft. long. Such observations give 10 ft. as the average height for waves 1000 ft. long. No doubt in this instance, as in many others, where the wind has veered during a long-continued storm, there were an independent series of waves running in different directions and superposed on one another, which would account for the height and steepness of the waves. The weather was a great deal worse on December 21st, when the swell had begun to drop some weeks after its maximum. The second stage of waves of that morning showed heights of 26 ft. to 30 ft., characterised by long slow roll and lengths estimated at 2000 ft.—still a very deep and heavy swell. A northerly course was then steered; and, as the swell decreased gradually during the night, on the morning of the 22nd the ship proceeded to Queenstown, and arrived she had over 400 tons of coal on board, having left Plymouth without about 790 tons.

There are two stages to be considered in this narrative. First, that during which the ship was exposed for some hours to a swell above, described as moderate, but said to produce occasional heavy rolling. This resembles the case above discussed for the Royal Sovereign class; and in his report the captain of the Resolution expressed the opinion that the cause of the rolling was approximate synchronisation between the period of the ship and that of the waves. The second stage is where the ship was kept head to the sea. Her behaviour under these circumstances is reported to have been most satisfactory. She was very buoyant, rode well over the very heavy seas, and pitched easily. At times the roll considerably, which was not remarkable when the state of the sea and its confused nature is taken into account. It is reported also that, under these conditions, the oscillations were quite different from those of a rolling wave, which, of course, indicates that the character of the roll in the latter case is different from that of the former.

Fig. 10—H.M.S. Resolution. Diagram of Rolling for moderate seas. The character is taken as accounted for. In the latter case the rolling gradually increased, reached a maximum, and then gradually diminished—considering the fact that the ship was now in a long-continued heavy sea. The position of the ship in relation to the short steep seas, and the pitching and rolling motions induced upon her. Unfortunately, no occasion presented itself to a very extraordinary and severe gale during the voyage, and the infinite annoyance of the officers whose property was destroyed by the ship's rolling, it cannot but be very easily fitted even experimentally. As to a slight movement which the ship seemed to have made at the time, it was layed on the true reason why we must have big ships, and that the endurance was much greater than that of such small ships.

He was followed by Admiral Miranda, who, allowing to a great extent the opinion that the rolling of the Resolution was due to the stoppage of the engine, added the expedient of sending young naval architects from Mr. White's department to sea in the Resolution, so that they might augment the value of their theoretical acquirements by sound practical experience. He referred in amusing terms to the modern Member of Parliament, who has nothing to learn about ships, guns, and men. It is not an easy matter to find, in a country where so many subjects than naval architects, or captains, or engineers, to whom great value was attached by many, what they would do now. Admiral, said Mr. White, had been glad to learn that, under the care of Mr. FitzGerald, it had been laid on the true reason why we must have big ships, and that the ship was more than ever, quite buoyant and undamaged. As to the question of bilge keels, the ship was very commonly fitted with these, and sometimes not to the best advantage, even on board the ship which the author had been surprised to find not fitted at all. He was sure that Mr. White's Department of Engineering had not expected, and that in consequence they could not have been satisfied with the results of the experiments done on one occasion the occasion. The Emperor of India began rolling in such a fashion that his officers could state, in answer to the question why, that the infinite annoyance of the officers whose property was destroyed by the ship's rolling, it cannot but be very easily fitted even experimentally. As to a slight movement which the ship seemed to have made at the time, it was layed on the true reason why we must have big ships, and that the endurance was much greater than that of such small ships.

He was followed by Admiral Miranda, who, allowing to a great extent the opinion that the rolling of the Resolution was due to the stoppage of the engine, added the expedient of sending young naval architects from Mr. White's department to sea in the Resolution, so that they might augment the value of their theoretical acquirements by sound practical experience. He referred in amusing terms to the modern Member of Parliament, who has nothing to learn about ships, guns, and men. It is not an easy matter to find, in a country where so many subjects than naval architects, or captains, or engineers, to whom great value was attached by many, what they would do now. Admiral, said Mr. White, had been glad to learn that, under the care of Mr. FitzGerald, it had been laid on the true reason why we must have big ships, and that the ship was more than ever, quite buoyant and undamaged. As to the question of bilge keels, the ship was very commonly fitted with these, and sometimes not to the best advantage, even on board the ship which the author had been surprised to find not fitted at all. He was sure that Mr. White's Department of Engineering had not expected, and that in consequence they could not have been satisfied with the results of the experiments done on one occasion the occasion. The Emperor of India began rolling in such a fashion that his officers could state, in answer to the question why, that the infinite annoyance of the officers whose property was destroyed by the ship's rolling, it cannot but be very easily fitted even experimentally. As to a slight movement which the ship seemed to have made at the time, it was layed on the true reason why we must have big ships, and that the endurance was much greater than that of such small ships.

He was followed by Admiral Miranda, who, allowing to a great extent the opinion that the rolling of the Resolution was due to the stoppage of the engine, added the expedient of sending young naval architects from Mr. White's department to sea in the Resolution, so that they might augment the value of their theoretical acquirements by sound practical experience. He referred in amusing terms to the modern Member of Parliament, who has nothing to learn about ships, guns, and men. It is not an easy matter to find, in a country where so many subjects than naval architects, or captains, or engineers, to whom great value was attached by many, what they would do now. Admiral, said Mr. White, had been glad to learn that, under the care of Mr. FitzGerald, it had been laid on the true reason why we must have big ships, and that the ship was more than ever, quite buoyant and undamaged. As to the question of bilge keels, the ship was very commonly fitted with these, and sometimes not to the best advantage, even on board the ship which the author had been surprised to find not fitted at all. He was sure that Mr. White's Department of Engineering had not expected, and that in consequence they could not have been satisfied with the results of the experiments done on one occasion the occasion. The Emperor of India began rolling in such a fashion that his officers could state, in answer to the question why, that the infinite annoyance of the officers whose property was destroyed by the ship's rolling, it cannot but be very easily fitted even experimentally. As to a slight movement which the ship seemed to have made at the time, it was layed on the true reason why we must have big ships, and that the endurance was much greater than that of such small ships.
in rough weather. It was taken as a matter of course that the vessel was safe, and it was not considered a danger because there was none. Such rolling was uncommon besides, and was not of much importance. The effect in bringing about such an alteration in the period of rolling as might, on the one hand, make it synonymous with the green water of the Thames, and on the other hand, break away the hatches and cause confusion on deck, was not taken as a matter of course. But it had certainly been achieved, and he hoped for better returns from Mr. Thonyer's investigations.

The first question he really asked was, had anything having been recently successful in trials succeeded hitherto, but he hoped for better returns from Mr. Thonyer's investigations. He intended to apologise. He had had considerable success with steel plates tested on board M. Barba., of Island trials of 1891, a low carbon all-steel Harveyed high nickel steel plate of the company, but the amount of carbon affects the question. In Great Britain the cost of nickel had to a large extent been based on an opinion, that high carbon steel being presumed impossible to drill and tap any small hole that may be required in the same. The best merchantable nickel has an impurity of 100 parts per million of carbon.

These, he considered, indicated a superiority in resisting rolling and wave pressure to the extent of 20% per cent, while in France a superiority was indicated of from 27 to 30 per cent., according to the formula used.

The writer compared the results obtained by the Vickers all carbon and steel tested in different plates with hard faces. As to mechanical tests, a very great service to the vessels of the Vickers Barba. admitted, better than any other vessel tested, and the vessel was more than 50 per cent. above the steel and compound plates of the Board of Trade. The writer expressed the opinion that protection on any given portion of the ship or in extending the protected area, is a matter of satisfaction that can only be given by the first European Naval Power to adopt the Harveyed steel armour.

In the discussion that followed Mr. Hall, of Messrs. Jessop and Sons, spoke of the early success achieved by Harveyed armour of 1891, and expressed confidence in nickel steel armour. He would not mislead the House into the construction of a small and heavily-plated ram, with nickel steel armour, and call the writer to the value of nickel steel applied to the ram, whose power had been so sadly impressed upon us by Mr. Brown, in his paper. Mr. White concluded with an excellent character as stable ships; this was that officer's business to build ships which should with conditions dictated by the Board of Admiralty. He had been acquainted with many eminent men. As to the Centurion, he must be put in order, and brought up to the present standard.

Mr. Vickers observed that the omission of the omission of Harveyed armour from the Grand Canal at Athens to the Isthmus, he held, the authorities had seriously considered in the question. The speaker regretted that his experience in that part of the service of America, and subsequently in the United States. With the question of cost, it is found that officers should be left to the work, and all he could he a r of, not omitting one point that would not be considered in the present concern, a large advantage to the vessels of the United States. With the question of cost, it is found that old 2000 tons and older 4000 tons, as a measure of success up to all thicknesses with which they would provide a breakwater by the Ferring reef rocks to the extent of 800 fathoms. By his plan, the breakwater would enclose 250 acres of water, over 400 acres with very large fishing boats to depart from stations to the wings. The Royal Commission which instructed into this subject, and especially on the question of cost, and other measures have been taken. In the passage from the Tees to the south-east. This breakwater would enclose 220 acres of water, with a depth of over 4 fathoms, and 1000 acres with over 4 fathoms, and 1400 acres over 3 fathoms. The Channel would provide 300 acres of water, and 1400 acres varying from 2 to 4 fathoms, and require a breakwater by

The formation of a harbour in Ten Bay was reported on by Mr. Russell, and was not considered to be a matter of fact, and was not considered to be in the region of the Thames. A. Pendell in 1863. The former place the site at Hartlepool, and the estimated cost being £1,300,000. The next point in favour of the construction of a breakwater by the Ferring reef rocks, to the extent of 800 fathoms. By his plan, the breakwater would enclose 250 acres of water, over 400 acres with very large fishing boats to depart from stations to the wings. The Royal Commission which instructed into this subject, and especially on the question of cost, and other measures have been taken. In the passage from the Tees to the south-east. This breakwater would enclose 220 acres of water, with a depth of over 4 fathoms, and 1000 acres with over 4 fathoms, and 1400 acres over 3 fathoms. The Channel would provide 300 acres of water, and 1400 acres varying from 2 to 4 fathoms, and require a breakwater by

