some useful invention, is not a promising investment? It at least is not a very extravagant one.

We all know of patents that have paid their millions, but we do not all know of the many thousands upon thousands of patents which have realized for their owners amounts varying from five thousand to fifty thousand dollars and upward. Contrast these realizations and the paltry outlay required with other investments, and where is the property which yields as large a return? That many patents do not pay is not always the fault of the invention, but not unfrequently is due to the want of proper commercial management, or to the clumsy form in which the invention, perhaps a very meritorious one, has been ushered to the public. But even these patents ultimately sometimes prove valuable, on account of the principle involved or some one particular construction or combination they cover, so that holders of subsequent patents are compelled to pay tribute, and it is never safe to consider a patent worthless because it is dormant. Its day, after the lapse of years even, may come unexpectedly.

Again, inventors frequently are at fault in not following up their inventions by fortifying the original patent with subsequent ones covering improvements in matters of detail. Nor should repeated failure discourage an inventor; for, if only one patent out of every ten pays, it will many times more than compensate for the cost of the ten. Not merely scientific men and mechanics, but men of leisure, will do well, then, to consider whether a patent, if only as a speculation, is not a cheap investment, even if the weightier consideration of advancing the cause of science or adding to human comfort, by ever so small a step, be altogether discarded.

VIBRATION OF RAILWAY BRIDGES.

It is not at all improbable that the coming railway engineer will design bridges and superstructures and machinery with a view to obviating the injury done to these structures by vibration caused by rolling stock in motion. To build a bridge capable of sustaining heavy loads is the aim of the engineer. He may accomplish this to his entire satisfaction so far as a dead weight is concerned; a tremendous load causes but little deflection, and the bridge is pronounced perfect. In one sense this would be a correct verdict, and yet it would not contain all the elements of a perfect bridge. The bridge is calculated to support a load much greater than it will ever be called upon to sustain, and the ordinary load will not strain any of its members by reason of the factor of safety. But when there is an undue or excessive vibration, the fibers are disturbed and a gradual weakening of the material is the result. To prevent vibration and unequal deflection it is important that the supports be made as uniform as possible. By making one portion of the rail support, whether on bridges or grade, stronger than another, the deflection being unequal, causes a vertical oscillation of rolling stock which is not only destructive to the stock but also to the substructure. This destruction arises not only from disturbance of foundations, but by reason of the tendency of long-continued vibration to separate the particles which constitute the mass of the material. We take a piece of tin, lead foil, annealed wire, or some similar metal, and bend it, and there is no perceptible injury or tendency to break, but we repeat the bending process between our thumbs and fingers, and pretty soon the fibers part and there is a break. This is precisely the case with an iron girder or other member of a bridge. Thus constant vibration has a tendency to weaken and destroy these structures, and to this may be assigned the cause of many mysterious and disastrous bridge failures. This vibration also tends to weaken joints and rivets, and unless the structure is under constant and thorough inspection disaster may occur. How to prevent excessive vibration is the question; but probably to follow the plan of the deacon in his construction of his "wonderful one-hoss shay," to "make each part as strong as the rest," would be as effective as any.

A cat, in walking along a large beam in a wood frame building has not the slightest effect on the structure; but let the feline take a lively trot on the beam, and the whole building trembles. A horse, in walking across a bridge, causes no perceptible vibration, but a trot gives it a thorough shaking up; and this vibration continues for some time after the animal has left the bridge. This vibration is more destructive than an excessive load moving slowly. A locomotive, in crossing a bridge at a high rate of speed, shakes the structure by the counterbalances on the driving wheels, precisely as the cat or the horse shakes the barn or the bridge.

The remedy for this, then, would seem to be to run slow over bridges, but this is obviously impossible with our high velocities on lines where bridges are frequently met with. It only remains, then, to prepare the bridges in all the details of construction to resist vibration as far as possible.

The above has reference to vertical disturbances; but the lateral strain, caused by the natural sway from side to side, which is the result of uneven surfaces, and the space left for lateral play between the flanges and the rails, is equally damaging to bridges. There is more or less lateral oscillation of rolling stock that cannot be avoided. This causes a series of vibrations in that direction which has the same tendency to weaken the members as the vertical disturbance.

