motion of the treadles or the momentum of the balance wheel. The invention consists of a seat and treadles arranged so that the operator can easily apply the weight of the body upon the latter, of novel attachments for slackening and tightening the driving belt, and for arresting and restoring motion to the needle bar.

Mr. John Connelly, of Hallowell, Me., has patented improvements in sewing-machines, which relate to a permanent attachment for sewing-machines of a certain class, the function of which is to aid in removing the shuttle from the raceway. It consists of a spring-plunger or lifting-rod, attached to the oil pan of a sewing-machine beneath the raceway, so that it is made available in raising the shuttle when it is to be removed.

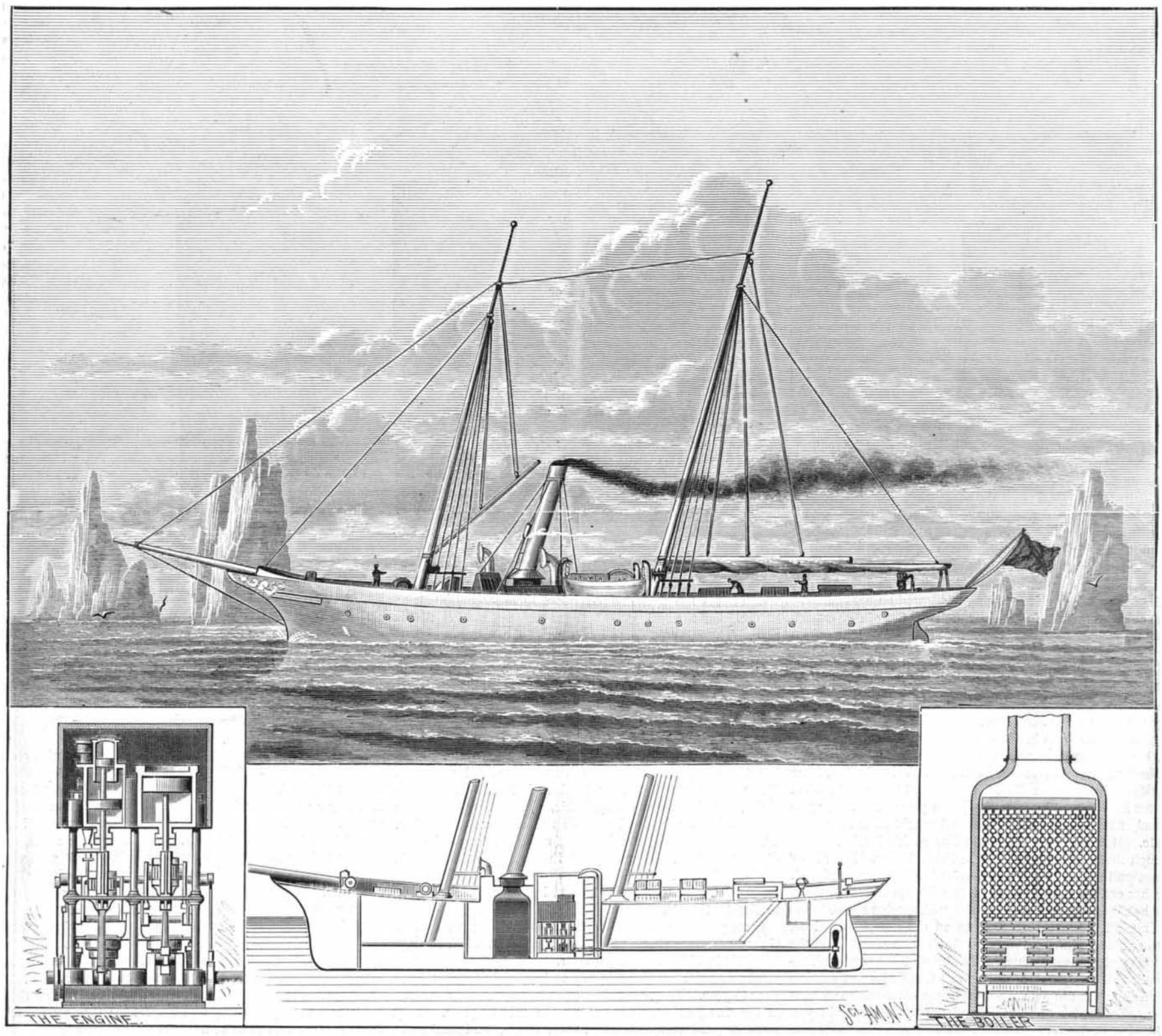
THE ANTHRACITE.

