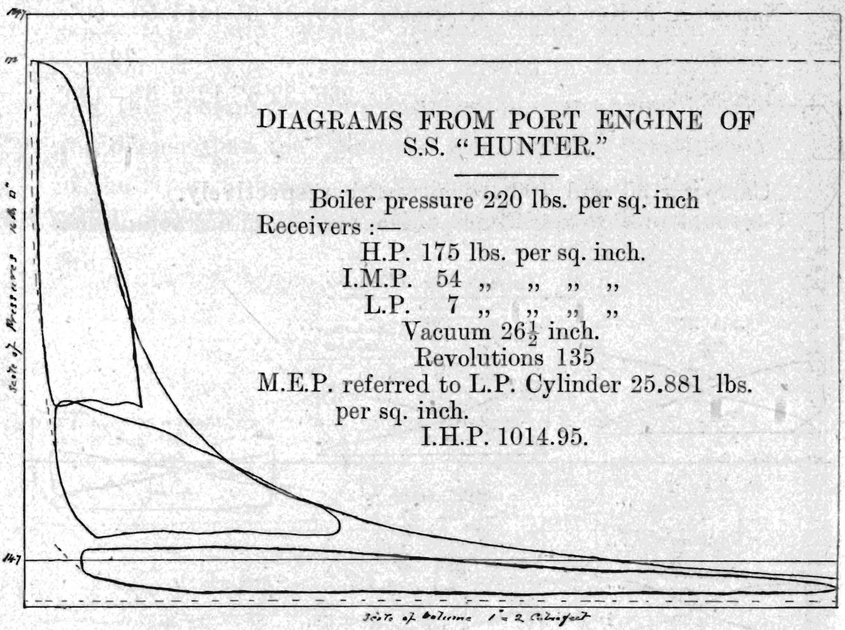
DIAGRAMS FROM PORT ENGINE OF
S.S. "HUNTER."
Boiler pressure 220 lbs. per sq. inch
Receivers :—
H.P. 175 lbs. per sq. inch.
I.M.P. 54 " " " "
L.P. 7 " " " "
Vacuum $26\frac{1}{2}$ inch.
Revolutions 135
M.E.P. referred to L.P. Cylinder 25.881 lbs. per sq. inch.
I.H.P. 1014.95.

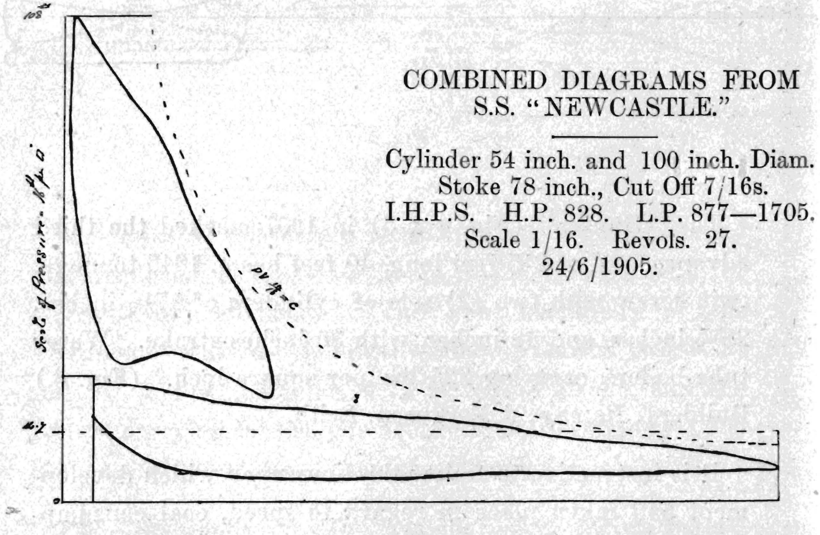
COMBINED DIAGRAMS FROM
S.S. "NEWCASTLE."
Cylinder 54 inch. and 100 inch. Diam.
Stoke 78 inch., Cut Off 7/16s.
I.H.P.S. H.P. 828. L.P. 877—1705.
Scale 1/16. Revols. 27.
24/6/1905.