It is claimed by good authority that long continued vibration crystallizes metal, which of course renders it unfit for service, and bridges that have seen long service should be examined to ascertain the exact state of the metal. The frequent breaking of rails is, no doubt, owing in a great measure to vibration as the primary cause. Many rails break near the ends, especially when the splices are loose and the ties near the joint and under it are "low." The ends of the rails being depressed by the wheels, spring back to their normal position, and vibrate with a singing noise like a huge tuning fork. If this looseness of joints continues long, a break is sure to follow. Oscillation produces vibration, which, in turn, produces crystallization, cracks, and breakages.

In a bridge, if one member is more exposed to vibration than another, it will in time become weakened, and the whole structure may fail mysteriously. A proper arrangement of stays and braces will prevent vibration, and this is a subject worthy the attention of engineers.

NAVAL AND COAST DEFENSE.

The annual reports of our military and naval authorities have lately given special emphasis to the well known facts that, though our relations with the rest of the world are friendly, war is ever liable to arise, and a sudden war would find our coasts utterly defenseless and our navy inadequate for any service likely to be put upon it.

A complete revolution has been wrought in the material and methods of naval and coast defense during the past fifteen years; and as a nation we have done little or nothing to keep ourselves abreast of the military and naval progress of the world. Meantime, our prolific inventors have been steadily at work devising new means and appliances of which the nations of Europe have not been slow to avail themselves; so that we as individuals have put into the hands of possible enemies the means of doing us fatal harm. Unless we bestir ourselves as a nation and begin to guard our rich and vulnerable seaports by defenses at once adequate for present needs and susceptible of easy strengthening as new needs may arise, the neglect may cost us in a day, in property destroyed and ransom demanded by a dashing enemy, more than it would have cost to make every seaport on the coast practically impregnable. The Chief of Engineers, General Wright, states the case very compactly when he says in his report:

"For many years no appropriations whatever have been made for the construction of new works or for the modifications of the old works which were built before the introduction of modern ordnance and armored ships, and which latter, although there were none better in their day, are now most of them utterly unfit to cope with modern ships of war. The earthen batteries more recently built in the positions which are available for such batteries in our harbors are generally in effective condition, though by reason of the late increase in the power of ordnance some of them should be strengthened by thickening the parapets and coverings of magazines. The casemated works of which our seaport defenses are necessarily largely composed were built when wooden walls were the only protection of guns afloat. Now ships of war are clad in armor up to two feet in thickness, and the old smooth-bores have been replaced by rifled guns, the largest of which throw shot of nearly a ton weight, and which burn at each discharge nearly a quarter of a ton of powder. While other maritime nations are adding to their already powerful navies heavily armored ships of war, which are armed with 81 and 100 ton guns, and which cost, exclusive of armament, more than $2,500,000, they are building armored defenses for the protection of their own coasts. Great Britain has already 500 guns in position behind armored defenses. We have not one such gun, nor have we any armored defenses whatever."

Approving of the position taken by the Chief of Engineers the Secretary of War lays proper stress upon the fact that "modern wars come on suddenly, that serious international disputes occur between nations the relations of which are apparently the most unlikely to be other than friendly, and that a condition of readiness for defense and an attitude of belligerency are sometimes the best preventives of actual war. We know that the necessary new works and the proper modifications of our old works will require many years for their completion, and it seems simply a matter of common prudence that we commence without delay and under liberal appropriations to put our coasts in an efficient condition of defense."

As to the means of coast defense the opinion of General Wright that the most efficient, most enduring, and least expensive are fortifications and torpedoes, is unquestionably the true one. One gun properly mounted and handled on land is as efficient as several guns of equal power afloat, owing to the greater certainty of aim.

An armored fort on land can have its power of resistance increased unlimitedly and much more rapidly than increased power of penetration can be given to guns. Not so with floating forts: their buoyancy is limited and their security is gone the moment a gun is made of greater penetration than they were built to withstand. Several fixed forts (whether simply revolving, or both revolving and movable about a defensive mole) can be built for the price of one sea-going ironclad mounting as many guns of like caliber; and the fixed fort is not liable to be enticed away, as ironclads are, leaving a harbor defenseless.

Our geographical position and general policy forbid offensive war on our part, thus relieving us absolutely of the need of building the huge sea going fortifications of the sort favored by European powers. This fact is clearly though grudgingly recognized in the recent report of the Naval Advisory Board, convened last summer to consider plans for the reconstruction or rather recreation of our Navy. They say:

"Since it was decided that iron clads must be left out of consideration, it became necessary to determine upon auxiliary means of defense, which, although not so far-reaching in their protection, should still hold foreign armored fleets in check until armored defense could be provided."