THE LITTLE STEAMER WHICH IS RUN BY ONE POUND OF COAL PER HORSE POWER PER HOUR.

The recent arrival of this little vessel in New York Harbor has excited an unusual degree of interest among engineers. Those interested in running marine boilers and engines are curious to know all the particulars regarding the machinery of the craft, which gives a practical illustration of the attainment of the greatest economy in fuel ever yet reached. We therefore present the accompanying engraving illustrating the general appearance of the steamer, and give outlines of her machinery, showing the proportionate space it takes up in the vessel. In former numbers of the SCIENTIFIC AMERICAN, as well as of the SUPPLEMENT, we have given some of the leading particulars regarding her construction, and have illustrated and described the Perkins system of utilizing steam at high pressures, and we now present some details not before given.

Of the 84 feet length of the Anthracite, her engines, furnaces, and boilers take up a space of 22 feet 6 inches, leaving a hatchway, kitchen, and forecastle cabin in the forepart of the boat, besides a water-tight bulkhead, which takes up 5 or 6 feet; abaft the engines are three cabins, with extra sleeping bunks beside the hatchway, and a water-tight bulkhead in the stern. The screw is of the ordinary fish tail pattern, with two blades. Her gross tonnage is 70·26 tons, and her registered tonnage 27·91 tons. Her average consumption of coal since she left England, on the voyage thence to Newfoundland, and from there here, has been one ton of coal a day, Welsh bituminous coal having been burned on the voyage. The weather was very rough coming out, consequently the sails could be used but little, and she is not remarkably well fitted for sailing, but her lines are such that she is well adapted to outride the roughest sea. The counter which registers the revolutions of her screw was set at 0 before she left England, and now marks 3,980,000. She has hitherto burned only bituminous coal, but it is intended to test the economy of using anthracite. In the voyage over the furnace was operated without any artificial blast, the natural draught only being used, but there is a fan blower connected with it which can be brought into use if increased consumption of fuel and a proportionately higher pressure of steam are desired.

The peculiarity of the machinery which effects the great economy of fuel lies solely in the means employed for using steam at very high pressures safely, and without undue wear or strain. The average boiler pressure on the voyage over was from 350 to 400 pounds to the square inch, but the boilers had previously been tested up to 2,500 pounds per square inch by hydraulic pressure, this pressure having been maintained for some time without showing any defects whatever. The body of the boiler consists of a series of horizontal tubes, welded up at each end, and connected together by a vertical tube, and the several sections are connected by a vertical tube to the top ring of the fire box, and by another to the steam collecting tube. The fire box is formed of tubes bent into a rectangular shape. The boiler is surrounded by a double casing of thin sheet iron, filled up with non-conducting material to prevent loss of heat. The cylinders and valve boxes are steam jacketed, and further protected by jackets of non-conducting material, so that, although all the parts are kept at a high temperature, the heat given out in the engine and fire room is much less than is usual with ordinary marine engines. The sections of tubes of the boiler are connected so that any one of the sections may be taken out and replaced without interfering with the others, and in case of any accident causing a rupture of one of the tubes, the comparatively small amount of steam liberated would escape up the smoke stack, while the remaining sections of tubes could be used with increased pressue to make good the loss. Very little water is lost in operating these boilers and engines. All the joints and valves are practically very nearly perfect. The steam generated is constantly and completely condensed in a surface condenser, and the water is reused; the loss of water is extremely small, and the additions required are easily provided for. Under these circumstances there is no deposit or scale inside the boiler, and the wear of the boiler is very slow. One built and operated on this principle, which was taken to pieces after twelve years' use, showed no appreciable effects of use. The steam required for the whistle, and also that for cooking, is generated in a small supplementary boiler heated by a coil from the main boiler, the coil being placed inside the boiler and in contact with the sea water, from which the steam is made. The steam coming from the main boiler is returned to the condenser to be reused in the boiler.



THE ANTHRACITE THE SMALLEST STEAMER THAT EVER CROSSED THE OCEAN.

The difficulty arising from friction and imperfect joints in practically working machinery at high pressures was one of the most serious obstacles encountered in developing this system. The inventor, after a long series of experiments, adopted an anti-friction alloy, of which the packing rings and internal rubbing surfaces are made. No lubrication is required beyond that furnished by the steam. The inventor states that cylinders fitted with piston rings made of this metal have been several years at work, the cylinders showing no signs of wear, the only wear occurring on the rings, which may be easily and cheaply replaced. Not only is the cost of oil and grease thus saved, but the destructive action on the machinery and boiler of the acids generated from lubricants is avoided.

