size, over 33 ft. high, the whole weighing over 110 tons. They are equal in power to about six double-flued Lancashire boilers 7 ft. in diameter by 27 ft. long, and are designed to supply hot purified feed water to eleven boilers, and also hot water for washing purposes throughout the works, their delivery being calculated at 12,000 gallons per hour. They will be heated by the exhaust steam from sixty-seven steam engines. By their application it is expected that a saving will be effected of about 6000 or 8000 tons of coal per annum, besides £800 in soap, and the further economies which these reductions will bring about.

A GOLD COLORED SURFACE ON BRASS may be produced with a liquid prepared by boiling together for about fifteen minutes, 4 parts of caustic soda, 4 parts of milk sugar, and 100 parts of water, to which 4 parts of a concentrated solution of sulphate of copper should then be added with constant stirring. The mixture is then cooled to 75° C. (=167° Fah.), and the well-cleansed orticles are immersed in it for a short time, when the gold color will appear. A longer immersion results in the formation of a bluish-green tint, and a still more prolonged action causes the formation af iridescent colors.

THE ELECTRIC LIGHT ON SHIPBOARD.—*Engineering.*

As the result of Messrs. Siemens' experience and practice, we note the following points as essential elements in the system which has led to success at sea, and which may produce equally satisfactory results on land.

1. *Motive Power.*—A strong plain engine, with very large wearing surfaces especially on the crank-pin; a crosshead with perfect arrangements for continuous lubrications of the moving parts; and a highly sensitive governor controlling a throttle valve, the expansion valve, if any, being regulated by hand.

2. *Transmission.*—Rope gear with ample provision for tightening the rope whilst running, or friction gear with a large margin of safety and complete arrangements for lubrication. These systems are quite free from the slight pulsations in the strength of the lights which are often visible with strap driving, owing either to thick or thin places in the belt, or to waving or flapping of the belt where the centres are far apart.

3. *Safety.*—Duplicate machines, each driven by a separate engine with hand adjustment to the governor, so that the speed and consequent electro-motive force may be adjusted accurately by the test lamps or voltmeter before changing from one machine to the other.

4. *Circuits.*—Complete arrangements on the key-board for changing to or from any circuit or machine whilst running without stopping or sparking, and for coupling machines parallel prior to changing from one to the other, so that the act of changing may not affect the strength of the light. To carry this out successfully the keyboard should be close to the engines, and every key should be properly labelled to avoid mistakes.

With machinery arranged on this system a steady light may be maintained for any length of time without fear of failure, even on vessels without duplicate machines. On the *City of Rome* and *Alaska* the engine-room and some other lamps are maintained without stoppage from Liverpool to New York and *vice versa*. The system of using the hull of the ship as "return," which is now known as "the single wire system," originated with Messrs. Siemens Brothers & Co., and possesses the following advantages:

1. With a given sectional area of conduetor the resistance is one-half and the cost one-half compared with the double wire system, or if the same weight of copper be used, the resistance of the single wire system is only one-fourth of that of the double wire.

2. The cost of laying the wires is very small.

3. The extreme simplicity of the fittings and attachments makes it easy to guard against short circuits in the keys and lamp-holders.

4. The average distance of the conductor from the metal of the ship is very much greater than the distances between the double conductors under ordinary circumstances.

The next point worthy of notice in the Siemens system is the large number of branch of sub-circuits. No lamps are coupled direct to a main directors, but branch wires are taken from the main, each forming a section of ten or twelve lamps. At every junction with the main conductor there is a safety bridge and key, and a descriptive name-plate. This arrangement reduces the effect of an accident to the smallest proportion and makes it a simple matter to trace and rectify faults. By a judicious selection of two or three places from which to start branches, the main conductor may be kept almost free from joints, and we are informed that in consequence of a strict adherence to this principle, there has not up to the present time been a single instance of trouble with a main conductor. This possibly is due, to some extent, to the use of a wire specially insulated, and served with jute for use on ships, or, in other words, to the fact that the single wire has got the insulating material of two ordinary wires and the jute in addition.

The section safety bridges mentioned above are not arranged to protect the lamps as is commonly supposed, but are made thick enough to stand a current much stronger than the normal, but they will melt with less current than is necessary to damage the smallest single-light wire in the section. The section keys break the circuit at two points to prevent arcs forming, and they make a very tight and clean contact.

The fittings, or brackets, pendants, &c., which carry the incandescence lamps are chiefly noticeable for their simplicity and strength. Referring to our illustrations, Fig. 1 is a bracket suitable for state-rooms and officers' cabins and with slight modification can be used in many positions. For instance, instead of the curved arm it may have a straight one rising from the top of the globe for attachment to the deck or ceiling. It is usually supported by an iron screw tapped into the iron deck, and serving also as the metallic contact required for the "return." Fig. 2 is a strong guarded lamp, specially adapted for steerages; it is fixed up with a "bayonet joint," so that it may be easily removed for stowage of cargo. The act of replacing it in position makes the connexion to the electric circuit. Fig. 3 is a bracket designed principally for engine-rooms. It carries a Swan lamp protected by a strong glass shade; it also serves as a socket for connecting the end of a flexible double wire in connexion with a hand lamp, Fig. 4, which is chiefly used in repairing or examining the main engines. These hand lamps are attachable to any of the engine-room brackets, and are provided with about 20 feet of flexible wire.

The whole of these fittings have similar internal parts, consisting principally of a central taper peg, which forms the terminal of the positive conductor, and which makes contact with the lamp-holder by fitting tight in a brass socket in the lamp-holder. The method of securing the glass globe is extremely simple and ingenious. Three brass fingers, each about ¼ inch longer thau the radius of the hole in the globe, support the weight of the globe, and a brass cover sliding on the central tubes sits on the flange of the globe and holds it in a central position. To remove the globe it is necessary to raise the brass cover with one hand and with the other hand to push the globe to one side, when it falls off one of the fingers, and may then be drawn sideways off the other two. This device has been in use since February, 1882, and has nearly stopped the breakage of globes, which before that time was a serious item, partly owing to screws jarring out and partly to over-screwing. The globes are all made in one mould, and are therefore interchangeable on every ship.

The lamp-holder, or device for making connexion to the platinum loops of the Swan lamp, has two noticeable points; it can be removed easily from its socket when a new lamp has to be fitted, thus enabling the attendant to effect the operation carefully without damaging the loops; and the supports and connexions of the lamp are perfectly elastic, which protects the filament from injury from the vibration of the ship and maintains good electric contact under all circumstances.

We have given a full description of Messrs. Siemens' system, principally because it is a system which may be traced as plainly in the first installation as in their latest, consequently every addition has been a progressive step towards that perfection which, it is hoped, will ultimately make the electric light not only as cheap but as reliable as gaslight. It is pleasing to note the support which Messrs. Siemens Brothers & Co. have given to their competitor, or rather coadjutor, Mr. Swan. They adopted his incandescence lamp at the outset, and have probably been his largest customers down to the present time. We are informed by Mr. J. S. Raworth, of Manchester, who, representing Messrs. Siemens Brothers, has had charge of the principal installations on shipboard, that the renewal of Swan lamps which at first was a most serious item, is now reduced to about 10 per cent. per voyage to New York and back.