Naturally professional spirit led the Board to contemplate only floating "armored defenses," the best service of which, as we have seen, may more cheaply and efficiently be rendered by armored defense on land.

The auxiliary means of defense recommended by the Board for immediate construction are:

Two first-rate steel, double-decked, unarmored cruisers, having a displacement of about 5,873 tons, an average sea speed of fifteen knots, and a battery of four eight inch and twenty-one six-inch guns. Cost, $3,560,000.

Six first-rate steel, double decked, unarmored cruisers, having a displacement of about 4,560 tons, an average sea speed of fourteen knots, and a battery of four eight-inch and fifteen six-inch guns. Cost, $8,532,000.

Ten second-rate steel, single-decked, unarmored cruisers, having a displacement of about 3,043 tons, an average sea speed of thirteen knots, and a battery of twelve six-inch guns. Cost, $9,300,000.

Twenty fourth-rate wooden cruisers, having a displacement of about 793 tons, an average sea speed of ten knots, and a battery of one six-inch and two sixty-pounders. Cost, $4,360,000.

Five steel rams of about 2,000 tons displacement, and an average sea speed of thirteen knots. Cost, $2,500,000.

Five torpedo gunboats of about 450 tons displacement, a maximum sea speed of not less than thirteen knots, and one heavy powered rifled gun. Cost, $725,000.

Ten cruising torpedo boats, about one hundred feet long, and having a maximum speed of not less than twenty-one knots per hour. Cost, $38,000.

Ten harbor torpedo boats, about seventy feet long, and having a maximum speed of not less than seventeen knots per hour. Cost, $250,000.

With the exception of the cruising torpedo boats recommended, all of the proposed vessels would seem to be gravely inefficient with respect to sailing capacity. An unarmored cruiser carrying only light guns, if unable to overtake a first class merchant ship or run away from an armored vessel carrying heavier guns, would be of very little use in actual warfare. They might be comfortable for naval officers to cruise in in times of peace, for lying off popular summer resorts, or for picnicking along friendly foreign shores; but they would not do to rest national security and honor on in times of serious conflict. Instead of speeds of from ten to fifteen knots an hour, our unarmored cruisers should aim to be able to make, when occasion demanded, not less than eighteen knots, and from that to twenty-five knots. Both armored and unarmored war ships of thirteen knots and less have gone out of fashion the world over, and except in a war of grain ships and mackerel smacks, the proposed thirteen knot rams would be as useless as so many billy-goats.

Our cruisers should be built with special reference to staunchness and speed. With proper coast defenses we would not be likely to be involved in war with any nation likely to hurt us except in harrying our coast-wise commerce or the foreign merchant marine, which is to be developed, we trust, in the near future. Against such an attack the means of striking back in kind would be our best weapon. And the same fast cruisers, wind-wafted for the most part in time of peace, would be best adapted for the scientific, humane, and other peaceful occupations likely to engage them during most of their lives. Instead of idling at home or in foreign ports, we should like to see our navy always engaged in works of exploration scientific investigations at sea, or cruising up and down the great commercial routes for the protection and relief of mariners and travelers. They should hover upon the track of storms like Mother Carey chickens, in search of distressed or disabled merchant men; and the practical schooling in seamanship, pluck, and energy, which our naval officers and men would thus gain in times of peace, would stand us in good stead during the trying times of war, should war ever prove honorably unavoidable.

Salt in Diphtheria.

In a paper read at the Medical Society of Victoria, Australia, Dr. Day stated that, having for many years regarded diphtheria, in its early stage, as a purely local affection, characterized by a marked tendency to take on putrefactive decomposition, he has trusted most to the free and constant application of antiseptics, and, when their employment has been adopted from the first, and been combined with judicious alimentation, he has seldom seen blood poisoning ensue. In consequence of the great power which salt possesses in preventing the putrefactive decomposition of meat and other organic matter, Dr. Day has often prescribed for diphtheritic patients living far away from medical aid the frequent use of a gargle composed of a tablespoonful or more of salt dissolved in a tumbler of water, giving children who cannot gargle a teaspoonful or two to drink occasionally. Adults to use the gargle as a prophylactic or preventive, three or four times a day.

How Voltaire Cured the Decay of his Stomach.