Fig. 5

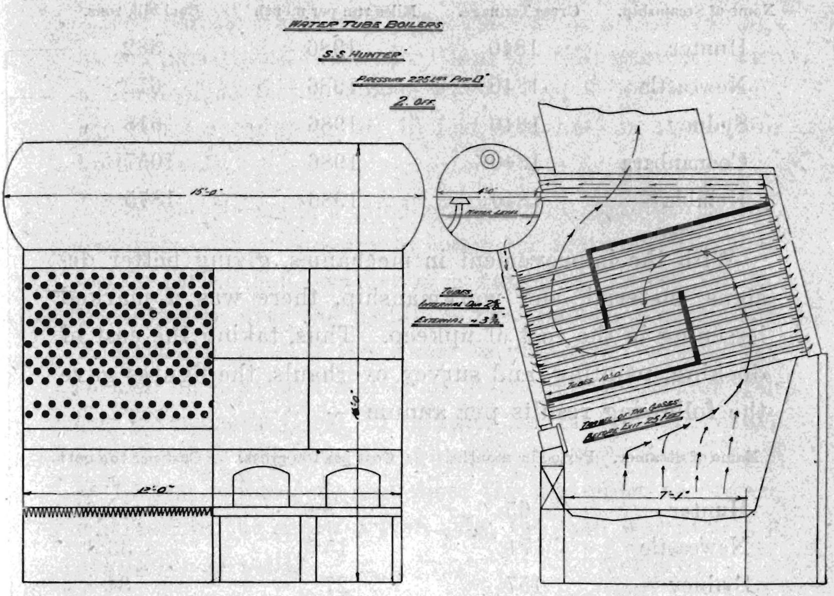

Fig. 6.

The service rendered by these different types was as follows, upon figures gained from the Log Book:—

S.S. Kembla, 440 tons gross, 10·6 knots, 40 tons of coal on the round trip to Morpeth.

,, Coonabarra, 901 tons gross, 10·9 knots, 55 tons; trip to Morpeth, equal 200 miles.

Of the next or compound type the figures are:—

S.S. Sydney, 634 tons gross. 11·1 knots, 23 tons for 200 miles

,, Namoi, 1414 tons gross, 11·4 knots, 38 tons for 200 miles

while the figures for the "Hunter" were:—

1840 tons gross, 12·6 knots, 36 tons for 200 miles,

for the triple compound twin screw.

But were it possible for the smaller vessels to do the same service as that rendered by the "Hunter," then the figures would be:—

Name of Steamship.	Gross Tonnage.	Miles run per month	Coal bill, tons.
Hunter	1840	1986	382
Newcastle	1840	1986	672
Sydney	1840	1986	618
Coonanbara	1840	1986	1057
Kembla	1840	1986	1875

With the improvement in mechanics, giving better designs, material, and workmanship, there was a marked lessening in the cost of upkeep. Thus, taking the cost of docking, painting, and survey overhauls, the figures gave the following results per annum:—

Name of Steamer.	Period in months.	Cost per ton gross.	Cost per ton nett
		d.	d.
Hunter	65	8·9	16·6
Newcastle	174	15·5	33·3
Sydney	157	27	34
Coonanbara	16	57	91
Kembla	34	61·9	93

The modern designs and make had also very materially reduced the weight necessary for the output. As a case in point: the "Newcastle" originally had 600 tons in engines and boilers to produce 2,500 H.P.; this was reduced to 520 tons, with an output of 1,700 or 1,800 H.P on service, her wheels alone weighing 40 tons each; whereas in the "Hunter" the weight was 291 tons for an output of 2,000 H.P., the propellors being each 2 tons, the boilers requiring 20 tons of water as compared with over 80 for the "Newcastle." On the other hand, complexity follows with a certainty that was peculiar: thus—the S.S. "Kembla" had but 7 steam cylinders, all told, as her full equipment; the "Newcastle," 25 years later, had 21; while the "Hunter," 22 years later, had a total of 48 for all purposes.

The paddle wheel as a propellor was at a disadvantage as compared with the screw; thus, the "Newcastle," with a beam of 32 feet 6 inches, was 63 feet 6 inches overall, the floats accounting for 10 feet 6 inches, or 21 feet for both wheels.

The paddle made a good propellor in moderate or fine weather, with a tendency to lessen the motion of the boat, but in facing bad weather or a head-wind or sea the extreme width over the paddle boxes must be a detriment. The sensitiveness of the wheel to immersion was a very serious matter; as a matter of long observation and test, the "Newcastle" lost 15 minutes on the run for every additional 6 inches in draught over 11 feet, or one hour at 13 feet immersion, and there the line must be drawn, whereas, in the screw-driven ship, the load was almost a negligible quantity.

The introduction of the surface condenser was a very important step in advance. With the jet condenser, the boilers were fed with sea water, and, to avoid the accumulation of scale, there was a continual discharge through the scum blow-off of approximately 50 per cent. of the supply, after it had been raised to the temperature of the steam, the usual working density being 10 oz. to the gallon. The cylinders were charged with steam independently, and filled to 7/10 of their capacity, the vacuum usually ranging from 24 to 26 inches, and the feed at 120 degrees. In the "Coonanbara" an effort was made for economy by using the steam expansively by means of a double beat valve, which cut off at three (3) grades, the full supply being 8/10 of the stroke, the cost in coal consumption per H.P. being 5 lbs.

