7. The engine must be economical in fuel, especially at its ordinary working speed.

8. It must be compact, light in weight, and well balanced, so as not to cause vibration.

9. It must not involve any risk of accumulation of gas in the ship, such as to form an explosive mixture.

10. Above all, it must be capable of using a fuel whose supply at a moderate price is practically unlimited, and can be readily obtained in any part of the world a ship might visit.

Referring to published plans for installing gas and oil machinery in 16,000-ton battleships, Mr. Elgar maintains that "this exists at present in imagination only." "It is impossible," he continues, "for any one to judge by what has been achieved up to the present in this direction, what weight or space, or what consumption of fuel would be required for the internal combustion engines of greater power, that might, perhaps, ultimately be made to fulfill the onerous requirements of marine work. Engineers and metallurgists may, by working together, succeed some day in overcoming the difficulties of producing large cylinders which will stand the high impulses and great and rapid variations

of temperature that occur with internal combustion, but until this is accomplished no great step ahead has been taken."

There are those who will be inclined to consider this view extreme. Many installations of large internal combustion engines have been successful ashore. It is natural to be credulous that in the future engineers may solve the problems of any new branch of engineering. Many times in the past a few years has sufficed to contradict the most distinguished disbelievers.

Another paper read at the conference told of the progress made with the marine steam turbine, which has grown in its application from the tiny "Turbinia" of 1894 to the gigantic "Lusitania" and "Dreadnought" of to-day. A curve showing the total horse-power of steam turbines applied to marine propulsion has its beginning at zero in 1896, and its end at 390,000 horse-power in 1906. It is doubtful if many engineers at the advent of the "Turbinia" expected a turbine propelled "Lusitania" within 10 years. Repeated instances of the sort have bred a confidence in the world's engineering genius, that warrants hope for great ships propelled by combustion engines, in the comparatively near

future, and cheaply, perhaps with crude oil, perhaps with alcohol or other clean fuel.

Yet Mr. Elgar's list of qualifications that the engine must possess is by no means unreasonable. It would be difficult to eliminate one of them. Some of the problems have not been nearly worked out in their application in a large sense, and others will require a good deal of advancement before they are completely solved, even for small powers. In large ships the engines must be as safe and sure and economical as the reciprocating engine or the turbine. The large power unit installed on unyielding, immovable foundations in a stationary power plant is surrounded by very different problems from those the marine engineer must face in applying the same type of engine to a large vessel. His difficulties are fully as great as those encountered in the development of the steam engine, and perhaps they are greater, because of the nature of the fuel and of its application to the engine. Great progress has been made with the marine combustion engine, but few will dispute that it is still in comparative infancy. The question is, how soon will it reach the maturity of an accepted type of engine for large ships?—Iron Age.

THE FIRST GERMAN SUBMARINE.

A DESCRIPTION OF AN INTERESTING CRAFT.

BY OUR BERLIN CORRESPONDENT.

THE construction of submarine boats has recently been taken up by German shipbuilders, and after a series of trials on a small model boat, the Germania shipyards at Kiel have just completed a large submarine of 240 tons displacement. The main dimensions of this vessel, constructed on patented designs, are: Length over all, 137.5 feet; maximum width across frames, 11.7 feet; draft of boat when emerged, 7.8 feet; displacement, 240 tons. An electric motor and gas engine, each with an output of 200 indicated horse-power, are fitted to each of the two propeller shafts, the propeller being adjusted from the inside of the vessel. The electric motors are designed for propulsion below water, and receive current from an accumulator battery installed amidships. The battery is sufficient to drive the boat below water for fully three hours at its maximum speed of 9 knots. When on the surface, the gas engines are preferably to be used. The fuel is carried in tanks, arranged outside of the boat (according to patents of the Germania shipyards) thus guarding against explosion. The store carried by the submarine enables the latter to cover a distance of 1,000 knots at her maximum speed of 11 knots on the surface.