For the use of steam at these high pressures three differ-

cnt sized cylinders are employed, all jacketed with spiral tubes cast in the metal, which are supplied with steam direct from the boilers, and keep up the temperature of the cylinders. The first and second cylinders are arranged one above the other, and their pistons are connected to a common piston rod. The operation is thus described by Mr. Loftus Perkins, the inventor, in a paper read before the Institution of Mechanical Engineers, London:

"The high pressure steam is introduced into the upper end of the first cylinder, where there is no gland, and where the piston is formed so as to require no lubricating material. The steam is cut off at about half stroke in this cylinder, and when it is admitted for the return stroke into the bottom of the second cylinder, of four times the area, the temperature is so much reduced as to cause no difficulty when brought into contact with the piston rod gland. From the bottom of the second cylinder the steam expands into the top of the same cylinder, which is of larger capacity than the bottom, and serves as a chamber, and is in direct communication with the valve box of the third cylinder; this last is double-acting, and is arranged to cut off at about a quarter stroke, and at the termination of the stroke exhausts into the condenser, with a total expansion of about thirty-two times."

Although it has been some years since Mr. Perkins began to advocate the merits of this system, and he has taken out many patents covering his inventions connected therewith, the difficulties attending its practical working, and the disposition to oppose it of those who had enormous sums invested in old style machinery, have thus far prevented its general adoption, although in several cases in England it has been successfully introduced. The boilers and engines of the Anthracite contain all the latest improvements of the inventor, and it is believed they afford a practical demonstration of the entire success of the Perkins system, and show how all stationary and marine engines can be run at an expense of less than one-half the present cost for fuel. Two and a half pounds of coal per horse power per hour is now considered very economical running, and some of our best managed ocean steamers use one hundred tons of coal a day in their voyages. To demonstrate the practicability of reducing this more than one-half, thereby not only saving the cost of fuel, but giving so much more space for freight, is the purpose of the visit of the Anthracite to our waters.

STATEN ISLAND AND OYSTERS.

[*Continued from page* 65.]

As soon as attention was turned to the necessity of cultivation, the Legislature was applied to. Laws have been enacted that allow each individual to take up three acres in his own name. The occupant must stake out and clearly mark the ground, and plant the same with not less than fifty bushels of seed oysters within six months, or he forfeits his right to hold it. Those owning land along the shore have the first right to the ground in front of them. No oysterman is allowed to take fish in any county but his own, nor anywhere on public beds, between the 15th of June and the 15th of September. No dredging is allowed on natural beds. The cultivators have found so much of their labor experimental that they have earnestly resisted all efforts to tax them for their grounds. They look upon a tax as a burden that would overweigh and seriously check their industry. The owners of grounds buy their seed from men who obtain it from natural beds. These men, by the hundreds, are engaged in procuring such seed. It is their business only, as they hire out to help in other things during the season that the law forbids their working upon natural beds.

Most of the cultivated ground lies in Prince's Bay, New York Bay, and Raritan Bay. The natural beds are found in Staten Island Sound, the Kills, and in parts of the bays previously named. Much seed is also brought from out of the State. Many of the cultivators live at Mariner's Harbor, though their oyster farms are in Prince's Bay. Near New Dorp, on this bay, Mr. Petler has built a fine summer hotel. He has endeavored to surround it with special attractions. He has fitted up one room as the "Pompeian room." He has made it to resemble a room in an old Pompeian palace, having obtained many things to do it with direct from the remains of ancient Pompeii. In this vicinity was the Vanderbilt home. It was a "pirogua" that Cornelius Vanderbilt first aspired to own when he began his career as a boat man. To this island of his birth he always remained loyal.

Most of the oysters grow for three or four years on ground that is a little muddy. They are moved the spring before using to a hard and sandy bottom. They are taken up by tongues or dredges, culled and put into floats, and taken where they may have an infusion of fresher water, and then to the markets. Most of the Staten Island oysters have to to taken up near Rahway for the freshening. They are usually left in the floats there over one tide.

Sail boats or yachts are almost universally used. One cultivator has lately procured a small steamer. The harbor of New York abounds in tugboats. Their captains have an understanding with the oystermen; so, if the wind is unfavorable or the tide, they hitch on and pull the oyster boats up to the city. For pay the oystermen keep the tugmen supplied with oysters. These boats carry all the way from one to four hundred bushels at each trip. The Staten Island men are considerably annoyed by persons from New Jersey oystering in their waters. So far they have failed to secure a very effectual check to this.