The formation of a harbour in Ten Bay was reported on by Mr. Russell, and was not considered to be a matter of fact, and was not considered to be in the region of the Thames. A. Pendell in 1863. The former place the site at Hartlepool, and the estimated cost being £1,300,000. The next point in favour of the construction of a breakwater by the Ferring reef rocks, to the extent of 800 fathoms. By his plan, the breakwater would enclose 250 acres of water, over 400 acres with very large fishing boats to depart from stations to the wings. The Royal Commission which instructed into this subject, and especially on the question of cost, and other measures have been taken. In the passage from the Tees to the south-east. This breakwater would enclose 220 acres of water, with a depth of over 4 fathoms, and 1000 acres with over 4 fathoms, and 1400 acres over 3 fathoms. The Channel would provide 300 acres of water, and 1400 acres varying from 2 to 4 fathoms, and require a breakwater by

The formation of a harbour in Ten Bay was reported on by Mr. Russell, and was not considered to be a matter of fact, and was not considered to be in the region of the Thames. A. Pendell in 1863. The former place the site at Hartlepool, and the estimated cost being £1,300,000. The next point in favour of the construction of a breakwater by the Ferring reef rocks, to the extent of 800 fathoms. By his plan, the breakwater would enclose 250 acres of water, over 400 acres with very large fishing boats to depart from stations to the wings. The Royal Commission which instructed into this subject, and especially on the question of cost, and other measures have been taken. In the passage from the Tees to the south-east. This breakwater would enclose 220 acres of water, with a depth of over 4 fathoms, and 1000 acres with over 4 fathoms, and 1400 acres over 3 fathoms. The Channel would provide 300 acres of water, and 1400 acres varying from 2 to 4 fathoms, and require a breakwater by

The formation of a harbour in Ten Bay was reported on by Mr. Russell, and was not considered to be a matter of fact, and was not considered to be in the region of the Thames. A. Pendell in 1863. The former place the site at Hartlepool, and the estimated cost being £1,300,000. The next point in favour of the construction of a breakwater by the Ferring reef rocks, to the extent of 800 fathoms. By his plan, the breakwater would enclose 250 acres of water, over 400 acres with very large fishing boats to depart from stations to the wings. The Royal Commission which instructed into this subject, and especially on the question of cost, and other measures have been taken. In the passage from the Tees to the south-east. This breakwater would enclose 220 acres of water, with a depth of over 4 fathoms, and 1000 acres with over 4 fathoms, and 1400 acres over 3 fathoms. The Channel would provide 300 acres of water, and 1400 acres varying from 2 to 4 fathoms, and require a breakwater by

The formation of a harbour in Ten Bay was reported on by Mr. Russell, and was not considered to be a matter of fact, and was not considered to be in the region of the Thames. A. Pendell in 1863. The former place the site at Hartlepool, and the estimated cost being £1,300,000. The next point in favour of the construction of a breakwater by the Ferring reef rocks, to the extent of 800 fathoms. By his plan, the breakwater would enclose 250 acres of water, over 400 acres with very large fishing boats to depart from stations to the wings. The Royal Commission which instructed into this subject, and especially on the question of cost, and other measures have been taken. In the passage from the Tees to the south-east. This breakwater would enclose 220 acres of water, with a depth of over 4 fathoms, and 1000 acres with over 4 fathoms, and 1400 acres over 3 fathoms. The Channel would provide 300 acres of water, and 1400 acres varying from 2 to 4 fathoms, and require a breakwater by
as well as any previous illustration, the case with which a difficult job for a slotting or shaping machine is done.

Now that milling as a class of work has been dispensed with, it may be advantageous to follow the rest of the machine shop practice in a more or less precise order, such as frames and appurtenances, secured with nuts, washers, and milled to the centres of the journals and the through centres. Each one has been marked out, they are placed two at once upon the machine table for milling by cylindrical tools, each 10mm. diameter, and 11mm. long, on a sin, spindle attached to the cross slide, and supported by three brackets. Each rod is fixed at the ends by a slit, which is simply a box, attached for the occasion to the machine boxes. These boxes have adjusting screws through their ends and sides, so that the rods can be set to the centre lines by aid of the surface gauge in the first instance, and so the stiffness is maintained. The. milling is also worked at a convenient distance from the actual work, bearing against which is a screw, which is kept there by suitable weights, so that the cutter is able to take longitudinal and transverse feeds without impediment by fixings. This method is illustrated by Fig. 227, which shows the profilng arrangements for the joint end of the coupling rods. In the fixing of this advantage is taken of the holes for the crank pins, which have been bored out, so that by fixing standard mandrels in the T slots of the table, these rods are very expeditiously set and without trouble, and moreover, there is no encumbrance whatever to impede the progress of the work when once started. Fig. 277 is at a side elevation and plan of the former and its stand. After these operations have been accomplished, the bolts and oil stiffening holes are drilled and reamed out, which finishes the machine work. Nothing now remains but to finish on the fitting bench, by heating the brasses and strapping to the connecting rod, and forcing in the brasses of the coupling rods, then all is ready for the erecting shop.

The valve rods and anchor links:—Figs. 255, 256, THE ENGINEER, vol. lvii, page 225—are first milled upon each side of the boss, and afterwards the pin holes drilled, two at once by the aid of a jacket, with case-hardened brasses and a twist drill. Afterwards they are put on a 2in. mandrel in the centre of the table of a vertical milling machine and worked round the bosses. Then they are placed upon the table of a small profiling machine, and milled upon the flanges by the aid of a jacket, which is secured to the table, and made specially for this job; they are of sufficient depth and width to receive the ends of two links—

Fig. 278 clearly showing this. They are then dropped upon a pin fixed in the same table at each end, and secured with nuts, washers, and milled round the edges, cutters being used which leave all fillets and radii all.

The stirrup links:—Figs. 237, 238, THE ENGINEER, vol. lviii, page 225—also for the joy motion, after being marked out is placed upon a vertical milling machine, and the outside faces milled up by parallel traverse of the table, then the pin holes are drilled and again dropped upon the milling table, and the profile angle of the faces. These are fixed, the swing links and all other work with sides not parallel but straight to the journals, are set up so that one side is made parallel with the cutter or the traverse of the table, and then the other side done. After each side has been milled they are put on to the table of a vertical cutter having circumferential movement, which mills the circular ends of the journals. These, as before stated, are the only rough portion remaining is between the forks, and this is milled by using the jacket shown in elevation—Fig. 279—and section A-B, Fig. 250—this is held to the table by aid of the T slots, and the cutter passes to its work after a vertical milling machine has worked it out, and the jacket also works this. A little margin is allowed for adjustment of each head, there being twenty tools fixed in each disc—2in.—by wedge bolts, and speeded to 250, per minute, and 1in. feed for steel castings, and increased to 1in. for iron castings. All the necessary holes for bolting or riveting to the frames, slide-bar brackets, anchor links, &c., are drilled and bored by the aid of jackets, and the steel castings are sent to the grinder to be finished. The foot or drum plate has the bearing for the tender-buffer rubbing blocks machine by an end milling minute and 1/2in. feed per stroke, after which they are removed to the drilling machine, which really consists of two radial arms 12ft. 6in. apart, the table for each being a carriage or trolley on an 18in. gauge capable of free traverse, which enables the machine to give the frames and longitudinal movement as the work proceeds, the whole process being exactly similar to that adopted for the lacquered plates in the boiler shop, and previously referred to. Some frames require a set inwards at the smoke-box end, for radial wall clearance, and this is done by the straightening table by the afore mentioned hydraulic jacks. The cross stay, motion plate, and the foot or drag plate are first machined on an ending or double-headed rotary facing machine, which will face anything that goes between the frames of an engine. A little margin is allowed for adjustment of each head, there being twenty tools fixed in each disc—2in.—by wedge bolts, and speeded to 250, per minute, and 1in. feed for steel castings, and increased to 1in. for iron castings. All the necessary holes for bolting or riveting to the frames, slide-bar brackets, anchor links, &c., are drilled and bored by the aid of jackets, and the steel castings are sent to the grinder to be finished. The foot or drum plate has the bearing for the tender-buffer rubbing blocks machine by an end milling
of ordinary dogs to the face plate, and this gift is removed by a parting tool, which is made out of bar steel 8 in. deep, jin. wide at the top, and 3 in. at the bottom, jumped up to 3 in. wide at the cutting edge. While thus fixed they are rough turned all over, including the wheel seat,顶尖 on the tread, and also the sides of the balance weight. They are then re-annulled, and the wheel seat is bored to the standard size, and pressed on to the axle. The pair are then turned to gauge for the tire, the speed varying from 10 ft. to 18 ft. per minute. Fig. 287 shows an extremely handy chuck for wheels of small diameter, say legs, etc., which is attached to the ordinary face plate. The drivers are represented at A, the bearings for the spokes at B, and adjustment under the rim at C. This arrangement admits of the following operations being performed during the one setting:—Boring the boss on wheel seat, turning the tread, and facing upon each side of the rim. The crank pin seatings are then bored out at a quarter-centre boring machine, parallel and both at once. This machine consists essentially of two headstocks, fixed upon one bed at a suitable distance apart, and in each is the gearing for driving the boring bar. The wheels and axle are placed between the centres, one crank pin seating below in a vertical centre line, the other seating will then be either leading or trailing. Between the wheels are two other standards or frames, for supporting the other end of the boring bar in a pedestal; this for the vertical seating is simply arranged for upward or downward traverse only, whereas the opposite can be transferred as required, leading or trailing, with a certain range of horizontal traverse, the boring bar being also capable of similar re-arrangement. The wheels are now ready for the three which have been bored and are ready to template at 10 ft. to 20 ft. per minute. These are put on by expanding, holding the sealing medium employed, which is simply a perforated tube encircling the tire, and giving to the whole a very uniform heat. The jin. tapping holes are then drilled through the rim for the securing bolts by a double-headed drilling machine, a smaller hole being drilled into the tire 1 in. deep for the end of the set screw, it being turned down accordingly.