In the "Memoirs of Count Segur," there is the following anecdote: "My mother, the Countess de Segur, being asked by Voltaire respecting her health, told him that the most painful feeling she had arose from the decay in her stomach and the difficulty of finding any kind of aliment that it could bear. Voltaire, by way of consolation, assured her that he was once for nearly a year in the same state, and believed to be incurable, but that, nevertheless, a very simple remedy had restored him. It consisted in taking no other nourishment than yolks of eggs beaten up with the flour of potatoes and water." Though this circumstance concerned so extraordinary a person as Voltaire, it is astonishing how little it is known and how rarely the remedy has been practiced. Its efficacy, however, in cases of debility, cannot be questioned, and the following is the mode of preparing this valuable article of fooa as recommended by Sir John Sinclair: Beat up an egg in a bowl, and then add six tablespoonfuls of cold water, mixing the whole well together; then add two tablespoonfuls of farina of potatoes; let it be mixed thoroughly with the liquid in the bowl; then pour in as much boiling water as will convert the whole thing into a jelly, and mix it well. It may be taken alone or with the addition of a little milk in case of stomachic debility or consumptive disorders.

PIG IRON BREAKER.

Among the exhibits at the American Institute Fair this fall, no machine attracted more attention than "Blake's pig iron breaker," exhibited by the Blake Crusher Company, of New Haven, Conn., the original patentees and manufacturers of the "Blake challenge rock breaker" of world-wide reputation. The pig iron breaker was designed and built in response to repeated solicitation from foundrymen and others for a machine to break pig iron into pieces, seven to eight inches in length, for foundry purposes.

Heretofore this has been done by hand, either by lifting the pig bodily and throwing it down on a V-shaped mass of iron or by striking with a sledge hammer. The work, especially in the case of the tougher varieties of iron, was necessarily severe, slow, and expensive. Repeated blows with a heavy sledge hammer wielded by a practiced hand would often fail to break a pig of iron. The pig iron breaker is strong and effective, and so simple that the illustrations of it which we present leave little to be desired in the way of explanation. The pig is fed in on an inclined or yielding trough, furnished with rolls, passed over a V-shaped knife to an adjustable stop on the end of the sliding head, A. This sliding head is provided with two knives, equidistant from the center knife on which the pig is supported, and has a motion of two inches.

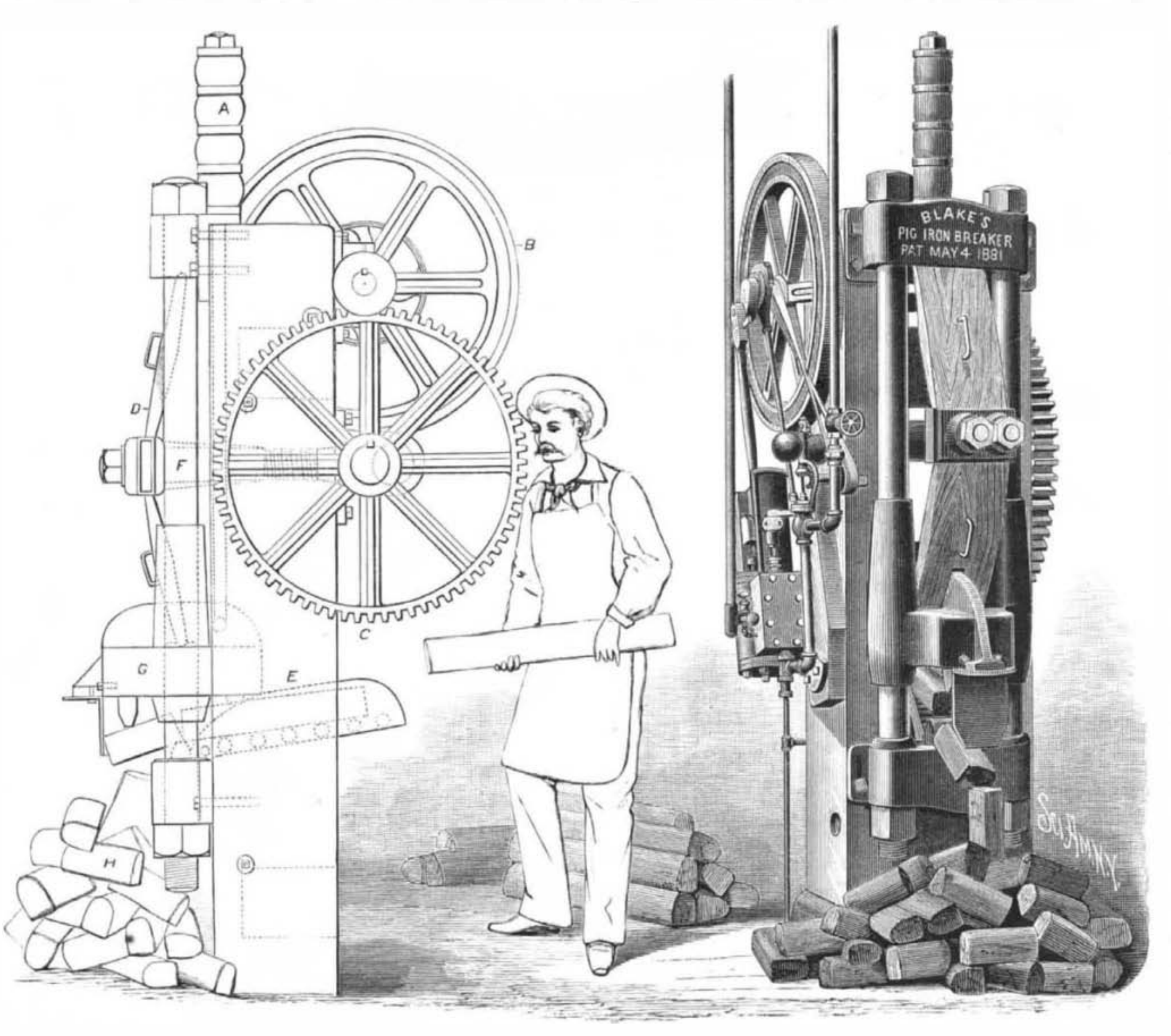
The sliding head descends, and a piece of the pig extending from the center bearing or knife to the "stop" is broken; it ascends, the pig is struck forward, and another piece is broken from the pig by its subsequent descent. In this way successive pieces are broken from the same pig with great rapidity and ease, with an expenditure of but from two to three horse power. In fact the product of the machine is limited only by the rapidity with which it is fed. Iron can be broken as rapidly as it can be discharged from the cart or car which brings it to the foundry yard.