The surface condenser eliminated the necessity for scumming, and thus very materially reduced the tendency to form scale, rendered the heating surfaces more effective, the use of steel in the construction of the boilers made higher pressures available, and thus in the second lot of vessels the steam pressure was 90 and 100 lbs. per square inch. The steam flowing from the H.P. to the L.P. in sequence, and so to the condenser, the boilers were fed with distilled water, and at a higher temperature.

The "Sydney" had a very efficient expansion valve, by which the steam could be cut off from 12 inches, or 1/5 of the stroke, and under these conditions she weathered the "Maitland Storm." Leaving Newcastle at 11.0 p.m., she reached Peat's Ferry, Broken Bay, at 6.0 p.m. the following evening, or at a speed of less than three (3) knots per hour, the cost per H.P. in these vessels ranging from 2½ to 3 lbs.

In the triple expansion engines, as in the "Hunter," the main engines propel the ship, all other services, such as air-pump, circulator, feed pumps, etc., being rendered by auxiliaries. In this vessel the steam pressure is 225 lbs. in the boilers, being reduced to 180 lbs. for the main engines, and still further for other services.

The improvements in design and construction made higher piston speeds available, thus materially reducing the size and weight of the moving parts and cylinders, and so increasing the output per ton thus:—

Name Steamer.	I.H.P.	Piston speed per minute	Volume swept per minute	Cylinder capacity.	Steam pressure.	Cost per H.P. in coal.
Kembla	720	260	6528	108 c. ft.	30	5 lbs
Newcastle	2000	390	27428	458 c. ft.	100	3 lbs
Hunter	2000	700	26096	93 c. ft.	180	1·8 lbs

The auxiliaries in the "Hunter" originally exhausted direct to the condensers, but had been lately diverted to the L.P. valve casing, and the gain in H.P. has been about 200 when at full speed, and a tendency to keep a cleaner boiler. The gain in the life of the boilers has been very great. When lost, the "Maitland" was running under her fourth (4th) set; the "Coonanbara" also attained to a like number. Those of the "Namoi" were 30 years old, the "Newcastle" a few months less, and both still doing good service. Although the third (3rd) set of tubes and the second (2nd) fitting of low furnaces are in operation, of the water tube, it may be early to say what would be their life, but, judging by the seven years' service in the "Hunter," they were shaping very well towards making a good record.

Attention is now drawn to the action of the vessel as affected by water carried as weight in the trimming tank, and also her action in a sea-way. On October, 1910, in navigating the river, the "Hunter" struck the Green Rocks, causing damage and a hole in the tank. This accident was the means of causing a close study of this problem, and also that of the water in the confined spaces.

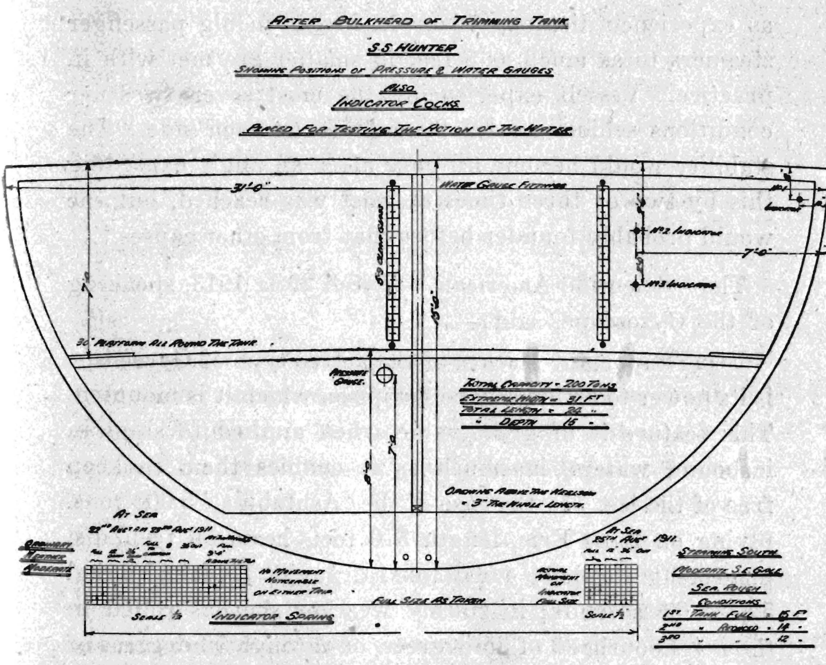

Fig. 7.

This tank (Fig. 7) was installed so that in navigating the river she might be placed on an even keel to lessen the draught, and contained 200 tons.

