

and 34½ in. by 22 in. stroke, supplied with steam from a multitubular marine boiler, 12 ft. 6 in. diameter by 10 ft. 3 in. long, working at a pressure of 160 lb. per square inch. The hull was built to drawings and specifications approved by the Department. The hull-planking, decks, keel, propeller, and rudder-posts are of wood, and the frames, reverse frames, floors, keelsons, transverse and longitudinal bulkheads, deck-beams, stringers, &c., are of steel.

The auxiliary scow "Otimai" has a tonnage of 207 gross and 111 register, and is 99.8 ft. long by 24.9 ft. beam by 7 ft. depth. She is propelled by two sets of semi-Diesel oil-engines of 160 b.h.p. The plans and specifications of the hull were approved by the Department before the work of building was commenced. The hull is built of wood, principally kauri, on the diagonal principle. The planking is made up of two diagonal skins of 9 in. by 1 in. kauri, and one fore-and-aft skin of 3 in. by 2½ in. kauri, sheathed with 6 in. by ¾ in. totara.

Extensive repairs have been carried out to many vessels. A new water-tube boiler has been installed in the tug "Dunedin." The previous boiler developed a serious defect after about four years' use, and had to be condemned. The defect occurred in the longitudinal seams of the cylindrical shell-plates, and was first detected by the leaking of the boiler at this part. An examination of the butt-straps and shell-plates showed that the plates and straps were very badly cracked. In addition to the main cracks visible to the naked eye, a very large number of fine branching cracks were found under the microscope. There have been a few, but very few, cases of similar defects. The matter was considered to be of so much importance and interest that portions of the defective plates were forwarded to England, to the Board of Trade and Lloyd's Register of Shipping, for investigation. The material of the plates has been examined by the National Physical Laboratory. It does not appear from their report that there is any definite proof that the material of the plates used in the construction of the boiler was faulty at the time when the boiler was constructed. In view of the great importance of the subject the Board of Trade have advised that they are taking steps to have various similar cases investigated as fully as possible, with a view to seeing whether any definite conclusions can be drawn as to the cause of these failures. The result of these further inquiries has not yet come to hand.

NEW BOILERS INSPECTED.

The number of new boilers inspected during the year totals 400: this is an increase of 15 per cent. on last year's total. 183 of the new boilers were made in the Dominion and 217 boilers were imported. As usual, the design of a number of new boilers submitted could not be approved for the desired working-pressure until amendments had been made. Unfortunately, quite a number of boilers were imported which did not comply with the Department's requirements. Alterations to these boilers were consequently more costly to make than if they had been carried out in the manufacturer's works. In one particular case a small imported boiler could not be granted any useful pressure. The material of which certain parts of the boiler were made was not suitable for its purpose, and the workmanship of the boiler was of the poorest class. Owing to the faulty workmanship of the boiler the parts could not be renewed in more suitable material without practically rebuilding the boiler. The owner of this small boiler was reported to have been seriously embarrassed financially by the Department's action, but the boiler was manifestly unsafe for the pressure required.

INSPECTION OF BOILERS.

A number of boilers were found to have serious defects. Increasing use is being made of the electric and oxy-acetylene processes of welding for boiler-repairs. These processes may be employed for repairs to cracks in plates not wholly in tension, for re-enforcing of the landing-edges of leaky seams reduced by repeated chipping and caulking, for thickening small patches of corroded surfaces, and for filling in pit-holes. In no circumstances should stays or shell-plates which are wholly in tension be welded. There are numerous records of satisfactory tests of welds, tested in a testing-machine, and an all-welded ship has been constructed (her name is "Fullagar," and from all accounts she is a success); nevertheless, welding in boiler-work must be treated cautiously. For want of confidence and experience, engineers at present can only approve of welding to a limited extent. The efficiency of a weld depends as much on the integrity and conscientiousness of the welder as upon his skill. Properly trained and trustworthy men only should be employed for welding-work. All facilities should be given the Department's Surveyors for inspection during the progress of such work. Welds must be well hammer-tested after the repairs are completed, and unless the welding is of a trifling character a hydraulic test of one and a half times the working-pressure should be applied to the boiler after the hammer-testing is effected. Opinions differ as to what is an adequate test for a weld. One of the requirements of the American Society of Mechanical Engineers, who have given much attention to this matter, is that a welded plate should be struck on both sides of the weld sharp vibratory blows with an 8 lb. to 10 lb. hammer. The blows should be struck 2 to 3 in. apart, and they should be as rapid as a man can conveniently strike a sharp swinging brow, and as hard as can be struck without indenting or distorting the plate. The boiler should be filled with water during the test. The Department's experience is that welds are sometimes unsatisfactory. Cracks which have been welded have given out and have had to be rewelded. Whether this was due to a defect in the welding or to fatigue in the original material it is difficult to state. In welding corroded portions of a plate, it should be borne in mind that there might be a difference in the electrolytic qualities of the original material and the added material of the weld which would accentuate corrosion. The co-operation of the engineer, welder, and surveyor are necessary to maintain confidence in this new art, which has been very helpful to many of those interested in repairs to boilers and machinery.