The machine may be stationary and run by belt or by small engine bolted to the side of its timber frame, to which steam is conveyed by pipe from the boilers at the works where it is used, or it can be mounted on a car with engine and boiler and be moved on a track along the piles of iron to be broken.

The Blake Crusher Company is now mounting one in this way for the Albany and Rensselaer Iron and Steel Company, Troy, N. Y., where 500 tons are broken daily for making Bessemer steel. At present the pigs are broken by hand into but two pieces.

It is thought that the breaking of pigs into a greater number of pieces by machine will secure a more intimate admixture with the fuel and fluxes in the cupolas, greater economy not only in heating but in melting, and a greatly increased product of steel in the same number of hours.

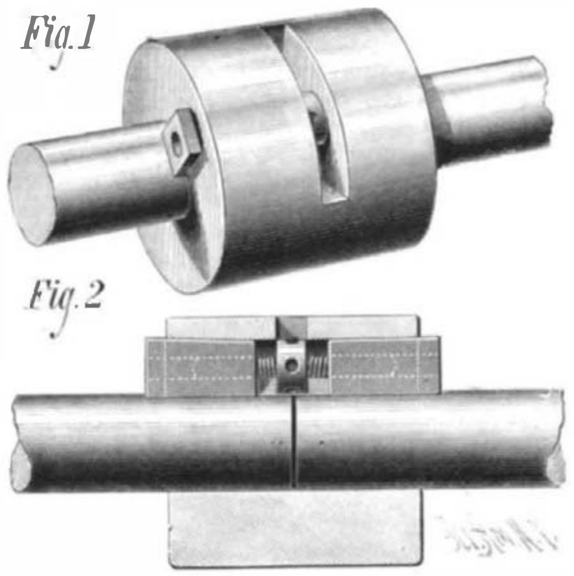
The machine is the invention of Theodore A. Blake, Mining Engineer and Secretary of the Blake Crusher Company, New Haven; was patented May 3, 1881, in the United States, also in England. It received the award of "medal of excellence" at the recent fair of the American Institute, where the Blake Crusher Company was awarded the semi-centennial gold medal for their challenge rock breaker.



BLAKE'S PIG IRON BREAKER.

IMPROVED SHAFT COUPLING.