A writer in "Cassiers" in August, 1911, dealt with these matters thus:—

"The great point is for a vessel to possess a sufficiency, but not an exaggerated amount, of initial stability, for the reason that she otherwise acquires 'stiffness,' resulting in quick or heavy rolling and discomfort to passengers when encountering weather or waves at sea, whereas with a more moderate amount of stability it would be productive of greater comfort, though the vessel would take longer to complete her rolling motion, with probably a greater angle of roll. What would be a reasonable amount of Meta Centric height to assign a vessel? Each class must be taken on its merits, and just such an amount as experience dictates; 10 or 12 inches in big passenger steamers to as much as 3 feet in smaller are met with in practice. Vessels experiencing the most severe weather conditions seldom exceed 20 degrees on each side. The stability would become nil only after an angle exceeding this by two or three times at least was reached, but she would probably founder before that from other causes."

The "Scientific American," March 29th, 1913, speaking of the Gyroscope, said:—

"One important feature of the active type of Gyrocospe is its power to artificially roll ships on which it is mounted. This feature is of great value when applied to ships in icebound waters, inasmuch as it enables them to keep free of the ice. In the case of the 'Ashtabula,' 5,000 tons, plying on Lake Erie, length 370 feet, beam 56 feet, displacement (loaded) 4,500 tons, draught 11 feet, period 5.5 to 6.6 seconds; in stormy weather she has rolled in the neighbourhood of 35 degrees, or through 70 degrees of Arc."

These quotations would enable them to form a good idea of the action of the "Hunter" in a sea-way, owing to her beam of 40 feet and shallow draught (10 feet 6 inches). She was exceptionally stiff, her meta-centric height being 4 feet 8½ inches. Recently, in taking a 10 ton lift from her hold and placing it 10 feet from her side, her Clinometer registered less than 3 degrees of movement—her period of rolling being from 7.2 to 7.5 double rolls per minute.

A tank (see Fig. 7) 24 feet long, with a width at the after end of 31 feet at the top, and divided by a fore and aft bulkhead amidships, having an opening equal to 3 inches along the lower edge for the whole length, was fitted virtually as an anti-rolling tank.

In "Engineering," April 11, 1911, an account was given of tanks fitted for this purpose, and for which claims were made for reducing the amplitude of the roll to 1/3; while this would be an excessive claim to make for the "Hunter," there had been a distinct advantage gained. From observations taken over an extended period, embracing 40 runs, the figures gave:—

Weather.	No. of runs.	State of Tank.	Amplitude of roll.	No. of rolls per minute.	No. of pitches per min.
Moderate	13	Full = 15 ft.	20·4	7·1	15
Moderate	16	Slack = 12·4 ft.	10·6	7·5	12·4
Heavy.	8	Slack = 12·2 ft.	23	7·4	12·2

These showed a reduction of one-half (½) in amplitude in ordinary weather, or that it practically reduced the motion of the ship in heavy weather to that in the first series in moderate weather with the tank full. These results proved what had been a matter of experience regarding the benefit from the action of the water in the tank. As a matter of history, the only occasion on which she had put back was a few months after going into commission, before the benefit from the tank had been fully seized, and the impression then held that it would be imprudent to slacken the water in a sea-way. To investigate this question, and to note the action, and to find if there was any extreme pressure caused by the action of the ship, a pressure gauge was fitted at a point seven (7) feet from the bottom on the after bulkhead, amidships, also two water gauge glasses giving a clear glass of 5 feet 9 inches, one near the amidship divisional, the other on the middle line of the other compartment. (See Fig. 7.) Observations were taken during 37 runs under the weather conditions before mentioned. During ordinary weather the pressure gauge showed a variation of ½-lb.; during the heavy weather runs, ¾-lb. was the heaviest variation noted. The movement of the water in the glass was much the same in each, and in number corresponded to the sum total of the rolling and pitching movements. The rise and fall in the glasses during ordinary weather was equal to 13.6 inches; in heavy weather it gave 24 inches on an average, the maximum being 33 inches, or 16½ inches above, and as much below the normal level.

The failure to find any evidence of heavy impact prompted the placing of the steam indicator with a 12 pr. inch spring on the bulkheads, No. 1 being placed 8 inches down and 10 inches inboard on the Starboard top corner; No. 2, 30 inches down and 7 feet inboard; No. 3, 4 feet 6 inches down and 7 feet inboard. In ordinary weather on two (2) trips the pencil gave no movement. The tank was then filled to overflow at the wharf, and a score taken off the three. A storm coming on, the vessel was storm-staid that night. On the following day all weather reports were showing Moderate S.E. gale, with rough seas. On getting outside Nobbys, the tanks being full, readings were taken, when a variation of 1½-lbs. was read off. This, at first sight, seemed puzzling, but on second thoughts it became evident that this variation was due to the rolling, the motion giving a good head one moment