

Inspection during manufacture and testing of the Electric Propelling Motor, Alternators and Control Gear at Messrs. British Thomson Houston Co. Ltd., Rugby, and intended for Swan Hunter's Yard No. 1689.

ALTERNATORS

It was not possible to carry out a full load heat run on the alternators, but short circuit, open circuit and no field heat runs were carried out with the machines on open ventilation except in the case of the port alternator where the air cooler was in circuit. The results of these tests are as shewn on the attached test reports, and it should be noted that the heat runs on the alternators were carried out equivalent to 5,000 K.V.A 4080 R.P.M., 68 cycles which corresponds to 120.5 R.P.M. on the propeller, and at 3060 r.p.m. 51 cycles, 4000 KW. which corresponds to 90.5 R.P.M. on the propeller. The tests on the propeller motor were taken at a rating corresponding to 11,000 S.H.P. total, 810 amperes 115 R.P.M. From the results obtained during the foregoing heat runs the expected temperature rises were calculated in the usual manner and indicated that the temperature rises at the full load ratings when operating continuously would comply with the Rules. In this connection however, it should be noted that the method of computing the temperature rise is empirical and has been found satisfactory for machines up to about 50 frequency. There is little or no evidence available to show that at 68 cycles the empirical rule is still correct, and particular attention should be paid on board to the actual temperatures obtained.

During the above tests and when the alternator rotors were run separately on overspeed for five minutes the mechanical balance was found to be satisfactory.

PROPULSION MOTOR

When the motor is running on or near full shunt field excitation, noise and a very small amount of vibration are present but are not considered deleterious. The noise and vibration disappeared on the short circuit tests and on low values of shunt field current indicating that the effects are the results of the magnetic circuit.

Short circuit and open circuit heat runs were carried out with the machine on open ventilation as it was not possible to connect the air coolers in circuit. Under these conditions the expected full load temperature rise as calculated in the usual manner from the temperatures obtained during the foregoing heat runs, indicated that the motor would comply with the Rules when operating continuously at 11,000 H.P., 810 amperes and 115 R.P.M.

It will be necessary to ascertain that the temperature rises are satisfactory on board with the air coolers in position.

CONTROL GEAR

The Control desk, cubicle, excitation panel etc., were fully erected at the Makers' works. The lever operating gear was also erected but it was not possible to connect up the lever operating desk and connecting rods to the main cubicle. The camshaft on the top of the main control cubicle was rotated separately and found satisfactory. The interlocking and independent operation of the lever operating desk was separately checked and found satisfactory.

Special considerations affecting this equipment.

The turbines, alternators, control gear and cables are satisfactory for a load of 13000 SHP at the propeller, but the propeller motor is only capable of carrying 11,000 SHP total continuously at 115 R.P.M. and 1620 amperes total. The motor is therefore the limiting feature in the propelling equipment, and tests should be made on board to ascertain at what propeller speed the motor requires 1620 amperes total, that is 810 amperes to each stator winding, as this may be somewhat different from 115 R.P.M. /cont.2

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The electrical connections between the alternators and the propulsion motor, are differently arranged from previous equipments. Considerable discussion has taken place with the manufacturers and it still remains to be proved that, as now arranged, the operation will be satisfactory. The motor is double unit and each half of the motor is entirely separately connected to one alternator. As a result there is no parallel electrical connection between the two alternators, the only tie being mechanical through the shaft of the two halves of the double unit motor. It is possible that this fact may have two effects. In the first place there will be no restoring effect due to phase angle between the two alternators within the limits of the electrical angle of advance of synchronous machines, ~~exists~~, the control will depend entirely upon the sensitivity of the turbine governors. The Rules permit a governor speed variation of 4% between full load and no load and apart from sticktion of the lever mechanism of the governor, a droop considerably in excess of 4% might be necessary to maintain load sharing of the alternators. The effect, therefore, may be that the load on one half of the propulsion motor and its associated alternator does not remain constant and gradually swings from one half motor to the other. This effect should be checked at various loads other than full load.

The second effect arises during manoeuvring or even starting from standstill. In either case, the condition arises where both turbo alternators are running light at the bottom speed with no field on either alternators or motors. Under these conditions the speeds of the turbines may be different, and in this connection special attention has been given to the lever control desk with the micrometer auxiliary adjusting wheels on the lever to eliminate backlash. It is highly improbable however, that if the propelling equipment has been running on load and the necessary adjustments made to share the load, that on pulling the lever gear back to the low speed position it will be found that both turbines running light on no field are exactly the same speed. In consequence when the levers are operated it will be found that one half of the motor will pull into step with the alternator and the other will still be out of step, and in fact will not pull into step without some further adjustment to the turbine governor. This will result in overheating of the motor etc., and unduly prolong the manoeuvring time. In other equipments the two alternators are paralleled so that quite apart from the motor, the alternators automatically pull themselves into step even before the motor.

All the above difficulties immediately disappear if the two half stators of the propulsion motor are paralleled electrically and no other change or modification to the existing equipment is necessary.

In this connection the manufacturers have taken special precautions to see that the poles on the two halves of the motor are mechanically in line so that circulating currents between the two stators will be negligible if it is found necessary to apply the parallelling connection mentioned above.

With the existing connections if only one alternator and one half of the propulsion motor are in service the motor is again the limiting feature and the current should not exceed 810 amperes. Readings should be taken on board of the speed at which the current is only 810 amperes with one alternator in service.

If the two half motors are paralleled then, with only one alternator in service, it is the alternator current which is the limit. The tests taken on the alternators at the Makers' works indicated that the temperature rise was satisfactory with 939 amperes which would mean 469.5 amperes in each half motor. Consequently, if it is found necessary to parallel the motor stators, readings should be taken on board indicating the propeller motor speed at which the alternator current is 939 amperes.

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