We give an engraving of an improved shaft coupling lately patented by Messrs. J. B. Dyson & S. K. Paramore, of New Britain, Conn. It is very simple, easily constructed and easily applied, and when it becomes necessary to disconnect the shafts it is easily removed. The adjacent ends of two shafts are inserted in a sleeve which fits the shafts and has a longitudinal groove formed in its inner surface. This groove is tapered or inclined on the top from its ends toward its center, as shown in the sectional view, Fig. 2.



NOVEL SHAFT COUPLING.

Two keys, corresponding in shape to the groove, fit against the inclined bottom of the groove. The inner sides of the keys are concaved or flat to rest upon the sides of the two shafts. One key has a right screw hole and the other a left screw hole cut through it, into which fit the threads of the right and left screw, whose middle part has a collar formed upon it in which are formed a number of radial holes to receive the end of a pin to serve as a lever or handle for turning the screw.

When the screw is turned in one direction the keys are drawn inward toward each other, and clamp the ends of the shafts securely, and when the screw is turned in the other direction the keys are pushed outward, releasing the shafts. It will be noticed that the sleeve is slotted transversely opposite the collar of the screw to allow the lever or operating handle to be inserted in the holes in the collar and turn the screw. It is unnecessary to mention the advantages possessed by this coupling, as it can readily be seen that it is in every particular a practical thing.

The American Public Health Association.

The American Public Health Association, in session at Savannah, Georgia, December 1, elected the following officers: President, Professor R. C. Kedzie, of Michigan; First Vice-President, Dr. Ezra M. Hunt, of New Jersey; Second Vice-President, Dr. Albert L. Gebon, U.S.N.; Treasurer, Dr. J. Berrier Lindsley, of Tennessee; Executive Committee—Dr. James E. Reeves, West Virginia; Dr. Stephen Smith, New York; Dr. Thomas L. Neal, Ohio; Dr. J. G. Thomas, Georgia; Edward Fenner, Louisiana; and Dr. John H. Rauch, Illinois. The papers read at this meeting have covered, as usual, a wide range of topics relating to public sanitation. The meeting next year will be at Indianapolis.

The King of Siam to the United States.

General Halderman, our Consul General in Siam, has received from His Majesty the King of that far off country a promise to furnish a memorial stone for the Washington National Monument.

Another Great Ocean Steamer.—The Servia.

The new Cunard steamship Servia arrived at this port Dec. 7, after a stormy passage of thirteen days. For the first seven days she had to buffet severe head winds, at times approaching a hurricane. Her best day's run was on the 6th, when she made 406 miles. Her gross tonnage is 8,500 tons; engine power, 10,000 horse power.

The length of the Servia is 533 feet; breadth, 52 feet; depth, 44 feet 9 inches. Her cargo capacity is 6,500 tons, with 1,800 tons of coal, and 1,000 tons water ballast. She has a double bottom on the longitudinal bracket system. The anchor davits are 8 inches and the chain cable pipe 22 inches in diameter. The propeller shaft weighs 26½ tons, and the propeller, boss, and blades are 38 tons in weight. The machinery consists of three cylinder compound surface condensing engines, one cylinder being 72 inches and two 100 inches in diameter, with a stroke of piston of 6 feet 6 inches. Her boilers are seven in number, 6 of them double and 1 single ended, all made of steel. She has 39 corrugated furnaces. There are 168 state rooms, with accommodation for 450 first class and 600 steerage passengers, besides a crew of 200 officers and men. The ship is divided into nine watertight bulkheads, and carries twelve life-boats. In the engine and boiler spaces are water-tight doors which can be shut from the upper deck in case of accident in about two seconds. The keel of the ship has five thicknesses, making a total thickness of 6¾ inches. The riveting was done by Tweedell's hydraulic riveter, and all the frames and beams of the vessel were riveted by this process. The lower deck is of steel, with a covering of teak above the engine and boiler spaces, and the upper and main decks are both of steel with wood coverings. All the deck houses and deck fittings, the positions of which render them liable to be carried away during heavy weather, are riveted to the steel decks underneath.

The Servia is equipped with Muir & Caldwell's steam steering gear, steam winches, a steering gear independent of that managed by steam apparatus, and Sir William Thomson's compasses. Every separate passage in the vessel is ventilated by a series of ventilators. The cabins and saloons are heated by steam. The construction of the Servia was superintended by Captain Watson, of the Cunard service, and Mr. William Muir, the company's engineer at Glasgow. In every part of the ship the most advanced scientific improvements have been adopted. The very best material has been used.