The motors can obviously be used also for propulsion above water, while both types of motor can also be used simultaneously for the propulsion of the vessel.

The submersion and emersion of the boat is effected by filling and discharging respectively the ballast tanks arranged inside, as well as by the aid of two pairs of horizontal rudders. The maximum admissible depth of submersion has been fixed at about 120 feet. Only five minutes are required to prepare for submerging the boat.

Special care has been bestowed on ventilation, which is secured by an electrically-operated ventilator, which, as long as the boat is above water, will constantly supply all the rooms with fresh air. When submerged, the vitiated air is passed through a cleaning tank, after which it returns toward the various compartments of the boat. With a crew of ten men the vessel is able to sail under water for periods up to 24 hours.

The armored conning tower arranged in the center of the boat and inclosing all necessary instruments, such as viewing apparatus, manometers, rudders, and telephones, is large enough readily to accommodate the commander and the pilot. Two periscopes have been provided, which, both in a vertical and horizontal di-

THE BOAT SUBMERGED AND TRAVELING AT FULL SPEED.

rection, cover a field of 50 degrees. The length of these inclosing telescopic tubes has been chosen with a view to allow the boat to travel at a depth sufficient to warrant it against gun fire, while still enabling it to cover the whole of the horizon.

The armament of the submarine comprises an 18-inch bow torpedo-launching tube. One of the three large-sized torpedoes carried by the vessel is contained in the tube, while the two remaining ones are arranged in water-tight reservoirs.

Trial runs performed in Eckernförde Bay, both in the emerged and submerged condition, have demonstrated the satisfactory sea-going qualities of the submarine.

RECLAIMING SILVER FROM PHOTOGRAPHIC SOLUTIONS.

By RANDOLPH BOLLING.

In the process of developing photographic plates and papers the removal of silver iodide and silver

bromide from the surfaces unacted upon by chemical rays is usually accomplished by using a bath of sodium hyposulphite. This operation is termed "fixing" in the art and has for its object the clearing of the photographic image and also to maintain the permanency of the plate or paper. The manufacture of photographic plates consists in mechanically imbedding certain haloid salts of silver in a retaining coating of gelatin. It therefore follows that a considerable portion of the silver employed is dissolved in the "hypo" bath which is usually thrown away after its utility has ceased. The silver present is often of considerable value where the dark room operations have been extensive on plates, films, and printing papers. The best and most economical method of working these solutions is to prepare first a saturated solution of ammonium sulphhydrate, which is easily done by arranging an evolution flask with suitable delivery tube, gas washing bottle, and a small reagent bottle containing a strong solution of ammonia; any kind of wide-mouth bottles will answer and a few feet of glass tubing and two-hole rubber stoppers arranged so that the sulphureted hydrogen gas evolved is first generated by the action of 200 grammes of iron sulphide on 500 cubic centimeters of dilute sulphuric acid, using 1 part of strong acid to 5 parts of cold water.

The gas is then conducted through the washing bottle to free it from impurities and then into the ammonia. After a brisk evolution of gas starts from the action of the sulphide upon the acid the ammonia will absorb all and become gradually more and more saturated until after complete saturation bubbles of sulphureted hydrogen will begin to escape in the air. Having thus prepared our reagent for precipitating silver from solutions in which it occurs as a double salt of soda and hyposulphurous acid we can proceed with its precipitation. This is best accomplished by filling an enameled iron kettle or deep dish with all of the old hypo solutions, then heating this to a strong boil and adding ammonium sulphhydrate until no further precipitation is noticed. The instant the alkaline sulphide meets the solution, a dense black precipitate of silver sulphide is formed which is insoluble and which will settle very easily if the solution is allowed to slowly cool. After the silver sulphide has completely settled to the bottom of the beaker, kettle, or vessel employed the clear solution must now be carefully decanted off so as not to disturb the silver sulphide at the bottom. At this point it is best to use a glass or enamel ware funnel with a plug of cotton to filter the precipitate on. After all the silver sulphide has been collected on the funnel it is washed twice with hot water and allowed to dry on a warm plate, using a piece of blotting paper to remove the surplus moisture. To reduce the silver sulphide which is now dry it is only necessary to scoop out a cavity on a piece of charcoal which will retain the precipitate and then heat it after giving it a liberal coating of dry sodium carbonate before any sort of gas blowpipe, or simply use an ordinary Bunsen burner with the air shut off and a jeweler's blowpipe. The silver sulphide will react under the blowpipe with the carbon and sodium carbonate and after a few minutes will form a beautiful glistening button of pure metallic silver which is chemically pure 1,000 fine. If it is desired to operate on a still larger scale sodium sulphide can be prepared in the same manner as the ammonia salt, only requiring the