(To be continued.)

THE TOWER BRIDGE.—At a meeting of the Court of Common Council, on the 8th inst., it was announced that the Prince and Princess of Wales had consented to open the Tower Bridge on a day in June next to be hereafter fixed.
NOTES AND MEMORANDA.

An interesting article on "Homogeneous Division of Space," describing the means of dividing any volume of space into equal and congruent parts, has recently been issued for distribution among the members of the Royal Society, and interest and duration of heating as well as temperature should be regarded in making such divisions. There are about 200,000 miles of telephone wire owned by the Western Union Telegraph Company and the American Bell Telephone Company; and numerous other lines owned by the telephone companies in all parts of the world, and the extension of the system is expected to be rapid. There is a paper on "The Alkali Transformation of Iron" by Mr. W. G. F. Abbot, in which the author shows that the degree of transformation is more rapid at the higher temperatures, and the transformation is accelerated by the presence of small amounts of certain impurities, and is arrested by the presence of other impurities.

There are two new steels that are awaiting the report of the Committee on Railway Engineering, and the steels are to be tested in the next session of the Society. The report of the Committee on Railway Engineering was received by the Society on the 20th of last month, and the Committee has been working hard to make a thorough investigation of the subject.

MISCELLANEA.

We understand that Mr. J. Harrison Carter is erecting new works at instncted, on the London and North-Western and London Midland and East Coast Railways, and that the new works will be ready for operation next year. The new works will be used for the manufacture of new locomotives, and the experiments to be made with new steel for gages is being watched with great interest. The new works will be the most important departures in gun manufacture of modern times, and the new steel will gun in performance all that the gunners have been looking for.

No sensitive man peculiarly felt as he was quite certain.

This bicycle seems to have thoroughly established itself as the workhorse of the day, and the manufacturers are making a large number of them. The new model is said to be quite an improvement on the old one, and is more durable and less subject to breakage.

The French have discovered, and are actively working on, a new method of cutting steel. The method is based on the principle of cutting steel with a high-speed tool, and the tool is made of a special steel which is said to be much harder than ordinary steel.

A new type of telephone is being developed in the United States, and is expected to be introduced into the market soon. The telephone is said to be much more efficient than the present type, and is expected to be a great improvement on the old model.

A paper on "The Law of the Sea" by Mr. J. H. Jackson, in which the author discusses the legal principles governing the use of the sea, and the author's views on the future of the sea are presented. The paper is expected to be of considerable interest to those who are interested in the marine law. A paper on "The Law of the Sea" by Mr. J. H. Jackson, in which the author discusses the legal principles governing the use of the sea, and the author's views on the future of the sea are presented. The paper is expected to be of considerable interest to those who are interested in the marine law.
THE CARGO STEAMER TURRET AGE
MESSRS. W. DOXFORD AND SONS, SUNDERLAND, BUILDERS

(For description see page 221)

THE TURRET AGE NEARLY READY FOR LAUNCHING

INTERIOR VIEW OF FORE BODY FRAME AND INNER BOTTOM
T he Cargo Steamship Turret Age.

Two presences implied in the selection of the name "Turret Age" for the novel type of cargo steamer built last year by Messrs. Wm. Doxford and Sons, of Pallion Yard, Sunderland, is rapidly being justified. This firm, who, as is now well known, are the patentees of this "turret" type of cargo steamer, have already produced two such vessels—the Turret and the Turret Age—which are now in actual service and giving every satisfaction. At the present time they have three more under construction in progress, and so far as we are advised, one of a double-hull type, each in actual service, will have been added to the firm's list before the end of the year, although at this writing the latter vessel is only 30 per cent. along the keel. The vessels are all of about 5,200 G.T., and the general arrangement of their machinery is so flexible that the ships can be adapted to carry a portion of deadweight cargo and the remainder of light cargo, as the case may be. The latter illustration is given in the Turret Age leaves a more interior space for stowage of cargo. In other words, the turret and the upper part of the main deck are utilized for accommodation, while the lower part is used for cargo stowage. The main deck, moreover, more especially applies to vessels intended, as those already under construction, for carriers of grain, and in consequence is built in bulk—coal, grain, etc., but at the same time, when trade requires the carriage of certain additional items, such as wool or oil feeding—makes the design equally adaptable to the alternative of bulk- or general-cargo carrying, with the advantage that the solid structural modifications are being adapted in it to other purposes.

While the Turret Age has been constructed more with a view to the carriage of coal and grain, where it will be on the average exchangeable for a cubic foot of 50 per cent. grain-feeding accommodation, it may be pointed out that this turret feature—as affording scope for the expansion of the machinery space and separated from the petroleum cargo by a large cargo deck, when not required, with the latest requirements of the Suez Canal authorities for vessels in this trade.

The position of the propelling machinery right aft and the increased height of the vessel from about midships, of course, the largest cargo carriers of the type which are now in the market, the vessels have been placed at the extreme after end, both the outward and homeward bunker coal being thrown on the machinery space, and separated from the petroleum cargo by a large cargo deck, when not required, with the latest requirements of the Suez Canal authorities for vessels in this trade. The position of the propelling machinery right aft and the increased height of the vessel from about midships, of course, the largest cargo carriers of the type which are now in the market, the vessels have been placed at the extreme after end, both the outward and homeward bunker coal being thrown on the machinery space, and separated from the petroleum cargo by a large cargo deck, when not required, with the latest requirements of the Suez Canal authorities for vessels in this trade. The position of the propelling machinery right aft and the increased height of the vessel from about midships, of course, the largest cargo carriers of the type which are now in the market, the vessels have been placed at the extreme after end, both the outward and homeward bunker coal being thrown on the machinery space, and separated from the petroleum cargo by a large cargo deck, when not required, with the latest requirements of the Suez Canal authorities for vessels in this trade. The position of the propelling machinery right aft and the increased height of the vessel from about midships, of course, the largest cargo carriers of the type which are now in the market, the vessels have been placed at the extreme after end, both the outward and homeward bunker coal being thrown on the machinery space, and separated from the petroleum cargo by a large cargo deck, when not required, with the latest requirements of the Suez Canal authorities for vessels in this trade. The position of the propelling machinery right aft and the increased height of the vessel from about midships, of course, the largest cargo carriers of the type which are now in the market, the vessels have been placed at the extreme after end, both the outward and homeward bunker coal being thrown on the machinery space, and separated from the petroleum cargo by a large cargo deck, when not required, with the latest requirements of the Suez Canal authorities for vessels in this trade. The position of the propelling machinery right aft and the increased height of the vessel from about midships, of course, the largest cargo carriers of the type which are now in the market, the vessels have been placed at the extreme after end, both the outward and homeward bunker coal being thrown on the machinery space, and separated from the petroleum cargo by a large cargo deck, when not required, with the latest requirements of the Suez Canal authorities for vessels in this trade.
excess of the corresponding upper member provided by the deck. From these general considerations it will at once be seen that, in the case of ships, as the case of the Turret Age—and of other, or vessels of the same type, the penetration of shot by the continuous longitudinal is in proportion, and therefore, to a certain extent, the number of shots necessary to penetrate any thickness of metal is determined by the ratio between the thickness of the shell and the mass of the shot. This is true, of course, only when the conditions are the same, but it is a fact that has been borne out by practical experience in modern naval warfare, and it is a fact that must be remembered in any design of vessels. However, this is not the only fact which must be considered, for the actual experience in modern naval warfare is almost entirely based on the assumption that the ordnance of the opposite side will be of the same type, and that the relative values of different types of guns are known. The best method of overcoming this difficulty is by means of a combination of the two methods of construction. In the ancient ships of unarmoured sailing vessels, the armament was usually placed in the forecastle and forecastle, with practical stagnation in the construction, armament, and equipment of the vessels, but in modern war-ships the situation is not so easy matter. Now the progress of invention is rapid, and change follows fast upon change, so that the decision of the various problems must be left to the experts, who will be able to give the best advice on the practical side. Whatever is done is certain to be challenged or criticised.

**KEATS’ MARINE GOVERNOR.**

The Governor, invented by Mr. F. C. Keats, of Garnings, is of a vertical type, its crane being an engine with a fly-wheel and a governor. It is actuated by a governor placed in the crank case of the engine, and driven by the engine to be governed by means of a screw or pitman, counter-shaft, and a counter-wheel, and the screw. By means of this multiplying gear, whatever the relative size of the cylinder and the speed of the nut wheel for the nut wheel can be obtained. To this nut wheel is attached the piston-rod, and it is so arranged that when the engine is going through the free air, the screw is driven at a distance equal to the speed of the nut wheel on the screw, the slide valve is closed again.

When this governor is connected with the main engines, and the tarry are travelling at their required speed, the screw and nut wheels are in the same position, and the nut wheel begins to travel on the screw, and opens the valve of the cylinder at one end or the other, as the case may be, when the piston rod travels towards or forwards, and so on, the throttle valve. If the engine is working at 72 revolutions per minute, the nut wheel is in revolving eight times as fast. When the main engine gains one-thirty-fifth of a revolution, the nut wheel gains one-eighth of a revolution; when it gains one thirty-second of a revolution, the nut wheel gains one-quarter of a revolution, and works the throttle valve accordingly. When the main engines gain one-thirty-sixth of a revolution, the nut wheel gains one-half of a revolution, it is disconnected from the screw, so that the speed of the small engine is not interfered with. It will be thus seen that the Governor is a very quick-acting and powerful machine, and is adapted to the requirements of the sea, and the satisfactory results in the Sunderland ships Advent and Vesta.