Thirty years ago the oysters were prepared for market by men and boys handling them all over to sort them. Workmen stood in the water even in the coldest weather beside a pile of oysters and sorted them into a boat. Then it took fifteen persons all day to get a boat ready. It involved great exposure and hardship. Some years ago an old man straightened himself up after such a job, saying he could stand it no longer. He contrived a fork, at first a little straight-tined affair, with a guard at the top to prevent the oysters falling off. It at once took with the men. All quickly provided themselves The day of hand culling was over. The fork was gradually improved in size and shape, until it has reached a very perfect and complete form. Now with this aid two men can accomplish more in two hours than fifteen men formerly did in a whole day.

The beds here are in shoaler water than on the Connecticut shore. But the full and swift tides render them a protection from ice in winter, and some other troubles of shoal water in more quiet seas.

Stars and drills have at times been a trouble, but their greatest enemy has been the "drum fish." When the oysterman hears him "booming" over his grounds he trembles for his property; for this fish will crunch up oysters as cattle will apples or clover. The "moss-bunker" fishermen are now catching many of them, and thus rendering good service to the oyster cultivators.

Every planter has from five to ten men in his constant employ. He also hires others for short periods from time to time. It will be seen that considerable numbers of the people living around the shores of Staten Island are working at some part of the oyster business. Quite a good many colored families live at New Dorp and Prince's Bay. Most of these find steady work in this line. Seed oysters are found in considerable quantities from Rossville, on the northwest shore, up to Elizabethport, New Jersey. The same is true around Schuten's Island, and from Kill von Kull down to Port Richmond.

Important facts are to be noted in the conclusions to which their long experience has led the Staten Island oyster cultivators.

1. They think their planting grounds need rest every few years. An element in the mud or sand, needful for producing good oysters, becomes exhausted by successive crops. To then leave the ground bare for a year or two enables it to regain that element anew.

2. The continual working of the ground produces many "poppy" mud holes. These are holes where the mud has become so soft and slimy it kills all that is put upon it. A year or two of rest allows the action of the water to fill up and "heal" over such holes.

Some say the "poppy" mud holes render the ground poisonous to the oyster. They note this condition by finding an increasing number of black-meated oysters, and soon after many dead ones. Ceasing all work there for one or two years they can then plant anew with an assurance of success.

3. The ground is affected by the change from winter to summer. Though no frost is in the bottom of the sea, yet there seems to be a certain hardness of the mud or sand which holds the oysters and renders them more difficult to secure. As the spring opens the men see a marked difference. There is an evident loosening of the bottom much as takes place in the upland as the frost comes out of it.

4. A wet summer is much more favorable to the growth and quality of oysters than a dry season. This partly accounts for the varying quality of oysters produced in the same waters. Thus, a year ago, New York Bay oysters were much better than usual.

5. One peculiarity is found in Staten Island oysters, making them superior to most others for several purposes. Their shells are unusually hard and firm, and preserve their meats better than other kinds. Therefore they can be shipped farther in good condition than almost any other. They are in considerable demand for the foreign and other distant markets. They are sent in large quantities north, south, and west. One firm sent three thousand barrels to California a year ago. They have been sent as far east as to Constantinople.

Some patrons are so attached to these oysters they continue to send for single gallons of them even when they go to reside in distant country places.

The demand for them increases in every direction from year to year. They are sold in three grades. The "box" is the finest grade, commanding the highest price. They must be good size, good color, good shape, hard shells, and even size. The next are "barrel" oysters, running a little smaller and a little less even. The third are "culls." The second grade are also called "counts." The "culls" sell from thirty to forty-five cents a hundred, when the "box" grade cost from sixty to ninety cents per hundred.

Those that are sold out of the shell are opened on the boats at New York. A single firm on the North River sometimes opens one hundred and fifty thousand counts in a single day. Men who open oysters there are able to earn about three dollars a day.

With a fair season and no special adverse circumstances, the business is lucrative. But in the present stage of practical knowledge the risks are so many and so great that no man is able to estimate with much certainty at the beginning of a season what its results may be. Every year shows improvement, however, both in the quality of the oysters and the modes and security of cultivating and handling them.

Hundreds of vessels, thousands of people, and millions of money are already employed in the business. Its growing value only begins to be realized. It most certainly has a grand future. Staten Island has been noted for several important things, but this developing industry promises more for it than all its other interests, ancient or modern.