THE NEW GERMAN SUBMARINE TRAVELING ON THE SURFACE.

substitution of caustic soda for ammonia, and the employment of commercial sulphuric acid. The precipitation can be performed in the cold, using a large wooden barrel as the precipitating tank, and then

siphoning off the supernatant liquid by means of rubber hose or by using an outlet near the bottom of the barrel. In reducing the silver sulphide use a large graphite crucible, powdered charcoal, soda, and a cover

of common salt, employing a wind furnace to bring the mass to a fusion. The writer has produced several silver ingots with perfect recovery of all the silver in large bulks of waste solutions.

THREE NEW ELECTRICAL DEVICES. IMPROVEMENTS IN INSULATORS.

THREE inventions, two of them new insulating devices, and the third a horizontal support for conductors, have recently been patented by Mr. Louis Steinberger, Brooklyn, N. Y. The first, a simple and ingenious insulating pin for supporting conductors carrying heavy currents, is shown in the accompanying engravings. Figs. 1 and 2 show front elevation and plan view of a cross-arm fitted with the pin; Fig. 3 is a vertical central section along the line 3, 3 in Fig. 2, and Fig. 4 a similar section along the line 4, 4. Fig. 5 shows a section through the pin at 5, 5, Fig. 4. A central solid rod, 11, preferably of fiber, dry wood, or other insulating material, is surrounded by a plurality of tubes, 11a, 11b, also of some insulating material, such as fiber or mica, chosen for having considerable mechanical strength. This composite core is imbedded in, and concentric with, the pin body, its purpose being to confer mechanical strength and to increase the insulating qualities of the body. The pin body 6, terminating at its upper end in a thread 7, is made of some suitable insulating material, preferably electrose. A weather shield, 8, is integral with the body. This weather shield is furnished with a trough, 9, and depressed lips, 10, which shed moisture away from the supporting cross-arm. The shield is further provided with drip surfaces, 12a, raised from the cross-

also provided with a number of radial supporting ribs, 10, each terminating at its upper edge in a flat surface, 11a; and with an annular skirt 10a. The upper part of the insulator body is in the form of a threaded

FIG. 6.

boss, 12, with a slot, 14, extending across its top. A groove, 12b, encircles the boss and may be used for retaining a tie wire. A hood, 15, Fig. 7, is provided on its under surface with an annular channel, 16,

FIG. 7.

bounded by a bead, 17. When the hood is in place this bead fits snugly down on the flat surface, 11a; and the channel, 16, arches over the notches 10a, 10b, 10c, in the ribs 11. The hood is shaped into a boss at 18,

FIG. 8.

having a slot, 19, in which the cable or conductor normally rests, being held in position by a tie wire in the groove, 12b. If the boss be broken the conductor may rest within the slot, 14, and be kept in position

FIG. 9.

with a tie wire in the groove, 12b. The notches, 10a, 10b, 10c, increase the surface over which leakage may take place and so tend to diminish surface leakage; they are also available if required as supports for ad-

ditional conductors. The supporting ribs, 10, receive a part of the weight of the hood upon their upper surfaces 11, 11a, and are constructed to distribute its weight as equally as possible with regard to the insulator body, 9. The spheroidal upper surface 7, of the supporting pin, and lower surface, 9a, of the insulating material are molded to fit neatly wherever they engage. By smooth fitting and a careful adjustment for strain a high measure of strength is obtained with a minimum of constructive weight.