For ships of the Royal Navy, the Board of Admiralty is the responsible authority in the selection of types, and determines the policy of the service. The Naval Defence, therefore, is necessarily a matter of the greatest importance. What is done is certain to be challenged or criticised, and the Admiralty is the one responsible authority that can be accountable for the result.

**The Engine.**

**KEATS’ MARINE GOVERNOR.**

The Governor is derived from the old-fashioned type of Governor, and has been modified in order to suit the peculiar conditions of the modern war-ship. The Governor is divided into two parts, a horizontal and a vertical one, the latter being the main body of the Governor. The Governor is actuated by the engine, and the governor itself is driven by the engine to be governed by means of a screw or pitman, counter-shaft, and a counter-wheel, and the screw. By means of this multiplying gear, whatever the relative size of the cylinder and the speed of the nut wheel on the screw, the slide valve is closed again.

When this governor is connected with the main engines, and the tarry are travelling at their required speed, the screw and nut wheels are in the same position, and the nut wheel begins to travel on the screw, and opens the valve of the cylinder at one end or the other, as the case may be, when the piston rod travels towards or forwards, and so on, the throttle valve. If the engine is working at 72 revolutions per minute, the nut wheel is in revolving eight times as fast. When the main engine gains one-thirty-fifth of a revolution, the nut wheel gains one-eighth of a revolution; when it gains one thirty-second of a revolution, the nut wheel gains one-quarter of a revolution, and works the throttle valve accordingly. When the main engines gain one-thirty-sixth of a revolution, the nut wheel gains one-half of a revolution, it is disconnected from the screw, so that the speed of the small engine is not interfered with. It will be thus seen that the Governor is a very quick-acting and powerful machine, and is adapted to the requirements of the sea, and the satisfactory results in the Sunderland ships Advent and Vesta.

For ships of the Royal Navy, the Board of Admiralty is the responsible authority in the selection of types, and determines the policy of the service. The Naval Defence, therefore, is necessarily a matter of the greatest importance. What is done is certain to be challenged or criticised, and the Admiralty is the one responsible authority that can be accountable for the result.

Universal experience in all navies and at all periods shows that there must be many battleships of different types. No single type can be trusted to perform all the services required at a given moment. Progress in invention and the production of new machines necessarily introduces further variety. It would be folly for the Admiralty to assert the ultimate immortality of any particular system of armament or machinery. On the "Effective List" of the British Army to destroy the 47-inch guns of the heaviest sea-going torpedoes, now either made or under construction, or of any system of armament and machinery which may be introduced in the future. The Naval Defence Programme provided for seventy vessels of various types and sizes, but the Development of the new types of armament and machinery is proceeding with great rapidity. The aims of the new types of armament and machinery are not known, and it is not possible to state with any certainty what the final result will be. It is necessary, therefore, to proceed with caution and discretion in the selection of types.

The Naval Defence Programme provided for seventy vessels of various types and sizes, but the Development of the new types of armament and machinery is proceeding with great rapidity. The aims of the new types of armament and machinery are not known, and it is not possible to state with any certainty what the final result will be. It is necessary, therefore, to proceed with caution and discretion in the selection of types.
those requirements available for service in the protection of commerce and the defense of the nation, which is likely to be organized from the Naval Defence ships, including all the battleships and the equivalent number of cruisers, which would surround the most crowded merchantmen and complete ships of similar classes that could possibly be built. The ships designed to be created rapidly and simultaneously, it is more homogeneous in character and less expensive in the discharge of its duties, its armament is entirely different from that of the battleship and cruiser. Its armament is limited to two 8-inch guns. Its speed, armament, is also, like the most modern description of a battleship and battleship cruiser, a tonnage of 8,000 tons, and long and long and 14,000 tons displacement. Analyzing the designs of warships, and comparing them with merchant ships—no need to the battleship cruiser, which has been prescribed entirely different services—one is forced to the conclusion that the battle cruiser is an improvement, but necessarily a moderate one.

The cost and fare are to be reduced, as some persons strongly urge, then it will be absolutely necessary to reduce some or all of the armament. But the battleship cruiser, accepting lighter guns, lower weight of protection, lower speed, and greater maneuverability, but with a smaller fighting machine of smaller individual power, comparing badly with the ships of most recent design built or building in the United States is a large number of less powerful ships for a given expenditure. The battleship cruiser is rather a deliberate attempt to represent individual inferiority in our ships to the navigation volunteers, and to produce a vessel where the necessary expenditure is faced, superiority in numbers as well as in terms of weight both of the public and of opinion undoubtedly intimate to that side.

If the constitution of the Naval Defence fleet is considered, it will be seen that the first line ship, the twenty-one ships of the largest class, would cost, in all, £790,000, tons, or about 14,200 tons, 7000 to 7500 tons, 11 from 1000 to 2000 tons, 1900 to 2400 tons, 2400 to 3000 tons, and 3000 to 3500 tons. Warship dimensions and cost are not to be regulated by the number of ships. You can not have an idea of approaching what the cost is of building a ship for meeting the possible attacks of foreign ships, and securing superiority in numbers and in fighting efficiency in each of these cases. It is necessary to remember, that every operation in the battle fleet, in the Royal Navy, for the last thirty years. A first-class battleship of 1800 required to be built for any service, in the coal consumption, the oxen, the men, and the monthly expenditure of the ship, the fuel, the coal, and the extraordinary expenses, is considerable. The blackness of sea-water, and power of keeping the seas, therefore, entirely upon the requisition for the use of higher steam pressures and greater expansion, the ratio of steam consumption to working power, which has become necessary in expenditure of power increase most rapidly. A first-class battleship of 1800 required a large amount of coal, and the consumption per mile had increased. A first-class battleship of 1800 required a large amount of coal, and the consumption per mile had increased. A first-class battleship of 1800 required a large amount of coal, and the consumption per mile had increased. A first-class battleship of 1800 required a large amount of coal, and the consumption per mile had increased. A first-class battleship of 1800 required a large amount of coal, and the consumption per mile had increased. A first-class battleship of 1800 required a large amount of coal, and the consumption per mile had increased. A first-class battleship of 1800 required a large amount of coal, and the consumption per mile had increased.

On the other hand, in recent ships great demands are made upon the coal. The 10,000-ton battleship requires between 3000 and 5000 tons of coal per hour, whereas a ship of a similar class in the Naval Defence fleet requires but 8000 tons of coal per hour.

All these considerations make it incumbent upon the Royal Navy to have a large coal-endurance, and the question of coal consumption cannot be considered a matter of plebeian consideration.

The original Royal Navy, which was first established, was a very remarkable improvement, and it is the result of thorough and careful reflection upon the coal consumption of the main engines. The seventy ships of the first-class, 1800-1850 tons, have been built for operating on the coast; since that date such accounts that have been made since the scheme was first established in 1855, have made it evident that the coal consumption of the main engines of the ships is much lower than it was in 1855. The average coal consumption of the ships of the Royal Navy is about 1000 tons per 1000 tons of displacement.

A modern fleet requires large expenditures for its construction, and the great increase in the armament of the ships of the Royal Navy is a great stimulus to our great industry.

The twenty-one ships of the largest class, the cost of £790,000, tons, would be £1,000,000, and no less. The seventy ships of the first-class, 1800-1850 tons, have been built for operating on the coast; since that date such accounts that have been made since the scheme was first established in 1855, have made it evident that the coal consumption of the main engines of the ships is much lower than it was in 1855. The average coal consumption of the ships of the Royal Navy is about 1000 tons per 1000 tons of displacement.

A modern fleet requires large expenditures for its construction, and the great increase in the armament of the ships of the Royal Navy is a great stimulus to our great industry.

The twenty-one ships of the largest class, the cost of £790,000, tons, would be £1,000,000, and no less. The seventy ships of the first-class, 1800-1850 tons, have been built for operating on the coast; since that date such accounts that have been made since the scheme was first established in 1855, have made it evident that the coal consumption of the main engines of the ships is much lower than it was in 1855. The average coal consumption of the ships of the Royal Navy is about 1000 tons per 1000 tons of displacement.

A modern fleet requires large expenditures for its construction, and the great increase in the armament of the ships of the Royal Navy is a great stimulus to our great industry.

The twenty-one ships of the largest class, the cost of £790,000, tons, would be £1,000,000, and no less. The seventy ships of the first-class, 1800-1850 tons, have been built for operating on the coast; since that date such accounts that have been made since the scheme was first established in 1855, have made it evident that the coal consumption of the main engines of the ships is much lower than it was in 1855. The average coal consumption of the ships of the Royal Navy is about 1000 tons per 1000 tons of displacement.

A modern fleet requires large expenditures for its construction, and the great increase in the armament of the ships of the Royal Navy is a great stimulus to our great industry.

The twenty-one ships of the largest class, the cost of £790,000, tons, would be £1,000,000, and no less. The seventy ships of the first-class, 1800-1850 tons, have been built for operating on the coast; since that date such accounts that have been made since the scheme was first established in 1855, have made it evident that the coal consumption of the main engines of the ships is much lower than it was in 1855. The average coal consumption of the ships of the Royal Navy is about 1000 tons per 1000 tons of displacement.

A modern fleet requires large expenditures for its construction, and the great increase in the armament of the ships of the Royal Navy is a great stimulus to our great industry.

The twenty-one ships of the largest class, the cost of £790,000, tons, would be £1,000,000, and no less. The seventy ships of the first-class, 1800-1850 tons, have been built for operating on the coast; since that date such accounts that have been made since the scheme was first established in 1855, have made it evident that the coal consumption of the main engines of the ships is much lower than it was in 1855. The average coal consumption of the ships of the Royal Navy is about 1000 tons per 1000 tons of displacement.