The island was General Horn's headquarters, and he had thirty thousand troops there during a most important crisis of the Revolutionary war. To the great disgust of its inhabitants a quarantine station was maintained on its north shore for many years. Some of its names recall noted places and persons of the Old World. Its climate is of great salubrity. Many seek its shores and elevations for quiet and healthy homes. Several humane retreats, like "The Sailors' Snug Harbor," "Retreat for Sick Seamen," "Home for Destitute Children of Seamen," "The S. R. Smith Infirmary for the Sick," are located upon it. Some of its old taverns bore the significant names of "The Black Horse," "The Bull's Head," "The Morning Star," "The Blazing Stars." But all these names and interests, though interesting and important, are eclipsed by the healthful and useful oyster cultivation.

ENGINEERING INVENTIONS.

The nuts of bolts for securing fish plates to railroad rails have been locked by means of bars or slotted plates, which were so constructed and applied as to abut against one or more sides of the nuts, and were held fixed in position by the nuts themselves, or by attachment to the bolts, or by wedging between the head or base of the rail and the nuts. Mr. James W. Payne, of Tipton, Mo., has patented a simple means for securing a nut locking plate, whereby it may be easily and quickly applied and removed.

Mr. Jacob Rhule, Jr., of Pittsburg, Pa., has patented a feed water heater for the inside of a boiler, which serves at the same time as a depository of mud and sediment from the water, and thereby prevents scale in the boiler.

Mr. John J. Reed, of Lyons, Ia., has patented an improvement in windmills. The invention consists in a wheel hung to swing in a horizontal plane, and having a vane hung on the wheel to swing in the same plane, the normal position of the vane being slightly inclined to the axis of the wheel, so that the wheel is held by the vane with its edge more or less presented to the wind, according to the pressure. This movement is regulated by an adjustable weight connected with the wheel. Brake mechanism of novel construction is applied to this mill.

Mr. William Tucker, of East Toledo, Ohio, has patented an improvement in the class of automatic couplings for railroad cars in which a spring jaw upon the draw head of one car engages with a jaw secured to the draw head of the next adjoining car when the cars are to be coupled, and in which chains secured to the spring jaw are employed to draw and hold the spring jaw in such position that it will not engage with the jaw of the next adjoining car, so that the coupling may be rendered inoperative when desired, or may be readily uncoupled without going between the cars.

An improved lubricator has been patented by Messrs. Isham T. Hardy and Noah H. Dibble, of St. Louis, Mo. The invention consists of a combined steam condenser, oil receptacle or tank, and gauge or indicator, so arranged that the steam from the boiler entering the condenser and condensing therein will flow into the oil receptacle or tank and force the oil thence through the gauge or indicator into the steam cylinder, to which the device may be attached.

The Tay Bridge Disaster.

The London *Times* makes the following editorial comments on the report of the Tay Bridge Investigating Committee: "The Tay Bridge, it appears, was simply blown down by a violent gale of wind while a train was passing over it. This is the net result of the inquiry when disengaged from its technical details. The bridge was not strong enough to bear the strain imposed upon it, and it gave way in consequence of the inherent weakness and defects of its structure. The remoter causes which brought about this result were numerous and far-reaching. First, the spans of the bridge were enlarged beyond the original design in consequence of difficulties encountered in connection with the foundations. Then, for the same reason, piers consisting of cast-iron columns were substituted for the piers of brickwork originally proposed. Moreover, the casting of these columns was very slovenly and imperfect; they were found in many instances to be of unequal thickness, and the bolt-holes connecting the various sections together, as well as those in the 'lugs' to which the cross-braces were attached, were all merely cast and left conical instead of being properly drilled and reduced to a cylindrical form. Thus, the cross-braces, on which the whole strength of the structure depended as regards resistance to lateral pressure, were very imperfectly fastened, and, by consequence, ill calculated to bear the strain imposed upon them. Such being the initial defects of the bridge, its practical supervision was intrusted to a person very imperfectly qualified, in the judgment of the court, to undertake such a responsibility. What defects he observed he did his best to remedy promptly; but he does not seem to have been sufficiently alive to the serious indications of weakness and danger shown in the loosening of the ties of the cross-braces, to the effect of which, as seems most probable, the disaster must be immediately attributed. In fact, it is impossible to resist the conclusion that the bridge was an unsafe structure from the very beginning. A weak and slender bridge is built in a peculiarly exposed situation; no attempt is made to calculate the possible effects of wind-