The horizontal support for cables, wires or similar conductors, one possessing novel and ingenious features, is shown in the accompanying diagram. Fig. 9 is a front elevation of the insulator, all movable parts being removed; and Fig. 10 is a fragmentary side elevation. Fig. 11 is a vertical longitudinal section through the insulator and its support, along the line 3, 3 of Fig. 12; and Fig. 12 is a central cross section upon the line 4, 4 of Fig. 11, showing the way in which the cable is mounted and its tension controlled. Fig. 10 shows the cross arm, 3, the upper edge of which is rounded and fitted with a metal saddle, 5. Molded rigidly on this saddle is a body portion 7, of insulating material made comparatively thick and provided internally with petticoats 8, 9. The ends of the body portion are provided with steps 11, for the purpose of shedding moisture away from the cross-arm. A num-

FIG. 11.

FIG. 13.

FIG. 12.

FIG. 14.

ber of disks, 10, are spaced apart, there being two of them to each end of the body portion and integral with it. The middle surface of the body portion, 7, is provided with corrugations, 7a, these diverting moisture to flow at right angles to the general plane occupied by the cross-arm, and at the same time diminishing the chances of surface leakage.

The saddle, 5, on which the body portion is molded, is held in position by metallic spikes, 12, 13, driven into the cross-arm; these may be driven through the saddle, insuring that no displacement can take place. The lower edges, 19a, of the body of insulating material are flush with the lower edges of the disks, 10; the body is also provided with horizontally-disposed sheds, 20, 21, 22, spaced apart for the double purpose of facilitating the drainage of moisture and decreasing surface leakage; and its upper surface is molded into a support, 23, Fig. 12, to hold the wearing plate.

A wearing plate, 14, shown in detail in Fig. 13, is imbedded within the body of insulating material as shown in position in Figs. 11 and 12. A link, 24, attached by a pin to the wearing plate, is provided with a threaded bolt, 25, and connected with this bolt is a revoluble buckle, 26, connected in its turn by a second bolt and pivot to a clamp, 28. There are two of these clamps, one attached to each end of the wearing plate, but only one connected by a revoluble buckle. They are shown in perspective, with their attachments in Fig. 12; they are made in halves and the detail of construction is given in Fig. 14. Each of the clamps is firmly gripped upon a cable, 35, and held in position

arm by a space, 12, as shown in Fig. 3. This space is annular and forms a dry space round the junction of the pin with the support.

The pin body is provided with an annular shoulder, 12c, and with a stem, 14. Imbedded in this stem is a metallic sleeve. This sleeve is placed in position when the stem is plastic, and it is provided with a slot and a flange to hold it more firmly in place. This sleeve is completely separated from the composite core. To place in position the pin is placed in the cross-arm as shown in Figs. 3 and 4, when the shoulder, 12c, fits down on the upper surface of the arm, forming a watertight joint which is further protected by the dry space, 12. The sleeve, 15, is threaded inwardly and a screw, 18, with head, 20, is fitted into it and holds the pin firmly in position.

The second insulator device, intended particularly for heavy currents and to prevent arcing from the line to the support, and which provides a number of supporting portions for the conductor as well as means for supporting a number of conductors on the same insulator, is illustrated in Figs. 6, 7, and 8. Fig. 6 is a plan view of the insulator; Fig. 7 is a vertical section through Fig. 6 along the line 2, 2; and Fig. 8 is a perspective view of the lower insulator body without the supporting pin or the upper hood. The supporting pin is shown at 4, Fig. 7, with a vertical boss, 8, threaded externally, rising from a spheroidal upper surface, 7. The insulator body, which may be of electrose, is provided with a skirt, 9a, shaped to fit the spheroidal surface of the supporting pin. The insulator body is