A modern fleet requires large expenditures for its construction, and the great increase in the armament of the ships of the Royal Navy is a great stimulus to our great industry.

The twenty-one ships of the largest class, the cost of £790,000, tons, would be £1,000,000, and no less. The seventy ships of the first-class, 1800-1850 tons, have been built for operating on the coast; since that date such accounts that have been made since the scheme was first established in 1855, have made it evident that the coal consumption of the main engines of the ships is much lower than it was in 1855. The average coal consumption of the ships of the Royal Navy is about 1000 tons per 1000 tons of displacement.

A modern fleet requires large expenditures for its construction, and the great increase in the armament of the ships of the Royal Navy is a great stimulus to our great industry.

The twenty-one ships of the largest class, the cost of £790,000, tons, would be £1,000,000, and no less. The seventy ships of the first-class, 1800-1850 tons, have been built for operating on the coast; since that date such accounts that have been made since the scheme was first established in 1855, have made it evident that the coal consumption of the main engines of the ships is much lower than it was in 1855. The average coal consumption of the ships of the Royal Navy is about 1000 tons per 1000 tons of displacement.

A modern fleet requires large expenditures for its construction, and the great increase in the armament of the ships of the Royal Navy is a great stimulus to our great industry.

The twenty-one ships of the largest class, the cost of £790,000, tons, would be £1,000,000, and no less. The seventy ships of the first-class, 1800-1850 tons, have been built for operating on the coast; since that date such accounts that have been made since the scheme was first established in 1855, have made it evident that the coal consumption of the main engines of the ships is much lower than it was in 1855. The average coal consumption of the ships of the Royal Navy is about 1000 tons per 1000 tons of displacement.
HER MAJESTY'S SECOND-CLASS BATTLESHIP CENTURION

(For description see page 224)
THE ENGINEER.

PETROLEUM IN SOMERSETSHIRE.

It is now some time since paragraphs began to appear in the Press alleging the discovery of petroleum by Mr. Ashwell in Somersetshire, and many and age have been spent in investigating the truth of the report. The geology of the district makes a full investigation necessary before any positive conclusion can be arrived at, and it may be well before entering upon a consideration of the commercial importance of the results which have been at one time attributed to Mr. Ashwell to determine whether the deposit of petroleum is of any geological or mineralogical importance or not.

In the Autumn of last year, Mr. Ashwell wrote a letter to the Editor of The Engineer, and subsequently submitted to the Council of the institution an outline plan of the exploratory operations on the estate of Sir Benjamin Bower, Bart., M.P., in the vicinity of Ashwick, near Taunton, and which reference occurred at the anniversary meeting of the Institution of Civil Engineers at Bath, in June last, and was published in the Proceedings of this Institution.

The views of the discoverer, which are set forth in detail in the report before referred to, are in brief that a deposit of petroleum is located in the vicinity of Ashwick, and that the oil is of a very high quality, being capable of being distilled for the purpose of lighting without the addition of any other material, and obtaining a Todd's number between 115 and 120. It is also stated that it has been proved by analysis that the oil contains about 77 per cent. of water, and that this point is of great importance. The following statement is also made:—

"The oil is of an extremely high quality, and is capable of being distilled without the addition of any other material, and with a Todd's number of 120. The oil is of a yellowish-green colour, and contains about 77 per cent. of water. It is stated that the oil has been produced in a well, and that it is capable of being distilled for the purpose of lighting without the addition of any other material."
too severe to be long continued in that special type of boiler. Reverting to the point made in the previous letter, we consider how it shall be used. The first essential is that both steam and water shall be cut off whenever the boiler shell is fully heated, and not one side only. The next point is that, in order to secure an ample supply of water shall invariably be provided to a great depth of two or three feet. If we have a long tube of small diameter, say an inch, and run the steam-pipe along the bottom of the shell, as in the bottom of the tube that all the water above will be blown overboard, so that a loss occurs. If the tube is situated below or above to fill the space, and this in turn will be ejected. We could name more than one water-tube boiler with the same defect, and it is therefore unnecessary to mention makers called the action "circulation," but it was not circulation which made the trouble, for the water was not in this way will soon be burnt out and cannot fail to pri­ nce heavily. This "gaping" action is exceedingly impor­tant, and it is impossible to overrate the effect of steam if the water is not kept in the tubes, and unless the con­ pendent that the tubes should be short. It is also evident that the diameter of the tube should be as small as pos­ Any approach to the horizontal will result in disaster with water, it is quite impossible to burn it.

In this direction, no doubt, torpedo boat builders have produced something new, and that is a boat in which the tubes are burned per square foot of grate per hour the tem­ perature is very high. But something still higher can probably be produced. The maximum temperature per­ sure to be had with proper arrangements and oil fuel, say 600°, can be had, and this is as high as many quality much like sealing wax. If, now, is precipitated in the cold, it, seems not to be at all improbable that an evaporation of 20/0, or 20 lb. of water per square foot can be induced. There are a number of facts which point away from the tube-surface and assume the spherical con­ dition of a globe. The water will be forced to ascend and must be taken to prevent the clinging of steam to the tube. If, for instance, a tube should boil itself dry, in less than a minute, it may burst and work very ill for a boiler. Fourthly, special arrangements must be made for getting the water out of the steam. To comply with all the above requirements, the boiler must be enclosed, and the whole of it so enclosed that even that every inch of surface not used for generating or dry­ ing must be taken to prevent the condensation of the draught. The principles to be observed are very simply stated. The first is that the heating surface, and indeed the whole of the water, should be in the form of a tube, in order to prevent the chance of hanging or clinging to the metal will follow. When we come to work with enormous tem­ peratures there is time to test each one of the above.

In this case it's upward rush does not depend on the balance of what is to be burnt out. It is held, of course, that it is possible to put up a boiler to last perhaps 20 years, and the experience of years makes it quite possible that the boiler will be worked for 15 years, and that it will then be put to 12. It will be cut off and the boilers filled again. If the fire is large, a whole ton of sand would be required to cool the tubes in order to get dry steam. The uniform rapidity with which the sand is cooled is not the only essential. There would be a loss in economy of fuel, but there would be an immense saving in the cost of the boiler. It is certain that the water neces­ sary in the length of the tubes would permit us to reduce the pressure of the water by two bars, and the efficiency of the boiler would both be helped by that alteration. There is, indeed, no reason to suppose that an express boiler must be dread­ ful unless it is constructed with the idea of making it to thoroughly economical end in failure, but the whole of the water must be in the tube. The question is only one of time, inasmuch as there are certain short periods, in which the spaces for the discharge of the products of combustion must be made contractile, but as little as 0.25. There was one idea that the draught could be returned, as Mr. H. B. of the Lancashire company, and one Mr. P. of the North-Eastern, with the exception of 3 or 4 degrees, which was of no practical importance. The tubes should be boiling, and the heat the more closely should the tube approach the vertical.

Experiment goes to show that so long as a tube is made of metal not too thick, and steam is passed with water, it is quite impossible to burn it. We have already in a former impression cited Mr. Maxim's experi­ ments in this direct line. Every year makes the truth of this more and more manifest. Dr. Bateman, looking at flying machines, Mr. Pope carried out experiments with a boiler which was burnt away, and the boiler and tubes were buried in a blacksmith's fire, and everything possible was done to destroy them, but fire could not be put out until the tubes were destroyed. In this direction, no doubt, torpedo boat builders have produced something new, and that is a boiler in which the tubes are burned per square foot of grate per hour the tem­ perature is very high. But something still higher can probably be produced. The maximum temperature per­ sure to be had with proper arrangements and oil fuel, say 600°, can be had, and this is as high as many quality much like sealing wax. If, now, is precipitated in the cold, it, seems not to be at all improbable that an evaporation of 20/0, or 20 lb. of water per square foot can be induced. There are a number of facts which point away from the tube-surface and assume the spherical con­ dition of a globe. The water will be forced to ascend and must be taken to prevent the clinging of steam to the tube. If, for instance, a tube should boil itself dry, in less than a minute, it may burst and work very ill for a boiler. Fourthly, special arrangements must be made for getting the water out of the steam. To comply with all the above requirements, the boiler must be enclosed, and the whole of it so enclosed that even that every inch of surface not used for generating or dry­ ing must be taken to prevent the condensation of the draught. The principles to be observed are very simply stated. The first is that the heating surface, and indeed the whole of the water, should be in the form of a tube, in order to prevent the chance of hanging or clinging to the metal will follow. When we come to work with enormous tem­ peratures there is time to test each one of the above.

The steam will very soon be burnt out and cannot fail to pri­ nce heavily. This "gaping" action is exceedingly impor­tant, and it is impossible to overrate the effect of steam if the water is not kept in the tubes, and unless the con­ pendent that the tubes should be short. It is also evident that the diameter of the tube should be as small as pos­ Any approach to the horizontal will result in disaster with water, it is quite impossible to burn it.

In this direction, no doubt, torpedo boat builders have produced something new, and that is a boiler in which the tubes are burned per square foot of grate per hour the tem­ perature is very high. But something still higher can probably be produced. The maximum temperature per­ sure to be had with proper arrangements and oil fuel, say 600°, can be had, and this is as high as many quality much like sealing wax. If, now, is precipitated in the cold, it, seems not to be at all improbable that an evaporation of 20/0, or 20 lb. of water per square foot can be induced. There are a number of facts which point away from the tube-surface and assume the spherical con­ dition of a globe. The water will be forced to ascend and must be taken to prevent the clinging of steam to the tube. If, for instance, a tube should boil itself dry, in less than a minute, it may burst and work very ill for a boiler. Fourthly, special arrangements must be made for getting the water out of the steam. To comply with all the above requirements, the boiler must be enclosed, and the whole of it so enclosed that even that every inch of surface not used for generating or dry­ ing must be taken to prevent the condensation of the draught. The principles to be observed are very simply stated. The first is that the heating surface, and indeed the whole of the water, should be in the form of a tube, in order to prevent the chance of hanging or clinging to the metal will follow. When we come to work with enormous tem­ peratures there is time to test each one of the above.

The Committee which has reported to the Council on the present inquiry cited amongst the many obstacles that the task of the Royal Commissioners is complicated by the undoubted fact that, what ever may come to pass later on, the ferration is perpetrated on the pre­ tendence of promoting the public good, and always in­evitably increases the wages of the men employed. It is therefore plain that the Committee have given full force to the statement of the Royal Commissioners that the price of the works proposed is not in accordance with the statements of the Royal Commissioners. The works are more or less ambitious, and that which is practicable may be left out of mind, and not only that which may be desirable.

It must be acknowledged that the companies are acting consistently. The water-supply of the metropolis must be extended, and the companies come forward with plans and schemes for the execution of these plans, though, at the peril of leaving London short of water. This will never do, and the companies are in the end not to be trusted. The company pointed out the situation in a report which he addressed to the Board of Trade, which, among other things, an­ ticipated the fact that, whatever may come to pass later on, the ferration is perpetrated on the pre­ tendence of promoting the public good, and always in­evitably increases the wages of the men employed. It is therefore plain that the Committee have given full force to the statement of the Royal Commissioners that the price of the works proposed is not in accordance with the statements of the Royal Commissioners. The works are more or less ambitious, and that which is practicable may be left out of mind, and not only that which may be desirable.

It must be acknowledged that the companies are acting consistently. The water-supply of the metropolis must be extended, and the companies come forward with plans and schemes for the execution of these plans, though, at the peril of leaving London short of water. This will never do, and the companies are in the end not to be trusted. The company pointed out the situation in a report which he addressed to the Board of Trade, which, among other things, an­ ticipated the fact that, whatever may come to pass later on, the ferration is perpetrated on the pre­ tendence of promoting the public good, and always in­evitably increases the wages of the men employed. It is therefore plain that the Committee have given full force to the statement of the Royal Commissioners that the price of the works proposed is not in accordance with the statements of the Royal Commissioners. The works are more or less ambitious, and that which is practicable may be left out of mind, and not only that which may be desirable.
and subterranean waters in the Thames and Lee water­
NCE, a sufficient supply was found. The want of a
people, a number exceeding by about three-quarters of a mil­
from the cost of water as it necessarily depend on such a supply in London and its environs.
There is also the expectation that a large amount of water will be obtained in the same way westward of the Kent County's district. But if all this stands good, the supply of water now in the Thames Conservancy Bill, scheme of enormous dimen­
cisions and calculated to stir up a host of opponents. Several prominent people have already been named, and the County Council to objects that part of the Bill dealing with the colonies of the Thames companies are allowed to draw what is known as the tithes of water from the stream. But it is obvious that if the requirement of the Royal Commissioners are to be carried out, or in other words, if the tithes of water need to be deducted from the supply, the quantity which the Bill allows to be taken from the streams is considerably less than that which, as we have already seen, has greatly increased contribution to the Conservancy Board from the water companies is proposed by the Bill, and to this extent, the Bill is against the interests of the consumer.

Yet if the companies are already charging the consumers the full prices, there is no doubt, after the present supply, it may be said, as the term is used, that the burden will be on the consumer. Yet the Bill states, we suppose, we are not sure, that the burden will be on the consumer. Yet, as we have seen, there is no doubt that the burden will be on the consumer. Yet the Bill states, we suppose, the burden will be on the consumer. Yet, as we have seen, there is no doubt that the burden will be on the consumer. Yet the Bill states, we suppose, the burden will be on the consumer. Yet, as we have seen, there is no doubt that the burden will be on the consumer. Yet the Bill states, we suppose, the burden will be on the consumer. Yet, as we have seen, there is no doubt that the burden will be on the consumer.
HIGH-PRESSURE AIR COMPRESSOR.

The air compressor which we illustrate above and on page 229, is one of a type introduced and constructed by Messrs. Ewell Fils, of Paris. The machine consists in effect of two double-acting compressing pumps, in which the air is compressed in four stages. The impellers are so calculated that the pressures shall be equalised on each side of the pistons. The pistons provided, it will be seen, with nozzles, and the first stage raises the pressure to about 57 lb. In the second stage this is brought up to 140 lb., in the third to 430 lb., and in the fourth stage to 1430 lb. per square inch. The two compressing cylinders are cast together, with a casing or jacket to contain water, in which are placed two coils of piping. The first serves as an intermediate receiver for the first cylinder, and the second coil, connected with the small cylinder, serves to cool the air before it is delivered into the storage reservoir. The air to be compressed is drawn into the large cylinder through eight valves E E in the cover, and kept closed by bellows springs. A spray of water is introduced at the same time, while a small quantity of oil is drawn in from the lubricator on the top of this cover. When the piston ascends it compresses the air in the portion of the cylinder marked A. When a certain pressure has been reached the valves F F for the piston are forced down and the air then enters the annular space B B between the sides of the cylinder and the trunk. On the return stroke the air is forced through the coil H H through the valve G. The action of the two pistons is identical. The process just described is repeated in the small cylinder. It is to be noticed that the water introduced into the first cylinder is recirculated to all stages and is always above the valves. It is claimed by the makers that this is a feature of much importance in machines running at a high speed, because then there is no danger of knocking a cylinder end out, or breaking a piston if too much water should chance to be admitted.

It is in reality a quadripole expansion engine, the final pressure attained amounting to 1400 lb. per square inch. The machines are made in several sizes. One to deliver 17-65 cubic feet of air per hour at the stated pressure, has the following dimensions:

- Diameter of large piston: 7 in.
- Diameter of small piston: 3½ in.
- Stroke of steam piston: 4½ in.
- Breathing per minute: 300 to 960.
- Pressure: 1430 lb. per square inch.

The following advantages are claimed for this system:

1. The use of a large auxiliary engine to begin with renders the loss due to clearance.
2. The division of the work into four stages permits the air to be effectively cooled between the two cylinders.
3. The last stages of compression being effected with a very small piston it is easy to make the piston tight, and the space over which leakage could take place is reduced to a minimum.
4. The whole machine can be taken to pieces and put together again in a very short time.
5. The delivery of the machine is independent of the pressure in the storage reservoir.

The quantity of air admitted amounts to about 15 cubic inches for every 200 cubic inches of compressed air delivered.

Our illustrations are so complete that we do not think any further description is needed to make the action of the machine intelligible.

It only remains to add that it has been specially designed for charging torpedoes, and has, we understand, been adopted by the French Naval authorities for that purpose.

LOCOMOTIVE FIRE ENGINE.

Messrs. Meredith Weather and Sons have brought out a useful modification of the fire engine. On January 30th we described a floating fire engine for Egypt, in which the vessel was propelled by two streams of water direct from the pumps. On the 16th inst. a fire engine, arranged to be carried on a locomotive, was satisfactorily tried at Southampton.

The machine is the invention of Mr. John Clark, the engineer to the Southampton Docks, and consists of a triple-cylinder steam fire engine, with double-acting gun-metal pumps, and mounted on a strong wrought iron frame. Beneath the latter provided with grooves are permanently fixed to the front buffer-plate of a locomotive, and the back of the frame slides in the grooves, so that it can be dropped into place in a few seconds. Connections are then made with the steam and exhaust pipes of the locomotive by means of flexible tubes, and the suction, which is also flexible, is secured on and taken to the nearest water.

The trial took place on a line of railway in the docks. The fire engine, which weighs 10 cwt., was suspended from a crane by two rods passing through holes in the top of the frame. It was put into place, the steam and exhaust pipes connected, and four lengths of suction pipe joined together in forty-five seconds. Four 2½-in. hose, with 1½-in. nozzles, were operated simultaneously, and directed streams of water over the roof of cross-shaft warehouses. We are informed that the engine is capable of delivering 750 gallons per minute to a height of 100 ft. The pumps, when at full speed, make 250 revolutions a minute, with a bore pressure of 101 lb. to 120 lb.

Messrs. Meredith Weather were represented at the trial by Mr. Jakeman; the South-Western Railway Company by Mr. Turner, and the Southampton Electrician Board by Mr. Dayson.

In docks, railway stations, or large factories, where there are usually several burning engines under steam, it will possibly be fitting them all with slides and with connections to the steam pipe and exhaust, to have a powerful steam fire engine in working order and ready to proceed at a minute's notice to any place where the rails are laid.

This invention should be even more useful in the United States than in England, but on account of the central buffer and "cow-catcher" it would require to be modified in shape before it could be used on American locomotives.

THE GENERATION AND DISTRIBUTION OF ELECTRICITY.—At the recent meeting of the Local Association of Engineers, the President—Mr. Alfred Fowler, M.I.M.E.—in the chair, a paper was read by Mr. Norman, on "The Generation and Distribution of Electricity." He said that although electrical science dated back to the early days of the ancients, it was only within recent years that the scientific progress of electricity had reached the stage of rapid development. He alluded to the processes of galvanism, volta, ampere, Faraday, and others, and showed that in the discovery that an electric current could be generated by cutting a wire across the lines of force in a magnet, the principle of the modern dynamo had been arrived at. The continuous current machine was useful for light, power, and storage, but the alternating current machine was improved. This type was useful for light, power, and storage. Mr. Hall described the method of distribution in the two-wire low-pressure system. A pressure of 100 volts could not be exceeded for incandescent lamps. In cases where the quantity required was less, the main would necessarily be of great size and when once laid down, would be difficult to get at for alteration or repair. This was the more objectionable when the current had to be conveyed to a considerable distance. By the employment of three wires the three phases of the three main could be distributed, and thereafter reduced four-fold, whilst at the same time the maximum pressure of 100 volts passed through the lamps. For distribution over large areas the two-wire high-pressure system was the best. For this it was essential to use the alternating current, the intensity of which could be diminished as required by passing it through the coil of a transformer. With a voltage of 2000 to the mains, instead of 100, their size could be reduced 400 times. The saving in material was therefore enormous, and the leads being conveyed in pipes could easily be drawn out for examination. Mr. Hall explained the construction of dynamo and transformer, and described the methods of insulation, by which high-pressure currents were rendered harmless. The paper was illustrated by numerous diagrams, models, and articles of manufacture, including a model made by the Westinghouse Company of America, which Mr. Hall said would not be more than 2 per cent, in working. A discussion followed, in which Messrs. Tewer, Hartman, Jackson, Wood, and Bowers took part. A vote of thanks was accorded to Mr. Hall. The members of the Association have, we understand, been invited to the York House to House Electricity Company, Aire-street. Mr. H. W. Edleston kindly conducted them round the plant.
HIGH-PRESSURE AIR COMPRESSOR
MM. ELWELL FILS, PLAINE ST. DENIS, ENGINEERS

(For description see page 228)
of the number of revolutions, with a given speed and equal per-
centage of reduction in the number of revolutions, would be greater in its case. Also, I believe some of their races are of
this general type.

From what I can gather, and speaking generally, English official engines are not of such a class as to endeavor to do anything of the kind, not that they have not been in some cases,
but that a gas could not expand against a constant resistance
without producing some other work. The action of the Dr. Lodge, quote, apparently an error. Further, and more important, I
say that a gas cannot expand against a constant resistance
whereupon some other work is produced. Dr. Lodge, quote, appears to ignore this fundamental error.

Fireproof buildings and sound.

Mr. Lodge would have to show how the temperature was
increased, and we have besides the loss. I do not think that 672 lb. would be more than the thought of it.

The residence must decrease as the gas expands. Before the point is reached at which the gas must be raised, and do we at will, on the other hand, a certain small amount. As a
time of lesser that a cycle, and the consequence of the
converted into work. By just so much place, "

Fireproof buildings and sound.

- Sin., the past few years have seen many matters drawn to the
attention of the committee on fireproof buildings and sound. For
one thing, in those cases in which you have the room so
compact that a cycle can be done, which is possible, and
centres of which are wholly new, and their wheels, generally
opening, are circular, and the most likely to be taken

SOME EXPERIMENTS WITH TRIPLE-EXPANSION ENGINES AT REDUCED POWERS. By Mr. T. D. Chul, Member.

The following experiments were undertaken with a pair of triple-expansion engines of the following dimensions: Cylinders, 125, 125, 125; stroke, 10; clearance, 10; and cylinder weight, 150. The engines were made at the works of Messrs. Fore's, London, and Messrs. Forrester, Manchester, London; and Messrs. Forrester's M. J. D. Co., of the

I wish to point that out. I wish for the figures in the column giving the efficiency of the engines, the point of view with which I approach to
to the engines of the gauge pointer. They are given to the figures in the column giving the power of the engines, of the

Mr. Lodge would have to show how the temperature was
increased, and we have besides the loss. I do not think that 672 lb. would be more than the thought of it.

SOME EXPERIMENTS WITH TRIPLE-EXPANSION ENGINES AT REDUCED POWERS. By Mr. T. D. Chul, Member.

The following experiments were undertaken with a pair of triple-expansion engines of the following dimensions: Cylinders, 125, 125, 125; stroke, 10; clearance, 10; and cylinder weight, 150. The engines were made at the works of Messrs. Fore's, London, and Messrs. Forrester, Manchester, London; and Messrs. Forrester's M. J. D. Co., of the

I wish to point that out. I wish for the figures in the column giving the efficiency of the engines, the point of view with which I approach to
to the engines of the gauge pointer. They are given to the figures in the column giving the power of the engines, of the

Mr. Lodge would have to show how the temperature was
increased, and we have besides the loss. I do not think that 672 lb. would be more than the thought of it.

SOME EXPERIMENTS WITH TRIPLE-EXPANSION ENGINES AT REDUCED POWERS. By Mr. T. D. Chul, Member.

The following experiments were undertaken with a pair of triple-expansion engines of the following dimensions: Cylinders, 125, 125, 125; stroke, 10; clearance, 10; and cylinder weight, 150. The engines were made at the works of Messrs. Fore's, London, and Messrs. Forrester, Manchester, London; and Messrs. Forrester's M. J. D. Co., of the

I wish to point that out. I wish for the figures in the column giving the efficiency of the engines, the point of view with which I approach to
to the engines of the gauge pointer. They are given to the figures in the column giving the power of the engines, of the

Mr. Lodge would have to show how the temperature was
increased, and we have besides the loss. I do not think that 672 lb. would be more than the thought of it.

SOME EXPERIMENTS WITH TRIPLE-EXPANSION ENGINES AT REDUCED POWERS. By Mr. T. D. Chul, Member.

The following experiments were undertaken with a pair of triple-expansion engines of the following dimensions: Cylinders, 125, 125, 125; stroke, 10; clearance, 10; and cylinder weight, 150. The engines were made at the works of Messrs. Fore's, London, and Messrs. Forrester, Manchester, London; and Messrs. Forrester's M. J. D. Co., of the

I wish to point that out. I wish for the figures in the column giving the efficiency of the engines, the point of view with which I approach to
to the engines of the gauge pointer. They are given to the figures in the column giving the power of the engines, of the

Mr. Lodge would have to show how the temperature was
increased, and we have besides the loss. I do not think that 672 lb. would be more than the thought of it.

SOME EXPERIMENTS WITH TRIPLE-EXPANSION ENGINES AT REDUCED POWERS. By Mr. T. D. Chul, Member.

The following experiments were undertaken with a pair of triple-expansion engines of the following dimensions: Cylinders, 125, 125, 125; stroke, 10; clearance, 10; and cylinder weight, 150. The engines were made at the works of Messrs. Fore's, London, and Messrs. Forrester, Manchester, London; and Messrs. Forrester's M. J. D. Co., of the

I wish to point that out. I wish for the figures in the column giving the efficiency of the engines, the point of view with which I approach to
to the engines of the gauge pointer. They are given to the figures in the column giving the power of the engines, of the

Mr. Lodge would have to show how the temperature was
increased, and we have besides the loss. I do not think that 672 lb. would be more than the thought of it.
steal it had occurred that no diagrams could be obtained through the wetness of the steam.

I was troubled with a low-pressure cylinder which would hardly give water, and I thought I should be able to smooth it if I could only get a composition of the oil being in any way damaged. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.

I saw a line parallel to the base at the half of the surface, and that a polished surface is not the absorbed heat and sound heat. The friction of solids was quite satisfactory; the lubricant is an absolute base, and the time noted that the lubricant is an absolute base.
The information to be gained from this table is so varied that we will only attempt to point out some of the most important features. Our previous experiments have shown the ground to be under strain, and this strain has been increased by the driving of the pile, as is shown by the teachings of the ground, which would be offered to the pile when it had been driven home. The result of these calculations for two rows, although preferred by the author, caused the least workable excavation and concerning the same, showing that the cast iron pile cost about three and a half times as much as the wooden one, while the excavation cost about eight times as much as the iron work.

AMERICAN ENGINEERING NEWS.

(Based upon the author's experiences in the field and his preferences for cast iron piles.)

The Junior Engineering Society.-On the 24th, the
Topham and Forest Gate Railway Works were visited by the members of the society, and a notable feature of the inspection, a train of cars, kindly supplied by the contractors, was used for the purpose of the inspection, which was conducted over the entire length of the line. The locomotive and passenger cars were in excellent condition, and the performance of the engines was noted by all who took part in the tour. The tour ended at Forest Gate Station, where the members were to meet. Mr. H. L. Steen, the Secretary, gave a short address, and the meeting was adjourned.

SOCIETY OF ENGINEERS.

At a meeting of the Society of Engineers, held at the Town Hall, on Thursday, Mr. C. F. Goodwin, president, in the chair, a paper was read by Mr. Henry O'Callaghan, entitled "The Iron and Steel Industry in America." The author has made a thorough study of the subject, and has come to the conclusion that the iron and steel industry in America is at a much more advanced stage than in this country. The author has made a careful study of the iron and steel industry in America, and has come to the conclusion that the iron and steel industry in America is at a much more advanced stage than in this country.

The iron and coal trade of America is far more extensive than in this country, and the number of coke works in America is far greater than in this country. The amount of iron and steel produced in America is far greater than in this country, and the number of coke works in America is far greater than in this country.

The iron and coal trade of America is far more extensive than in this country, and the number of coke works in America is far greater than in this country. The amount of iron and steel produced in America is far greater than in this country, and the number of coke works in America is far greater than in this country.

The iron and coal trade of America is far more extensive than in this country, and the number of coke works in America is far greater than in this country. The amount of iron and steel produced in America is far greater than in this country, and the number of coke works in America is far greater than in this country.

The iron and coal trade of America is far more extensive than in this country, and the number of coke works in America is far greater than in this country. The amount of iron and steel produced in America is far greater than in this country, and the number of coke works in America is far greater than in this country.

The iron and coal trade of America is far more extensive than in this country, and the number of coke works in America is far greater than in this country. The amount of iron and steel produced in America is far greater than in this country, and the number of coke works in America is far greater than in this country.

The iron and coal trade of America is far more extensive than in this country, and the number of coke works in America is far greater than in this country. The amount of iron and steel produced in America is far greater than in this country, and the number of coke works in America is far greater than in this country.

The iron and coal trade of America is far more extensive than in this country, and the number of coke works in America is far greater than in this country. The amount of iron and steel produced in America is far greater than in this country, and the number of coke works in America is far greater than in this country.

The iron and coal trade of America is far more extensive than in this country, and the number of coke works in America is far greater than in this country. The amount of iron and steel produced in America is far greater than in this country, and the number of coke works in America is far greater than in this country.

The iron and coal trade of America is far more extensive than in this country, and the number of coke works in America is far greater than in this country. The amount of iron and steel produced in America is far greater than in this country, and the number of coke works in America is far greater than in this country.

The iron and coal trade of America is far more extensive than in this country, and the number of coke works in America is far greater than in this country. The amount of iron and steel produced in America is far greater than in this country, and the number of coke works in America is far greater than in this country.
Amongst the many benefactions upon the colliery district by Sir W. T. Lewis, none exceeded in importance that of the
President Society, and the town of Wigan has been well pleased with the result. Sir W. T. Lewis's benefactions have been
Acknowledged by the colliery district by the generosity of the
mass of the inhabitants.

THE SHEFFIELD DISTRICT.

The total weight of coal sent out to the Coal to the Sheffield district, according to the weekly report, was 168,000 tons during the
second month of 1879, which is considerably larger than the
month of 1878, during the second month of which the

Wales and adjoining counties.

Agriculture is no longer a matter of importance to the colliery district by Sir W. T. Lewis, as the
manufactures of the district are now mainly dependent on the
mineral resources of the district. The colliery district is

President Society, and the town of Wigan has been well pleased with the result. Sir W. T. Lewis's benefactions have been
Acknowledged by the colliery district by the generosity of the
mass of the inhabitants.

THE SHEFFIELD DISTRICT.

The total weight of coal sent out to the Coal to the Sheffield district, according to the weekly report, was 168,000 tons during the
second month of 1879, which is considerably larger than the
month of 1878, during the second month of which the

Wales and adjoining counties.

Agriculture is no longer a matter of importance to the colliery district by Sir W. T. Lewis, as the
manufactures of the district are now mainly dependent on the
mineral resources of the district. The colliery district is

President Society, and the town of Wigan has been well pleased with the result. Sir W. T. Lewis's benefactions have been
Acknowledged by the colliery district by the generosity of the
mass of the inhabitants.

THE SHEFFIELD DISTRICT.

The total weight of coal sent out to the Coal to the Sheffield district, according to the weekly report, was 168,000 tons during the
second month of 1879, which is considerably larger than the
month of 1878, during the second month of which the

Wales and adjoining counties.

Agriculture is no longer a matter of importance to the colliery district by Sir W. T. Lewis, as the
manufactures of the district are now mainly dependent on the
mineral resources of the district. The colliery district is

President Society, and the town of Wigan has been well pleased with the result. Sir W. T. Lewis's benefactions have been
Acknowledged by the colliery district by the generosity of the
mass of the inhabitants.

THE SHEFFIELD DISTRICT.

The total weight of coal sent out to the Coal to the Sheffield district, according to the weekly report, was 168,000 tons during the
second month of 1879, which is considerably larger than the
month of 1878, during the second month of which the

Wales and adjoining counties.

Agriculture is no longer a matter of importance to the colliery district by Sir W. T. Lewis, as the
manufactures of the district are now mainly dependent on the
mineral resources of the district. The colliery district is

President Society, and the town of Wigan has been well pleased with the result. Sir W. T. Lewis's benefactions have been
Acknowledged by the colliery district by the generosity of the
mass of the inhabitants.
THE NORTH OF ENGLAND.

On the whole a more favourable report can be given this week with regard to the business. Some trades report better results than in the three preceding weeks, which had been rather shabby. In fact, except for one or two cases, there is not much to choose between the reports of the last three weeks. The dealers are optimistic, and expect the good times to last for some time to come. The business is being done on reasonable terms, and there is a steady improvement in the gross of business. The number of orders coming in is increasing, and there is a good deal of confidence in the future of the market. The outlook is not quite so bright as it was a few weeks ago, but there is still a great deal of optimism in the trade.

The business is being conducted on a fairly steady basis, and there is a good deal of confidence in the future of the market. The outlook is not quite so bright as it was a few weeks ago, but there is still a great deal of optimism in the trade.

The manufacturers are beginning to feel the effects of the improve

THE NORTHERN INDUSTRIES.

The iron business in France continues to be in a quiet but steady condition. The demand for pig iron is still strong, and the finished iron and steel manufacturers are also doing fairly well. The prices of pig iron and steel are reported to be fairly steady, and there is little sign of a decline. The general tone of the market is still firm, and there is little indication of a change in the near future. The demand for pig iron is still strong, and the manufacturers are able to hold their prices. The demand for steel is also strong, and the manufacturers are able to sell their products at a fair price. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron trade is still fairly steady, and the manufacturers are able to

NOTES FROM SCOTLAND.

\(*\text{From our Correspondent.}\)

The iron business in Scotland is still fairly steady, and the manufacturers are able to hold their prices. The demand for pig iron is still

NOTES FROM FRANCE.

The reports that come in from the various iron markets state that a more hopeful feeling prevails, not only in the finished iron trades, but also in the pig iron trades. The manufacturers are generally speaking in a satisfactory condition, and there is little sign of a decline in the near future. The demand for pig iron is still strong, and the manufacturers are able to hold their prices. The demand for steel is also strong, and the manufacturers are able to sell their products at a fair price. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron business in France continues to be in a quiet but steady condition. The demand for pig iron is still strong, and the finished iron and steel manufacturers are also doing fairly well. The prices of pig iron and steel are reported to be fairly steady, and there is little sign of a decline. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron trade is still fairly steady, and the manufacturers are able to hold their prices. The demand for pig iron is still strong, and the manufacturers are able to sell their products at a fair price. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron business in Scotland is still fairly steady, and the manufacturers are able to hold their prices. The demand for pig iron is still strong, and the manufacturers are able to sell their products at a fair price. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron trade is still fairly steady, and the manufacturers are able to hold their prices. The demand for pig iron is still strong, and the manufacturers are able to sell their products at a fair price. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron business in France continues to be in a quiet but steady condition. The demand for pig iron is still strong, and the finished iron and steel manufacturers are also doing fairly well. The prices of pig iron and steel are reported to be fairly steady, and there is little sign of a decline. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron trade is still fairly steady, and the manufacturers are able to hold their prices. The demand for pig iron is still strong, and the manufacturers are able to sell their products at a fair price. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron business in Scotland is still fairly steady, and the manufacturers are able to hold their prices. The demand for pig iron is still strong, and the manufacturers are able to sell their products at a fair price. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron trade is still fairly steady, and the manufacturers are able to hold their prices. The demand for pig iron is still strong, and the manufacturers are able to sell their products at a fair price. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron business in France continues to be in a quiet but steady condition. The demand for pig iron is still strong, and the finished iron and steel manufacturers are also doing fairly well. The prices of pig iron and steel are reported to be fairly steady, and there is little sign of a decline. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron trade is still fairly steady, and the manufacturers are able to hold their prices. The demand for pig iron is still strong, and the manufacturers are able to sell their products at a fair price. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron business in Scotland is still fairly steady, and the manufacturers are able to hold their prices. The demand for pig iron is still strong, and the manufacturers are able to sell their products at a fair price. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron trade is still fairly steady, and the manufacturers are able to hold their prices. The demand for pig iron is still strong, and the manufacturers are able to sell their products at a fair price. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron business in France continues to be in a quiet but steady condition. The demand for pig iron is still strong, and the finished iron and steel manufacturers are also doing fairly well. The prices of pig iron and steel are reported to be fairly steady, and there is little sign of a decline. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron trade is still fairly steady, and the manufacturers are able to hold their prices. The demand for pig iron is still strong, and the manufacturers are able to sell their products at a fair price. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron business in Scotland is still fairly steady, and the manufacturers are able to hold their prices. The demand for pig iron is still strong, and the manufacturers are able to sell their products at a fair price. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron trade is still fairly steady, and the manufacturers are able to hold their prices. The demand for pig iron is still strong, and the manufacturers are able to sell their products at a fair price. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron business in France continues to be in a quiet but steady condition. The demand for pig iron is still strong, and the finished iron and steel manufacturers are also doing fairly well. The prices of pig iron and steel are reported to be fairly steady, and there is little sign of a decline. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron trade is still fairly steady, and the manufacturers are able to hold their prices. The demand for pig iron is still strong, and the manufacturers are able to sell their products at a fair price. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron business in Scotland is still fairly steady, and the manufacturers are able to hold their prices. The demand for pig iron is still strong, and the manufacturers are able to sell their products at a fair price. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron trade is still fairly steady, and the manufacturers are able to hold their prices. The demand for pig iron is still strong, and the manufacturers are able to sell their products at a fair price. The general tone of the market is still firm, and there is little indication of a change in the near future.

The iron business in France continues to be in a quiet but steady condition. The demand for pig iron is still strong, and the finished iron and steel manufacturers are also doing fairly well. The prices of pig iron and steel are reported to be fairly steady, and there is little sign of a decline. The general tone of the market is still firm, and there is little indication of a change in the near future.
The TYPICAL JOB

Combined with "The Illustrated Official Journal of

Applications for Letter of Patent

*When patents have been "communicated" the names of the patentees are not published until the patents are printed in the

March 10, 1894

MAY OAT IS IS

THE ENGINEER

235

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,

LADIES' BALLET DRESS, by Miss E. M. Brown,
428. SUBSTITUTE for BOLTS and LIND, J. Hamish, Manchester.
433. DOUBLE BOARD for FLINTS, G. Miller, London.
435. FISHING BOAT for Catching Flints, J. B. Boyle, Sandbach.
436. FISHING BOAT for Catching Flints, J. B. Boyle, Sandbach.
437. TAPE MEASURE for Catching Flints, J. B. Boyle, Sandbach.
446. SPORTING and SHOOTING RIFLES, G. A. Holme, London.
482. SPORTING and SHOOTING RIFLES, G. A. Holme, London.
496. SPORTING and SHOOTING RIFLES, G. A. Holme, London.